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HOW MANAGEMENT SCIENCE OBTAINS EMPIRICAL TRUTH: A REVIEW OF KARL POPPER'S CRITICAL RATIONALISM AND THE CRITICISM OF THOMAS KUHN AND IMRE LAKATOS

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Karl Popper emphasized that to distinguish science from pseudoscience, a theoretical system must be falsified, not verified. This paper aims to show that management science research meets the empirical truth criteria Popper identified as the demarcation of science. The findings of this study show that Karl Popper's critical rationalism has limitations when applied to the field of management research. In addition, this article highlights the importance of Thomas Kuhn and Imre Lakatos' critique of Popper's rationalist approach in contributing to the development of management science. Although Popper's critical rationalism has been widely discussed in various papers, there is a research gap in how to integrate Popper's ideas along with the critiques of Kuhn and Lakatos, in particular, into management theory. This paper seeks to address this gap. The pragmatic truth of management theories used by management practitioners must also meet the criteria of empirical truth based on Popper's concept of rationalism, which also includes the critiques of Kuhn and Lakatos.

The implications of this research suggest that the Lakatos thinking model approach is the most appropriate for the current state of management science, while also noting the relevant elements of Popper and Kuhn's theories and how these elements can be used to strengthen the Lakatos model approach. Management science with the Lakatos model approach can provide a stronger framework for evaluating management practices and theories, resulting in a more effective and scientifically grounded decision-making process in the field of management.

Keywords: Critical Rationalism, Falsification, Imre Lakatos, Karl Popper, Management Science, Thomas Kuhn.

INTRODUCTION

Science is one of the objects of study in philosophy, known as the philosophy

of science. As an object of philosophical study, the philosophy of science cannot be separated from various criticisms and debates by philosophers regarding claims to the truth or scientific truth of a science (Davatos 2024, 100). According to Creswell and Creswell (2018, 40—54), a scientific research framework consists of a research approach, research design, and research methods (Rothman, 2004). In the view of Borden and Abbott (2021, 13), a science can be called scientific if it meets the requirements of being logical and consistent with the facts (rational), can be tested (testable), has a rigorous explanation (parsimonious), is generally applicable (general), is temporary (tentative), and rigorously evaluated. Is a theory resulting from scientific research called true if it can be verified based on the criteria mentioned? Is a theory called true because of the many attempts to verify its truth? (Aleke 2023, 36).

Karl Popper put forward his argument that the characteristic of scientific truth of a theory in science is when the theory can show conditions that indicate its weakness so that it can be falsified. This also applies to management science resulting from the management science research framework. The management science research framework needs to be tested to determine if it meets the criteria for empirical truth as defined by Karl Popper's critical rationalism, ensuring that the resulting management theories possess empirical validity. This article shows that management science research meets the criteria for empirical truth according to Popper's concept of critical rationalism, along with criticism from Thomas Kuhn and Imre Lakatos, which will be projected in management science research and development.

SCIENCE AND SCIENTIFIC RESEARCH

According to Kenneth S. Bordens and Bruce B. Abbott (2021, 3), knowledge is acquired through a set of methods used to collect information about a particular field of phenomena and build a reliable knowledge base about it. In the epistemic view of scientists, science does not have absolute truth. All scientific observations, conclusions, and theories are always open to modification and perhaps even abandonment as new research results emerge and falsify old knowledge (Leavitt et al. 2010, 648-651; Popper 1992, 9-10). Basically, scientific research activities in science are only about reducing errors until they approach objective truth as far as possible.

The development of science is carried out by destroying theories because they are proven to be no longer valid or irrelevant, to then be refined with new, stronger theories, the results of the testing process, or error testing (Parvin 2011, 236). Whether this view is in accordance with Popper's critical rationalism thinking and whether this is in line with the paradigm view of Thomas Kuhn and Imre Lakatos' progressive research program, specifically in management science, is the focus of the discussion of this article.

In general, activities consisting of the stages of collecting data, analyzing, and interpreting the results of data analysis are known as research methods (Bordens & Abbott 2021, 23-25; Creswell & Creswell 2018, 53). The research method consists of data collection and analysis procedures, as well as the interpretation of research results (Aguinis et al. 2018, 21; Creswell & Creswell 2018, 40). Choosing a research design

is a step in narrowing research questions and developing a hypothesis or research focus that will be tested (Creswell & Creswell, 2018, 159). Specific statements that connect research variables then build research hypotheses (Knight et al., 2022, 39-52). A scientist is obliged to propose a hypothesis and test it step by step in a structured and systematic manner. In the field of empirical science, specifically, a scientist builds a hypothesis and tests it through observation and testing (Colquitt & Zapata-Phelan 2007, 1282).

Karl Popper's Critical Rationalism

According to Popper (1992, 66), a scientific theory must fulfill the fundamental requirement, namely that it can be falsifiable. Science is a collection of propositions that undergo continuous refinement through scientific testing or proof in scientific research based on proposed hypotheses. The falsifying hypothesis must have a logical relationship to the basic proposition and can be proven empirically.

According to Popper (1992, 10), a theory in empirical science can never be proven or verified, but can be falsified, meaning that it can and must be tested by a decisive research process. If the results of scientific research on a theory by following the correct approach, design, and methods show that the theory is proven, then the theory is still valid and strengthened or 'corroborated.' However, if the results of scientific research show that the theory is refuted, then the theory being tested is declared invalid because it has been falsified (Grattan-Guinness 2004, 108). Popper (1992, 10) argued that science is built on procedures that provide logical analysis, namely an empirical scientific method. But what is this 'method of empirical science,' and what is called 'empirical science'? This is the basis for Popper to propose his theory of 'Critical Rationalism.'

Induction Logic Problems and Deductive Logic Solutions, according to Karl Popper

Karl Popper appeared to reject the philosophical view which stated that the induction method was the single truth method in science. According to Popper (1992, 4), any conclusion drawn in this way may always be false. For example, no matter how many white swans have been observed, those observations cannot justify the conclusion that all swans are white. According to Popper (1992, 4), the question of whether an inductive conclusion is justified or under what conditions it is justified is known as the problem of induction.

The problem of induction can be formulated as a question about the validity or truth of universal statements inferred from single or partial experiences to build a theoretical system in empirical science (Parvin 2011, 263). Popper argued that an inductive claim is essentially a conjecture that has no necessary foundation (Parusniková 2016, 108). It was clear to Popper that an explanation of experience because of an observation or test result, in the first place, could only be a single statement and not a universal statement.

According to Popper (1992, 4), the induction method functions only to determine probabilities or is only able to conclude probabilities. Therefore, inductive logic cannot be given to science to reach a truth. In Musgrave's explanation, any form of inductive logic, the logic of temporal inference, or 'probability logic,' leads to an infinite regress or the doctrine of apriorism. (Musgrave 2004, 22). For Popper (1992, 6), the inductive logic that appears in explaining the truth of science only has the power of 'verified' conclusions, and therefore, the theory resulting from inductive conclusions can only be determined as 'true' partially in the limited domain, or even only 'probable' and therefore needs to be equipped with a deductive logic approach which tests a theory based on the constructed hypothesis and obtains the results to 'proved its mettle.'

According to Popper (1992, 9-10), deductive logic is the basis of a testing method in scientific research that can empirically test the truth of a theoretical system. Popper demonstrated the logical impossibility of deriving inductively from single or particular observational statements into infinite universally quantified propositions. While the resulting theories cannot be verified, they can nevertheless be refuted or falsified by observational statements. (Popper 1992, 46). As long as a theory survives systematic and structured testing within an appropriate approach, design, and research methods, it can be said that it has ‘proved its mettle' or that it was 'corroborated' based on the results study (Grattan-Guinness 2004, 108). Popper (1992, 18) emphasized that to show that a theoretical system falls within the demarcation criteria, it is not verifiability but falsifiability that needs to be done. The following are the arguments put forward by Popper (1992, 18).

> Now, in my view, there is no such thing as induction. Thus, inference to theories, from singular statements which are ‘verified by experience’ (whatever that may mean), is logically inadmissible. Theories are, therefore, never empirically verifiable. If we wish to avoid the positivist’s mistake of eliminating, by our criterion of demarcation, the theoretical systems of natural science, then we must choose a criterion which allows us to admit to the domain of empirical science even statements which cannot be verified. But I shall certainly admit a system as empirical or scientific only if it is capable of being tested by experience. These considerations suggest that not the verifiability but the falsifiability of a system is to be taken as a criterion of demarcation.

According to Popper (1992, 17-20), falsification is a tool for determining demarcation, namely differentiating between what Popper called genuine science and what is called pseudoscience (Hirvonen & Karisto 2022, 7—8). A theory is never derived from a single statement, but can be contradicted by a single statement (Popper 1992, 53).

THE RELEVANCE OF KARL POPPER'S CRITICAL RATIONALISM IN MANAGEMENT RESEARCH APPROACHES

Research in management science is part of research in the field of social sciences. The objects of study in social sciences, including management, are humans and organizations that contain complex entity problems. Peter Drucker (2018, 13) formulated that management is about people; its task is to make people capable of joint performance, making their strengths effective and their weaknesses irrelevant. Peter Drucker further said that management is realized in organizations, and that is the reason why management is a critical determining factor.

But despite this, the regularities in organizations and their environments and their complexity can at least partly be understood by scientific reasoning and explanation, even if the predictions of such theories are probabilistic (Moss 2003, 31). There are many purposes for conducting social research. According to Patricia Leavy (2022, 19-22), there are several objectives of social research (including management), namely: 1. Exploration, 2. Description, 3. Explanation, 4. Change or Action Research, 5. Evaluation.

Research approach and research design are essentially the same, but research design refers to a more specific type of technical approach. The management science research framework scheme can be seen in Figure 1 below:

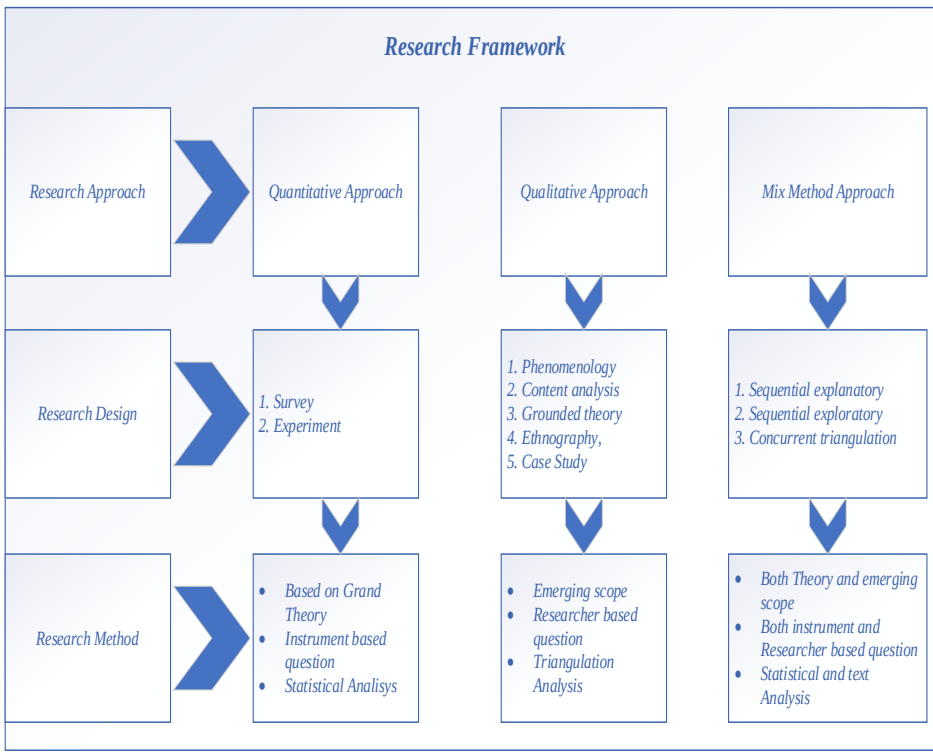

Figure 1. Research Framework

Source: Modified from Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Creswell 2018, 53)

The research framework, according to Creswell (2018), is a comprehensive approach consisting of three main elements: research approach, research design, and research methods. The research approach directs researchers in choosing a quantitative or qualitative or mixed method approach depending on the research objectives and the type of data required. Research design plans the structure and steps to be taken in the research, such as survey, experimental, phenomenology, content analysis, grounded theory, ethnography, case study, sequential explanatory, sequential exploratory, or concurrent triangulation to ensure the validity of the answer to the research question. Research methods determine the data collection and analysis techniques used, such as surveys, interviews, or observations, to obtain relevant and accurate information.

Within each research approach, there are many possibilities for how research can be conducted. So, researchers need to consider two main questions, namely: (1) What do you want to achieve? and (2) How to achieve that goal? This is the process of building a research approach, which is a plan for how the research will be conducted (Aguinis et al. 2023, 2; Kunisch et al. 2023, 7—11).

The Relevance of Karl Popper's Thought in the Quantitative Approach

Research with a quantitative approach has long dominated research activities in the field of management. One of the principles in a quantitative research approach is the construction of knowledge explicitly, concisely, and following structured formal procedures to define and measure the variability of a theory being tested, by proposing a hypothesis. However, some social scientists who are oriented towards a qualitative research approach, doubt this quantitative approach and argue that real social phenomena in the management field are too unique to be measured and standardized based on certain numerical measures and may even lose their true social meaning (Gehman et al. 2018, 1-4).

The focus of the quantitative research approach is identified as a work process that is concise and limited and focuses on solving research problems into parts that can be measured or expressed with numerical figures and analyzed with statistical tools in accordance with the research objectives (Creswell & Creswell 2018, 54). Quantitative research requires a hypothesis to be tested, with data collection using analytical techniques and statistical formulas that have been determined in each quantitative research design (Creswell & Creswell 2018, 41). The work procedures that occur in this research approach are in line with the method known as the hypothetico-deductive method in Karl Popper's critical rationalism thinking. (Baggini & Fosl 2020, 80—81).

Before carrying out data collection activities, it is necessary to determine the instrument testing technique used in data collection. The instrument used also needs to undergo an instrument testing process to ensure the validity of the instrument items and reliability to measure the unit of analysis and obtain data precisely and accurately. (Bordens & Abbott 2021, 116-119). To avoid the use of speculative instruments, the

instruments in the quantitative research approach have been falsified which is in line with Popper's concept of critical rationalism.

Data analysis uses various statistical analysis methods that provide information that can be used by researchers in deductively drawing conclusions (Creswell & Creswell 2018, 68; Bordens & Abbott 2021, 430). Research conducted by Genin has proven that standard statistical techniques can be used to determine with certainty which hypotheses can be statistically falsified (Genin 2022, 13). Research conclusions drawn from the results of hypothesis testing obtained through a quantitative research approach can be generalized within the scope of the research population.

The Relevance of Karl Popper's Thought in the Qualitative Approach

The qualitative research approach is an approach that relies on observations of phenomena that occur during the research. This means that the qualitative research approach is research that takes place based on natural conditions as they are and is not experimental research in the laboratory (Bluhm et al. 2011, 1871). So, the qualitative research approach is called naturalistic research or field research. The qualitative research approach emphasizes real or existing conditions in the research object without conditioning or intervention on the part of the researcher so that the context does not change (Creswell & Creswell 2018, 162).

Data collection in qualitative research usually involves observation, interviews, and document analysis. By positioning themselves as an instrument, researchers can adjust the field to changes that occur during research, which is impossible in quantitative research approaches with non-human instruments. (Creswell & Creswell 2018, 53). In a qualitative research approach, the meaning and interpretation of the researcher can be negotiated and agreed upon between the informant and the researcher. Consent is basically a form of acknowledgment that can be used to verify the accuracy of information provided by an information source (Creswell & Creswell 2018 292—293). This reflects what Popper said was inter-subjective testing which is a critical aspect of the idea of inter-subjective criticism, or the idea of rational supervision through critical discussion. (Popper 1992, 22).

In qualitative research, data analysis is inductive and deductive. Qualitative researchers typically work inductively, building patterns, categories, and themes from the bottom up by organizing data into increasingly general units of information. Then, deductively, the researchers looked back at their data from the themes to determine whether more evidence could support each theme or whether they needed to collect additional information (Maciag 2018, 2). So, while the process begins inductively, it then continues with deductive thinking, which also plays an important role as the analysis moves forward (Creswell & Creswell 2018, 257-258).

The Relevance of Karl Popper's Thoughts in the Mixed Methods Approach

The emergence of a mixed methods approach is an effort by scientists to overcome the weaknesses of quantitative research approaches and qualitative research approaches (Creswell & Creswell 2018, 294). The use of a mixed methods research

approach has the following two reasons, namely: (1) results that provide stronger and deeper conclusions and (2) research results that are in accordance with the formulation of research problems that cannot be answered by other research approaches (Gibson 2017, 24). The mixed methods research approach is the result of the falsification of quantitative research approaches and qualitative research approaches.

The purpose of using a mixed methods research approach comes from the information needed to answer the research topic and formulate the research problem. The aim is to combine quantitative and qualitative research approaches in one study (Schoonenboom & Johnson 2017, 4). A mixed methods research approach can use sequential or concurrent research designs. Each model has different data analysis methods depending on the researcher's needs, namely simultaneous and sequential (Creswell & Creswell 2018, 300-303). In principle, the mixed methods research approach has more advantages than disadvantages compared to other research approaches, because the mixed methods research approach aims to cover the weaknesses or shortcomings of the quantitative research approach and the qualitative research approach.

In the mixed methods research approach, there are several research models that have been offered by experts. In general, there are three designs that can be chosen when using this mixed method, namely 1) sequential explanatory design, 2) sequential exploratory design, and 3) concurrent triangulation design (Warfa 2016). The relevance of the harmony of Popper's critical rationalism thinking in quantitative research approaches and in qualitative research approaches is the result of the harmony of Popper's critical rationalism thinking in this mixed methods research approach. At the same time, Karl Popper's criticism of the inductive logic that is still used in qualitative research approaches is answered and resolved in the application of mixed methods research approaches.

THOMAS KUHN AND IMRE LAKATOS' RESPONSE TO KARL POPPER'S CRITICAL RATIONALIST THOUGHT

The main difficulty in applying Popper's concept of falsification lies at the practical level, which reflects the behavior of applying management theory, rather than at the theoretical level, where falsification is a concept that is too ideal, according to critics. In practice, scientists do not easily reject a theory by continuously falsifying existing theories to become more perfect and increasingly able to explain existing phenomena and solve problems (Ulrich 2006, 5-15).

The relevance of the concept of falsification in Popper's critical rationalism does not mean that the theory is without weaknesses. Popper's views invited criticism from later figures, including Thomas Kuhn and Imre Lakatos.

Thomas Kuhn's Criticism

Thomas Kuhn took a different view from Popper's concept that the development of science occurs within the framework of a paradigm revolution. Scientists always

work with paradigms that include ontological, methodological assumptions and value structures. A paradigm is a fundamental description of the subject matter in science that functions to define what must be studied, what questions must be asked, how these questions must be asked, and what rules must be followed in interpreting the answers obtained (Adewumi et al. 2019, 4). A paradigm is the broadest unit of consensus in science and serves to differentiate one scientific community from another. It summarizes, defines, and relates the examples, theories, methods, and instruments contained therein (Ritzer 1975, 157).

The paradigm itself becomes a conceptual framework for understanding the universe; therefore, there is no neutral perception because all perceptual experiences are shaped by the conceptual framework used (Kuhn & Hacking 2012, 65-71). On the other hand, according to Popper, science moves evolutionarily. Popper believed that there is a cognitive accumulation that allows rational comparison of one theory with another. So, there is always continuity between theories in the development of science.

However, Kuhn (2012, 8) rejected Popper's concept and proposed the concept of incommensurability. According to Kuhn, continuity between theories is impossible because all theories operate within their own paradigms. Kuhn noted that the development of science does not occur through the falsification of existing theories, but rather, the development of science occurs from a paradigm shift that responds to crises caused by anomalies in certain scientific groups. The process of scientific development goes on forever because anomalies are always discovered, and never stop (Fuller 2004, 18-33).

The scientific revolution, according to Kuhn, is characterized by a paradigm shift, through a process that begins with a view to the future when scientists try to develop a central paradigm by solving puzzles and confronting anomalies (Marcum 2017, 4). However, when scientists fail to adapt their paradigm to the concept of 'normal science,' a crisis occurs that demands a scientific revolution (revolutionary science), and a new paradigm emerges. (Kuhn & Hacking 2012, 8-9). In the Kuhn paradigm, there are values of the scientific community that essentially follow certain values in their scientific activities. Thus, it is within this scientific paradigm that concrete problems are studied and solved (Fuller 2004, 18-33). When deciding on a particular paradigm and the theories that arise from it, scientists are willing to focus only on problems that lie within the scope of the paradigm and the boundaries of their chosen theory. (Pinter & Pinter 1998, 297).

According to Kuhn (2012, 59-60), Popper distorted reality by using hypotheses to explain the emergence of empirical science, followed by attempts at falsification. According to Kuhn, change only occurs through a scientific revolution, which is a non-cumulative trend in which existing paradigms that are completely or partially incompatible are replaced by new ones.

Thus, Kuhn criticized Karl Popper's critical rationalism by emphasizing that the development of science does not take place through an orderly and logical process of falsification as proposed by Popper. Kuhn argues that science develops through a series of paradigms that define the framework and methodology for the scientific community. These paradigms are not abandoned simply because of the discovery of anomalies or falsification, but rather a prolonged crisis that then gives rise to a scientific revolution. According to Kuhn, this paradigm shift is a complex social and

historical process, not just the result of rejecting hypotheses that do not match observational data, as proposed by Popper.

It is possible that Popper would reject Kuhn's view of paradigms being irrational and scientific change being revolutionary and socio-historical. Popper would probably argue that while social and psychological influences cannot be ignored, the core of the scientific method must still be based on rigorous testing and falsification. Popper would probably argue that the focus on anomalies and crises as drivers of paradigm shifts ignores the importance of critical and logical processes in evaluating scientific theories. According to Popper, science advances through a sustained effort to refine and replace theories that cannot stand up to rigorous empirical tests (Rowbottom 2011).

Criticism Of Imre Lakatos

Imre Lakatos criticized Popper for placing too much emphasis on falsification as the main criterion of science. According to Lakatos, scientific thinking is not only about rejecting wrong theories, but also about building better theories. Falsification alone, according to Lakatos, does not provide a complete view of the development of science. Lakatos emphasizes that the falsification proposed by Popper as a criterion of science is flawed, especially in the context of a continuous scientific research program.

The absolute falsification proposed by Popper seems too strict to explain the real dynamics of science. According to Lakatos in Agassi, scientific theories often have a protective belt that can protect the main theory from being proven wrong. A research program or scientific theory consists of a hard core consisting of fundamental principles and basic assumptions that are an essential part of the theory. This hard core is the foundation that must be protected because it is a central element that cannot be compromised in a research program (Agassi 2014, 121).

Lakatos provides space and even emphasizes the need for the "co-existence" of several alternative research programs in the same field. According to Lakatos (1978), researchers can objectively compare the relative progress of competing research traditions through a research program consisting of two main parts, namely: 1. negative heuristic: hardcore, namely core problems that cannot be developed, and 2. positive heuristic: refutable, namely problems that can be developed, changed, and modified.

Hardcore (negative heuristic) has the characteristic of being accepted by consensus and cannot be refuted or refuted by those running the research program; it will have an impact on progressive problem transfer (Barseghyan & Shaw 2017). Meanwhile, positive heuristics are very useful for saving scientists from problems and confusion caused by anomalies and therefore, positive heuristics are more flexible than negative heuristics because they always grow and develop over time (Harman 2019). The research program also has what is called a "protective belt." This protective belt consists of additional elements that cover the hardcore and can be changed or adapted to changes or new research results without damaging the hardcore itself. This protective belt is what Lakatos means as a positive heuristic.

The two elements of the research program above are then complemented by a set of theories that ensure that the theories are interrelated because the theory that emerges later always complements the previous theory. According to Lakatos, when a core theory faces challenges or evidence seems to contradict it, scientists in a research program must work to save the core theory. They can do this by changing or expanding the protective belt, digging deeper, or proposing additional hypotheses that protect the hardcore without sacrificing essential core principles. Basically, the development of science has been and should be the history of many competing research programs. Therefore, heuristic power (development power) and sustainability are needed in science development activities (Lakatos et al. 1978).

As Popper explained, science develops through a process of falsification, in which theories that contradict the results of hypothesis testing are immediately discarded, and science develops as an exclusive process. Kuhn saw this as an idealistic view of science, where Kuhn saw science as consisting of episodes of "normal science," where testing of theories is carried out within a particular paradigm, and scientists stick to their theories in the face of anomalies. Normal science is a period of knowledge accumulation in which scientists work and expand the prevailing paradigm (Ritzer 1975). However, Lakatos' view of science lies between the two views mentioned above (Agassi 2014, 77–79).

Lakatos believes that falsification, if used correctly, will be part of efforts to strengthen scientific theories. In an ongoing scientific research program, falsification can be used to identify areas where theories need to be improved, and this can encourage the development of better science. This concept is different from Popper's concept of falsification. Lakatos believes that a research program or scientific theory should be tested within a broader framework rather than simply discarding a theory in the face of seemingly contradictory evidence. In rescuing core theories, Lakatos emphasizes that the development of science often involves a more complex process than simply rejecting conflicting theories in the face of new evidence. He emphasized the need for continuity in the development of science through efforts to modify and protect the core of a research program (Lakatos et al. 1978).

The key to Lakatos' thinking is his idea of 'theory.' Lakatos points out that a "theory" in science is actually a series of slightly different testing techniques developed over time, all of which have the same core. The development of science is the development of theory. A scientist working in a particular research program protects the core of his theory from falsification with additional hypotheses. According to Lakatos et al. (1978), a research program is a series of theories that are open to further development and able to overcome anomalies or problems that arise. In Lakatos' view, these theories may undergo changes and adjustments over time, but the core of the research program remains intact.

Progressive research programs are characterized by more accurate predictions of new facts. In contrast, a declining program is characterized by a lack of growth; its additional zones do not lead to new predictions, which then become obsolete (Harman 2019). For Lakatos in Barseghyan and Shaw (2017), the unit of methodological assessment is a research program defined as a set of theories that share a certain fixed core. Rationality, for Lakatos, is exclusively concerned with the ways in which research programs are modified. Because there are many ways in which a research

program can be modified, it is important for Lakatos's methodology to articulate which types of modification are progressive and which are regressive. According to Lakatos, research program modifications are progressive if all of the following conditions are met.

Lakatos's thinking about the research program leads to an improved and additional nuance of Popper's falsification, namely that rather than rejecting theory outright through observation, science now seems to be moving towards constant adaptation and development of positive heuristics around the core of its research program, and this is systematic processes that are part of Kuhn's version of "normal science." By replacing the paradigmatic concept of research programs with hardcore and positive heuristics, Lakatos legitimizes the actions of researchers who expand positive heuristics to preserve the hard core of research programs as much as possible. Furthermore, according to Lakatos in Agassi (2014, 121–126), in a paradigm shift, there is a shift from a degenerative research program to a more progressive research program, so that the paradigm shift is rational, not irrational, as stated by Kuhn.

Against Kuhn's views, Lakatos rejects the concept of scientific revolution that emphasizes paradigm shift as a revolutionary and subjective process. Lakatos argues that scientific change is more gradual and rational than Kuhn describes, with competing research programs evaluated on the basis of their progressivity in producing new discoveries and better explanations. Popper would probably appreciate Lakatos' efforts to refine and extend falsificationism but still insist that direct and unequivocal falsification is a key element of the scientific method. Popper could criticize Lakatos' approach of allowing theories to survive longer despite being tested with negative results, arguing that this could lead to a slowdown in scientific progress and retain theories that should be abandoned. Popper might have stressed that while research programs can be helpful in organizing science, they should not be a reason to delay replacing theories that have failed the test.

IMPLICATION

Although the theories of Karl Popper, Thomas Kuhn, and Imre Lakatos have criticisms of each other, each theory offers valuable insights in understanding the scientific nature of management science. Each theory provides a helpful framework for evaluating and developing management theories, although management science may not be fully scientific in all three senses simultaneously. The view that the theories of Karl Popper, Thomas Kuhn, and Imre Lakatos are contradictory can be defended by looking at the fundamental differences in their understanding of how science develops and how scientific truth is established.

Karl Popper emphasized falsifiability as the core of the scientific method, where a theory is considered scientific only if it can be tested and potentially proven false. This emphasizes rationality and rigorous logical processes. Popper's theory, with its emphasis on falsification, provides an important tool for testing the validity of management theories. Through hypothesis testing and attempts to prove theories wrong, management scientists can ensure that theories have a strong empirical basis

and are not merely speculative. Popper's model approach encourages rigor and helps to ensure that theories applied in management practice are truly effective and efficacious.

In contrast, Thomas Kuhn argues that scientific development occurs through paradigm shifts characterized by crises and revolutions that are not necessarily rational or logical but rather socio-historical. Old paradigms are only replaced after the accumulation of anomalies and collective acceptance of new paradigms, emphasizing the psychological and sociological aspects of scientific development.

Kuhn's view of paradigms and scientific revolutions offers the perspective that developments in management science often occur through major shifts in thinking and practice. An understanding of the dynamics of paradigm shifts helps management practitioners and researchers to be more adaptive and responsive to changes in a complex and fast-changing business environment.

Imre Lakatos's criticism emphasizes the importance of relevance and practicability in scientific research in the field of management, which is very relevant. His criticism of Popper was that Popper's critical rationalism focused too much on the falsification of theories without providing sufficient guidance on how to build better theories. In the context of management science, this means that the resulting research and theory must have practical relevance and be applicable in real managerial situations (Lakatos 1978, 200).

Imre Lakatos offers a middle ground, criticizing both Popper and Kuhn. He proposes that science develops through a program of scientific research involving a series of theories protected by negative and positive heuristics. Lakatos rejects Popper's view that outright falsification can end a theory, and also criticizes Kuhn's view of revolutionary and subjective paradigm shifts, emphasizing that changes in science are more gradual and cumulative.

There are many overtures to mainstream management theory that are distinctively Popperian in terms of their critical philosophical stance. Experience alone, without theory, teaches management nothing about what to do to improve quality and competitive position, or how to do it. So, it is not surprising that a statement from Kurt Lewin was quoted by Rothman (2004, 1-7), that, "there is nothing more practical than a good theory." Management's job is to think about, set, and direct those goals, values, and objectives (Burke and Litwin 1992, 529). This not only benefits individual professionals but also creates a positive impact on the success of the organization in achieving its strategic goals (Colquitt et al. 2022, 7). Every organization consists of people with different skills and knowledge doing different types of work built on communication and individual responsibility (Michael J. Wesson 2019, 386).

In contemporary management research, especially in quantitative research, the use of falsification is no longer the only dominant principle. While the principle of falsification popularized by Popper remains an important part of scientific research methodology, other approaches such as verification, qualitative exploration, and mixed approaches are increasingly gaining recognition in management studies. The application of these methods aims not only to prove or disprove hypotheses in the traditional manner proposed by Popper, but also to understand broader contexts, explore complex phenomena, and unearth deeper insights into organizational and

management dynamics. Thus, noting the variety and evolution in methodological approaches used in management research, no longer relying entirely on Popperian methodologies, reflects the ever-evolving nature of research methodologies in management science.

Thomas Kuhn's thinking about paradigms can stimulate interdisciplinary approaches in management science. When paradigms from various disciplines, such as economics, psychology, sociology, and information technology, converge, this can create a more comprehensive framework for understanding and managing organizations. The concept of Kuhn's paradigm can also be used to explain the development of management theory. However, over time, this paradigm can experience a crisis when it is no longer able to cope with challenges or changes in the business environment. This can trigger the emergence of new paradigms, such as productivity management, quality management, and innovation management, which offer different views and approaches to managing organizations. Furthermore, Silverstein et al. in Bouwer summarizes this concept very well and shows the development of management theory in structured systems as organizational capabilities (Bouwer, 2015, 2).

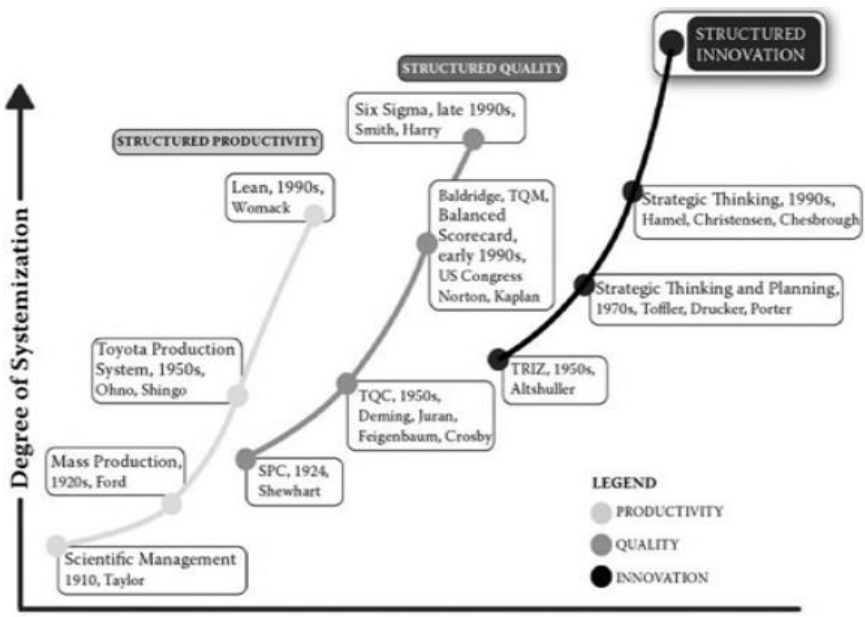

Figure 2. Development of Management Theory
Source: Capabilities-Driven Innovation Management Framework: Crossing the Innovator's Chasm (Bouwer, 2015, 2).

Karl Popper's philosophy of science emphasizes the falsifiability of theories. However, the figure 2 does not visually represent this process of falsification or any criteria that align specifically with Popper's philosophy. Instead, it describes the evolution of management theories from productivity to quality and innovation without explicitly indicating how these theories were tested or falsified in a Popperian sense.

If Kuhn's criticism is used to explain the revolution of productivity theory into quality theory and ultimately into the innovation theory that applies today, then this would also be inappropriate. Even though it appears that there has indeed been a shift from the productivity paradigm to a quality paradigm, and to an innovation paradigm, the productivity paradigm and quality paradigm remain in effect and were not replaced when the innovation paradigm was the basis for management scientists conducting much of their current research. In other words, the quality paradigm and productivity paradigm remain valid in becoming an organization's competitive efficiency. Thus, the paradigm revolution does not seem appropriate to apply in the development of management science. This is in line with George Ritzer's (1975, 164) explanation that each paradigm, if it stands alone, is inadequate. Each paradigm requires insights from other paradigms to explain social phenomena as a whole (including management). Therefore, more paradigmatic integration efforts are needed, both inter-paradigmatic and intra-paradigmatic.

Lakatos' theory, with its concept of a scientific research program, provides a way to understand how management theories can develop gradually through constant adjustment and refinement. The research program enables the development of a more stable and coherent theory over time, by protecting the core of the theory while allowing modifications to fewer central parts. This approach fits well with management's need to continuously innovate and improve its practices based on empirical experience and new evidence.

Lakatos' theory, which combines elements of the previous views, provides the most reasonable and suitable framework for the development of management science. Management science, with its complexity and dynamics, requires an approach that accommodates continuous change and adaptation, but remains within a rational framework. Lakatos' scientific research program allows for flexibility in theory development, recognizing the need for modification and adjustment without having to abandon the overall research program. This approach reflects the reality that management theories are constantly evolving and adapting to new practices and contexts, ensuring continued relevance and practicality.

As such, management science can utilize the most relevant aspects of all three theories. Popper's falsifications enhance scientific rigor, Kuhn's paradigm shifts explain major innovations and changes, and Lakatos' research program allows for the steady evolution of theories. While management science may not be fully scientific in the sense of Popper, Kuhn, or Lakatos individually, the combination of these three perspectives provides a richer and more comprehensive foundation for the development and application of effective and adaptive management theories.

Management theories do not simply replace one another but rather evolve through the integration of various paradigms, as suggested by Lakatos' methodology. Thus, the development of management science benefits from combining the rigor of Popper's falsifiability, the innovation explained by Kuhn's paradigm shifts, and the

continuous improvement outlined in Lakatos' research programs. This approach ensures a comprehensive and nuanced understanding of how management theories develop and adapt over time, accommodating the strengths of each philosophical perspective.

CONCLUSION

The quantitative research approach in management is a more relevant approach in terms of Karl Popper's concept of 'Critical Rationalism.' Meanwhile, qualitative approaches and mixed methods approaches are not entirely relevant or limited to Karl Popper's concept of 'Critical Rationalism.' This is mainly because qualitative research approaches, which aim to understand the meaning of research problems more deeply in natural object conditions (natural settings), often focus more on description, interpretation, and in-depth understanding of phenomena. This makes it difficult to test directly or to produce empirical evidence that can support or refute certain theories in a way that is consistent with Popper's falsification principle.

Kuhn's main criticism of Popper's approach was that change in science does not always occur through falsification and rigorous testing. Kuhn suggested that paradigm shifts often occur as a result of broader paradigmatic shifts, in which the scientific community shifts from one conceptual framework to another. In management science, this can be interpreted as a major change in the way of understanding and managing organizations, which may not be explained in the simple way proposed by Popper. Business organizations often face paradigm shifts in response to external changes such as technological developments, market changes, or regulatory changes. These changes are triggering a transformation in how organizations manage resources, processes, and strategy. Leaders and decision-makers in organizations must be sensitive to paradigm changes. They need to be able to identify when existing paradigms are no longer relevant and when it is time to look for new solutions or approaches. The ability to adapt to paradigm changes can be the key to success in organizational management. The concept of Kuhn's paradigm is increasingly relevant in the context of change management. When an organization experiences a paradigm shift, for example, in the implementation of a new system or a new strategy, effective change management becomes important. This includes managing resistance to change and helping organizational members to adapt to the new paradigm.

Furthermore, according to Lakatos in Barseghyan and Shaw, a successful research program is a program that can withstand repeated criticism and testing. According to Lakatos, "In a research program, a theory can only be dispelled by a better theory, namely a theory with more empirical content than its predecessor, some of which is later confirmed." As for eliminating entire research programs, Lakatos says that they can be eliminated (or ‘saved’) only if they are replaced by other programs that “progressively explain more” (Barseghyan & Shaw 2017, 7).

In management science, this means that management theories and approaches must withstand rigorous criticism and ongoing assessment from the scientific community and management practitioners themselves. Lakatos acknowledged that

sometimes new paradigms emerge due to the development of ongoing research programs. This shows that openness is needed to the possibility of new management paradigms or approaches that can produce a better understanding of management practices. In this case, Lakatos emphasizes the importance of creativity and innovation in the development of management theory and practice. To develop successful research programs in management science, creative thinking is needed to create better frameworks and theories, which can help overcome managerial challenges and problems. To develop a sustainable research program in management science, intensive collaboration and discussion between scientists and practitioners in the management scientific community is necessary. It enables the exchange of ideas, critical thinking, and theory testing in an environment that supports the development of management knowledge.

Lakatos also notes that Popper's methodology, which is more suitable for the natural sciences, may be less suitable for the social sciences, including management science. Social sciences often involve variables that are more complex and difficult to measure, which makes applying Popper's falsification principle more complicated. Therefore, in management science, there needs to be a balance between a strictly Popperian approach and a more contextual and complex understanding of managerial phenomena.

In the development of management science, many theories that have been falsified by previous scientific research are still used as the grand theory in current research. For example, Figure 2 (Bouwer, 2015, 2) shows that productivity theory and quality theory, which have been proven in various scientific studies, have been falsified and replaced with innovation theory to build the competitive advantage of a business organization. This is contrary to Popper's concept of rationalism, which states that when a theory has been falsified in testing or research, then the theory is declared invalid and replaced with a theory that invalidates it.

In management practice, although the theory of quality and the theory of productivity have been proven to fail in various research results and replaced by the theory of innovation, the theory of productivity and the theory of quality are still maintained and complemented by the theory of innovation. In this case, productivity theory and quality theory are part of the innovation theory that needs to be built by organizations to improve their competitiveness in the industry. In this case, Lakatos' criticism that science develops in a continuous research program is indeed more appropriate and relevant to explain the phenomenon. According to Lakatos, management theories that develop over time need to be able to answer new questions and overcome new challenges that arise in the world of management. This requires updating, adapting, and developing existing theories.

It is clear that there is no absolute truth in the views of either Popper, Kuhn, or Lakatos. This shows that philosophy is a critical science that tries to question answers, but the answers offered always raise new questions. Answers in philosophy are never eternal. Therefore, philosophy is never finished and never comes to a satisfactory end of a problem. The issue of Popper's critical rationalism is no exception, which later invited criticism from Kuhn and Lakatos, as explained in this paper.

Problems in philosophy are never solved precisely because they are philosophical. The problem of philosophy is the problem of man and the world

(reality). On the one hand, humans are the subjects who question, but on the other hand, the problems faced by humans have developed according to their context. The problem of methods in scientific research has developed in terms of language or linguistics, in terms of the conceptual limitations of human understanding (epistemology), and the limitations of interpretation in accordance with the times. Indeed, this paper is not written to provide a complete answer to the problem of empirical truth in management science, but this paper is written to question 'a methodological examination of how the management science research approach is viewed from Popper's critical rationalism along with the critiques of Kuhn and Lakatos' as an alternative temporary answer which is the object of questions that can still be debated in further discussion and research.

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