

Theoretical and Conceptual Modelling: An Integral Part of Research Process

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Abstract

This study employed a comprehensive literature review to identify existing articles that address theoretical and conceptual frameworks. Articles were sourced from reputable academic databases such as Google Scholar, Academia.edu, ResearchGate, among others. This approach involves summarizing and synthesizing existing literature in a narrative format. The study provides a descriptive overview of key concepts, findings, and debates within theoretical and conceptual modelling as an integral part of research process. The research paper provides a broad overview of a topic or to explore emerging trends and debates. The research was guided by keywords related to theoretical and conceptual frameworks. This study extensively discusses the significance of incorporating theoretical and conceptual models. To address these implications, researchers must prioritize the integration of conceptual and theoretical models into their research processes, ensuring that their studies are grounded in established theories, address meaningful research questions, and contribute to theory development and innovation within their fields.

Keywords: *Conceptual Modelling, Literature Review, Research Process, Theoretical Modelling, Theoretical Research*

Introduction

In the absence of conceptual and theoretical models, researchers may inadvertently duplicate or replicate existing research without adding new insights or value (Boote & Beile, 2005). This can result in a proliferation of studies that contribute little to the cumulative body of knowledge or fail to address pressing research questions. Without a clear understanding of the theoretical underpinnings of their research, researchers may struggle to position their work within the broader literature or identify its unique contributions (Caliendo & Kyle, 1996). The implications of not

using conceptual models and theoretical models by researchers in the contemporary world can include a lack of theoretical foundation, ineffective problem-solving, limited generalizability, missed opportunities for innovation, and the risk of redundancy or replication (Collins & Stockton, 2018).

Theoretical modelling

A theoretical model, or modeling, refers to the construction and analysis of abstract representations or frameworks that depict the relationships between variables, concepts, or phenomena within a specific theoretical framework or paradigm (Adom *et al.*, 2018). Theoretical modeling aims to provide a structured and simplified representation of real-world systems or processes, allowing researchers to make predictions, test hypotheses, and gain insights into the underlying mechanisms driving observed phenomena (Torraco, 2005).

Theoretical models can take various forms, including mathematical equations, graphical representations, conceptual diagrams, or computer simulations, depending on the nature of the research question and the level of complexity involved. These models may be deterministic or probabilistic, static or dynamic, and may incorporate assumptions, constraints, or simplifications to make the analysis tractable (Kivunja, 2018; Torraco, 2005).

Theoretical modeling plays a crucial role across various disciplines, including physics, economics, biology, social sciences, and engineering, among others. In physics, for example, theoretical models are used to describe the behavior of physical systems, predict the outcomes of experiments, and formulate fundamental laws of nature. In economics, theoretical models help economists understand the interactions between agents in markets, predict the effects of policy interventions, and analyze economic phenomena such as inflation, unemployment, and economic growth (Peshkin, A. (1993).

Theoretical modeling serves as a powerful tool for theory development, hypothesis testing, and knowledge generation across a wide range of disciplines, enabling researchers to explore and understand complex systems, uncover underlying patterns, and make informed predictions about the behavior of phenomena under different conditions (Lester, 2005; Ravitch & Riggan, 2017).

Theoretical modeling can be applied to a wide range of phenomena and systems, including physical systems (e.g., climate models, fluid dynamics), biological systems (e.g., ecological models, population dynamics), social systems (e.g., economic models, social network analysis), and engineering systems (e.g., structural models, control systems) (Kivunja, 2018). It provides researchers with a powerful tool for theory development, hypothesis testing, and knowledge generation, enabling them to explore complex systems, uncover underlying patterns, and make informed predictions about the behavior of phenomena under different conditions (Torraco, 2005).

Moreover, theoretical modeling often involves iterative refinement and validation, with researchers continuously revising and updating the model based on new data, insights, or theoretical developments (Varpio *et al.*, 2020). This iterative process helps to improve the accuracy and robustness of the model over time, enhancing its utility for understanding and predicting the behavior of real-world systems. Overall, theoretical modeling serves as a fundamental approach

for advancing knowledge and understanding across a wide range of disciplines, driving innovation, discovery, and progress in science and engineering (Torraco, 2005).

Conceptual modeling

Conceptual modeling tends to be more abstract and qualitative, focusing on representing high-level concepts and relationships in a clear and understandable manner (Ravitch & Riggan, 2017). The emphasis is on providing a conceptual understanding of the system rather than precise quantitative predictions. In contrast, theoretical modeling often involves a higher level of abstraction, with a focus on formalizing theoretical constructs using mathematical or computational representations (Kivunja, 2018). Theoretical models may incorporate precise mathematical equations, algorithms, or formal logic to describe the relationships between variables and make predictions about the system's behavior.

Conceptual models are primarily used for conceptualization, communication, and analysis, providing a framework for understanding and discussing complex systems or problems. While they may inform empirical research by guiding the development of hypotheses or research questions, conceptual models themselves are not typically subject to empirical testing (Ravitch & Riggan, 2017). Theoretical models, on the other hand, are often developed with the explicit aim of making testable predictions that can be validated or falsified through empirical research. Theoretical models serve as formal representations of hypotheses or theoretical constructs, which can be empirically tested using data or observations.

Conceptual modeling is broadly applicable across various domains and disciplines, providing a versatile tool for visualizing, analyzing, and communicating complex systems or phenomena (Kivunja, 2018). Conceptual models can be used in diverse contexts, from social networks and organizational structures to business processes and decision-making frameworks. Theoretical modeling, while also applicable across different domains, is more commonly associated with scientific disciplines such as physics, economics, psychology, and sociology, where formal theories and mathematical models play a central role in theory development and hypothesis testing (Varpio *et al.*, 2020).

Conceptual modeling often serves as an initial step in the research process, helping researchers conceptualize the problem space, identify key concepts and relationships, and develop a shared understanding among stakeholders (Torraco, 2005). Conceptual models provide a foundation for further inquiry, guiding the formulation of research questions, hypotheses, and study designs. Theoretical modeling typically occurs later in the research process, after the conceptual groundwork has been laid. Theoretical models are used to formalize hypotheses, specify the relationships between variables, and generate predictions that can be tested empirically, contributing to theory development and refinement (Varpio *et al.*, 2020).

Both conceptual modeling and theoretical modeling play important roles in social and management sciences research processes, they differ in terms of their level of abstraction, empirical testability, scope of application, and role in the research process (Ravitch & Riggan, 2017). Conceptual

modeling provides a qualitative understanding of complex systems, while theoretical modeling formalizes hypotheses and generates testable predictions using mathematical or computational representations. Both approaches are valuable tools for researchers, offering complementary perspectives and insights into the study of social and organizational phenomena.

Conceptual modeling, or the creation of conceptual models, involves the development of abstract representations that depict the key concepts, relationships, and structures within a particular system, domain, or problem space (Ravitch & Riggan, 2017). These models provide a simplified and structured view of the system, focusing on its essential components and their interrelationships, without delving into the specific implementation details or technical aspects (Kivunja, 2018).

Conceptual models can take various forms, including graphical diagrams, conceptual frameworks, flowcharts, mind maps, or narrative descriptions, depending on the nature of the system and the preferences of the modeler. They serve as a means of communication and visualization, helping stakeholders, researchers, or decision-makers to understand, analyze, and discuss complex systems or problems in a clear and concise manner.

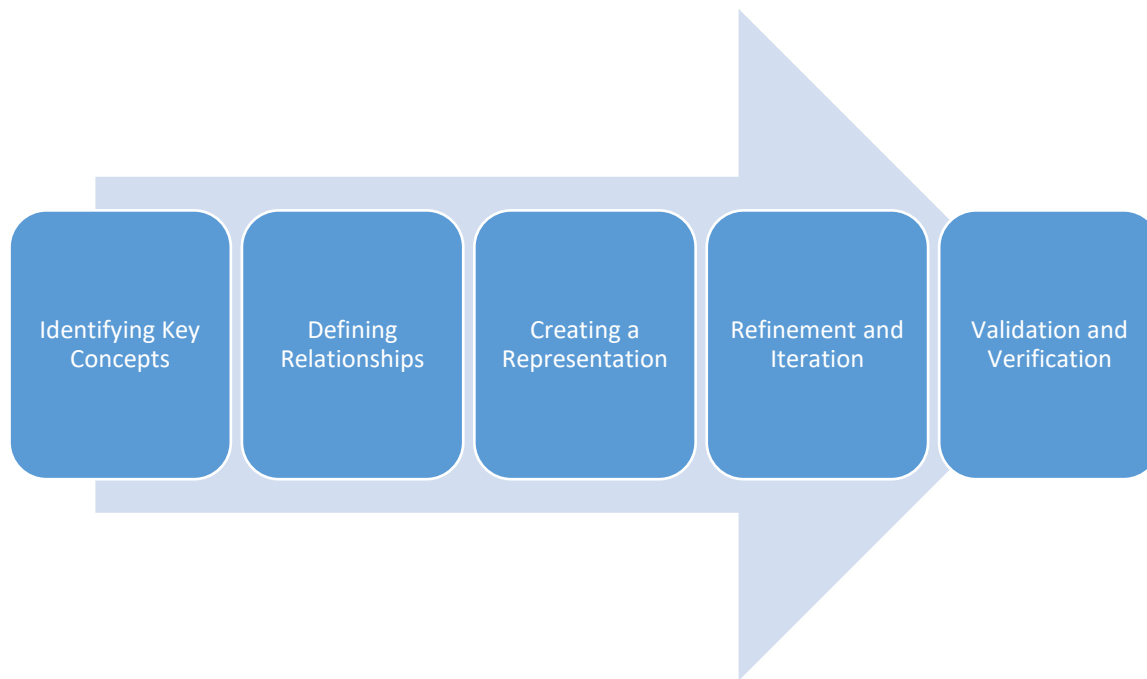


Figure 1: Process of conceptual modeling

Source: Authors' constructs, 2024

As depicted in Figure 1: The process of conceptual modeling typically involves five key steps:
Identifying Key Concepts: Identifying the fundamental concepts, entities, or components within the system to be modeled, based on domain knowledge, stakeholder input, or problem analysis;
Defining Relationships: Establishing the relationships, dependencies, or interactions between the

identified concepts, indicating how they are connected or influence each other within the system; Creating a Representation: Developing a graphical or textual representation of the conceptual model, using appropriate symbols, notations, or languages to depict the concepts and relationships in a coherent and understandable way; Refinement and Iteration: Iteratively refining and revising the conceptual model based on feedback, insights, or new information, ensuring that it accurately captures the essential aspects of the system and meets the needs of stakeholders and Validation and Verification: Validating the conceptual model through review, discussion, or simulation, to ensure that it accurately represents the system and effectively communicates the intended information to stakeholders.

Conceptual models serve as a common language for stakeholders to communicate and collaborate on understanding complex systems or problems (Lester, 2005). By providing a visual or structured representation of the system's key concepts and relationships, conceptual models facilitate clearer communication among stakeholders with diverse backgrounds and expertise (Varpio *et al.*, 2020). Conceptual models help stakeholders analyze and understand the structure, behavior, and dynamics of systems or processes. By abstracting away implementation details and focusing on high-level concepts and relationships, conceptual models enable stakeholders to identify patterns, dependencies, and causal relationships within the system, fostering deeper insights and understanding (Ravitch & Riggan, 2017).

Conceptual models support problem-solving and decision-making by providing a systematic framework for exploring and evaluating alternative solutions or strategies. By visually representing the components and interactions of the system, conceptual models help stakeholders evaluate the potential impacts of different decisions or actions, weigh trade-offs, and identify optimal courses of action (Ravitch & Riggan, 2017). In fields such as software engineering and information systems, conceptual models are used to specify the requirements and design of software systems or applications. By capturing the essential features, functionalities, and constraints of the system in a conceptual model, stakeholders can ensure that the resulting software solution meets the needs and expectations of users and stakeholders.

Conceptual models play a key role in innovation and design processes by providing a framework for brainstorming, exploring ideas, and generating creative solutions. By visualizing concepts and relationships in a structured manner, conceptual models help designers and innovators explore new possibilities, uncover insights, and iteratively refine their ideas to create novel and effective solutions.

Conceptual modeling is a versatile and powerful tool that supports various aspects of problem-solving, decision-making, and innovation across different domains. By providing a structured and visual representation of complex systems or problems, conceptual models enable stakeholders to communicate effectively, analyze systems comprehensively, and make informed decisions that drive positive outcomes and innovation.

In the context of social and management sciences research processes, conceptual modeling and theoretical modeling serve distinct purposes and focus on different aspects of the research process:

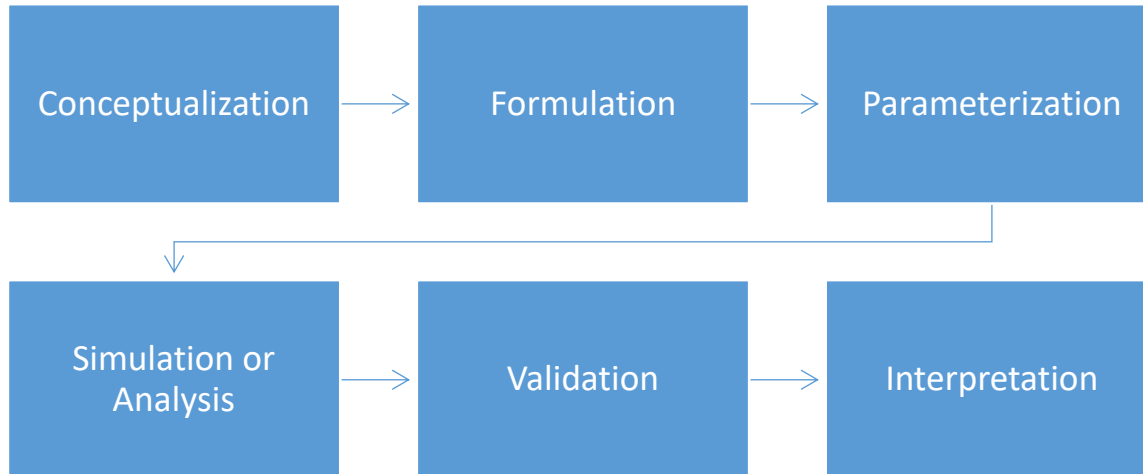


Figure 2: Six (6) key steps theoretical modeling

Source: Authors' constructs, 2024

Figure 2 above illustrates theoretical modeling which involves several key steps: Conceptualization: Identifying the key variables, concepts, or phenomena to be modeled and establishing the theoretical framework or paradigm within which the modeling will take place; Formulation: Developing mathematical equations, conceptual diagrams, or computational algorithms that represent the relationships between the variables or components of the system being studied; Parameterization: Assigning values to the parameters within the model based on empirical data, expert knowledge, or theoretical assumptions; Simulation or Analysis: Running simulations or conducting analytical procedures to explore the behavior of the model under different conditions, test hypotheses, and make predictions about the system's dynamics or outcomes; Validation: Comparing the model's predictions or simulations with empirical observations or experimental data to assess its accuracy, reliability, and validity and Interpretation: Analyzing the results of the modeling process to gain insights into the underlying mechanisms driving the system, identify patterns or trends, and draw conclusions about the phenomena being studied.

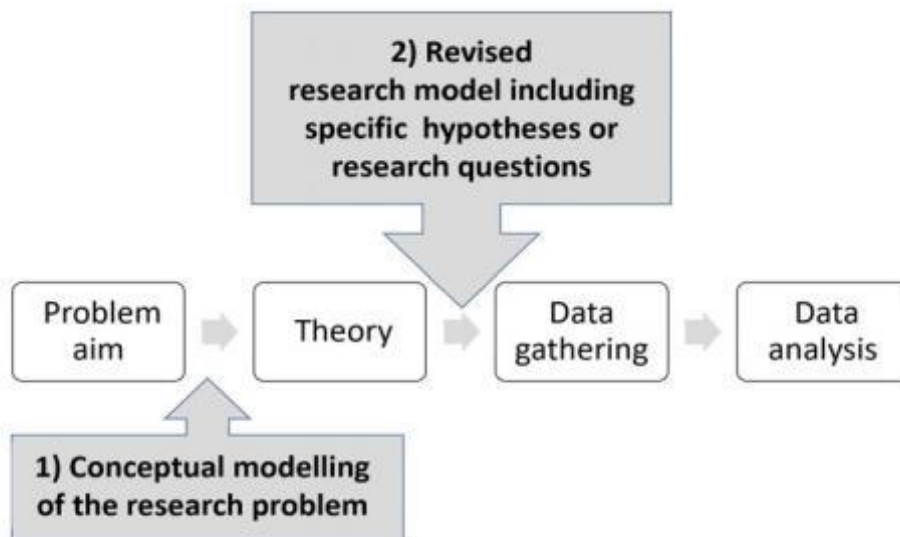


Figure 3. Research process and place of the Conceptual model

Source: Adopted from Ludviga (2023)

Conceptual Modeling:

Conceptual modeling involves the development of abstract representations that depict the key concepts, relationships, and structures within a particular system, domain, or problem space (Ravitch & Riggan, 2017). The primary purpose of conceptual modeling is to provide a simplified and structured view of the system, focusing on its essential components and their interrelationships. Conceptual modeling focuses on capturing the high-level concepts, entities, and relationships relevant to the research problem or topic (Imenda, 2014). It abstracts away from specific implementation details or technical aspects and emphasizes understanding the system's structure, behavior, and dynamics. In social and management sciences research, conceptual modeling is commonly used to visualize and analyze complex social systems, organizational structures, business processes, or decision-making frameworks (Ludviga, 2023). It helps researchers and stakeholders understand the underlying mechanisms, identify patterns, dependencies, and causal relationships, and communicate insights effectively. Conceptual models in social sciences research might include diagrams depicting social network structures, organizational hierarchies, or decision-making processes within businesses or institutions (Ludviga, 2023). These models provide a visual representation of the key concepts and relationships within the system, facilitating analysis and discussion among researchers and stakeholders.

Theoretical Modeling

Theoretical modeling involves the construction and analysis of abstract frameworks or models that describe the relationships between variables, concepts, or phenomena within a specific theoretical framework or paradigm (Sinclair, 2007). The primary purpose of theoretical modeling is to develop formal representations of theoretical constructs and hypotheses, which can be tested and validated empirically (Imenda, 2014). Theoretical modeling focuses on developing formal representations of theoretical concepts, often using mathematical equations, computational algorithms, or conceptual diagrams. It aims to provide a structured framework for making predictions, testing hypotheses, and gaining insights into the underlying mechanisms driving observed phenomena. In social and management sciences research, theoretical modeling is used to develop and refine theoretical frameworks, propose hypotheses, and analyze the theoretical implications of empirical findings (Sinclair, 2007). It helps researchers formalize theoretical constructs, specify the relationships between them, and generate predictions that can be tested using empirical data (Ludviga, 2023). Theoretical models in social sciences research might include mathematical equations describing the relationship between variables in a psychological theory, computational algorithms simulating the dynamics of social networks, or conceptual frameworks outlining the underlying assumptions and propositions of a management theory (Ludviga, 2023).

Merits and demerits of integration of theoretical and conceptual modelling into research process

Theoretical modeling and conceptual modeling are both crucial in the research process, each with its own strengths and weaknesses, along with various implications. Theoretical models provide a framework for predicting outcomes based on established principles or hypotheses. They can often be applied across different contexts, allowing researchers to draw conclusions that transcend specific instances (Imenda, 2014). Conceptual models offer visual representations of complex systems or processes, aiding understanding and communication. They can be adapted and modified to accommodate new information or changes in understanding. Conceptual models facilitate the integration of knowledge from various disciplines, fostering interdisciplinary research.

They offer a clear structure for understanding complex phenomena, making it easier to communicate ideas and findings.

Theoretical models may oversimplify reality, disregarding important nuances and variables. They rely on assumptions that might not always hold true in real-world scenarios, leading to inaccuracies. The validity of theoretical models depends on the availability and accuracy of relevant data, which may not always be sufficient or reliable. The construction of conceptual models involves subjective interpretation, which can introduce bias or overlook important aspects. Some phenomena may be inherently complex and difficult to represent accurately using conceptual models. The validity of conceptual models depends on the accuracy and completeness of the conceptualization, which may be difficult to assess (Imenda, 2014).

Theoretical models guide research by shaping hypotheses and directing the collection and analysis of data. They inform policy decisions by providing insights into the potential effects of interventions or changes. Theoretical models serve as educational tools, helping students grasp complex concepts and theories more easily.

Conceptual models facilitate communication among researchers, practitioners, and stakeholders by providing a common language and visual reference. They assist in problem-solving by clarifying relationships and dependencies within complex systems. Conceptual models support decision-making processes by highlighting key factors and potential outcomes (Ravitch & Riggan, 2017).

Citing theoretical backing, scholars like Karl Popper and Thomas Kuhn have emphasized the importance of theoretical frameworks in guiding scientific inquiry, while others like Herbert Simon and Peter Checkland have advocated for the use of conceptual models in understanding and managing complex systems (Fisher, 2007). Both approaches play essential roles in advancing knowledge and a

Theoretical models are built on established principles or hypotheses, allowing researchers to make predictions about how systems or phenomena will behave under certain conditions. For example, in physics, mathematical equations derived from theories like Newtonian mechanics can accurately predict the motion of objects (Lester, 2005). Theoretical models aim to capture underlying principles that apply across different scenarios. For instance, economic theories such as supply and demand can be applied to various markets, from commodities to labor. Theoretical models provide a structured framework for understanding complex phenomena, making it easier to communicate ideas and findings within the scientific community. They often involve mathematical formulations or conceptual diagrams that offer clear representations of relationships and mechanisms (Sinclair, 2007).

To make complex systems manageable, theoretical models often simplify reality by making assumptions or ignoring certain variables. While this simplification aids understanding, it can also lead to inaccuracies when real-world situations deviate from these assumptions (Sinclair, 2007). The validity of theoretical models relies on the accuracy of underlying assumptions. If these assumptions are flawed or not applicable to real-world scenarios, the predictions of the model may be unreliable. The effectiveness of theoretical models is contingent on the availability and quality of data. In fields where data collection is challenging or incomplete, such as climate science or economics, the validity of theoretical predictions may be limited.

Theoretical models guide the direction of research by providing a framework for hypothesis generation and testing. They help researchers identify key variables and relationships to investigate further. Theoretical models inform policy decisions by providing insights into the potential outcomes of different interventions or policies (Lester, 2005). For example, economic models can help policymakers assess the impact of tax reforms or stimulus packages. Theoretical models serve as educational tools in academic settings, helping students understand complex concepts and theories more easily. They provide a structured framework for teaching and learning, facilitating deeper comprehension.

Conceptual models use diagrams, charts, or other visual aids to represent complex systems or processes. This visual representation makes it easier for researchers and stakeholders to grasp the underlying structure and relationships within the system (Sinclair, 2007). Conceptual models are often flexible and adaptable, allowing researchers to modify them as new information becomes available or as understanding evolves. This flexibility is particularly valuable in dynamic or rapidly changing environments. Conceptual models facilitate the integration of knowledge from different disciplines by providing a common framework for understanding complex phenomena (Lester, 2005). They help bridge the gap between disparate fields and encourage interdisciplinary collaboration.

The construction of conceptual models involves subjective interpretation, as researchers must decide which variables and relationships to include or exclude. This subjectivity can introduce bias or overlook important aspects of the system being modeled. Some phenomena are inherently complex and may be difficult to represent accurately using conceptual models. As a result, conceptual models may oversimplify reality or fail to capture the full complexity of the system under study. The validity of conceptual models depends on the accuracy and completeness of the conceptualization process (Sinclair, 2007). If key factors or relationships are overlooked or misrepresented, the model's predictions or insights may be compromised.

Conceptual models serve as powerful communication tools, allowing researchers, practitioners, and stakeholders to visualize and discuss complex systems or processes more effectively (Lester, 2005). They provide a common language and reference point for discussions and decision-making. Conceptual models assist in problem-solving by clarifying relationships and dependencies within complex systems. They help identify potential solutions and anticipate the consequences of different actions or interventions. Conceptual models support decision-making processes by providing a structured framework for evaluating options and assessing their potential impacts (Ravitch & Riggan, 2017). They help stakeholders make informed decisions based on a better understanding of the system's dynamics and potential outcomes

Summary, conclusion and recommendations

The study underscores the importance of theoretical and conceptual models in facilitating research across various topics. Consequently, researchers in these fields must engage in critical analysis to understand and select the most suitable models thoughtfully. Moving forward, scholars and students alike should prioritize the integration of both theoretical and conceptual models into their research endeavors to ensure the delivery of high-quality research that is applicable in real-world settings.

Both conceptual modeling and theoretical modeling are important aspects of research processes, they serve different purposes and focus on different aspects of the research process. Conceptual modeling aims to provide a simplified and structured view of the system, focusing on its essential components and their interrelationships, while theoretical modeling involves the construction and analysis of formal frameworks or models that describe the relationships between variables, concepts, or phenomena within a specific theoretical framework or paradigm.

Furthermore, the integration of theoretical and conceptual models alongside empirical studies fosters interdisciplinary insights and innovation within social sciences and management sciences. By drawing from theories and concepts across multiple disciplines, researchers can synthesize diverse perspectives, enriching the theoretical framework and expanding the scope of research. Moreover, conceptual reviews provide opportunities for theory building and refinement, encouraging researchers to propose new theoretical models or frameworks that address contemporary challenges or emerging trends. Through this interdisciplinary approach, researchers can contribute to the advancement of knowledge and theory within their respective disciplines, fostering collaboration and cross-fertilization of ideas.

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