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Structural Grounded Modeling: An Extension of Grounded Theory Method

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Abstract

Grounded Theory (GT) has been widely used in different fields of social sciences since its inception. On the other hand, the interpretive structural modeling (ISM) method has been well embraced by researchers to develop the relationships between the relevant factors. So far, the two research approaches have been used separately, while by combining and kneading these two widely used methods, an integrated method can be emerged so that will bring special advantages to research methodology. The main objective of this paper is to extend the GT integrating it with ISM. Concurring with the foremost objective of this research, a qualitative approach was carried out. Relying on the capacity and practical experiences of the researcher in directing and leading qualitative researches, in particular hiring both methodologies, the initial spark for the integration of both methods took place. Then, this idea was discussed with key informants (e.g., professors, talents and professional experts) and its application, sophistication and advantages were assured. As well instructed, an algorithm was developed to explain the application and use of this novel research methodology in a simple manner. The study outlines an algorithm for integrating GT with ISM. This integration promotes the richness of research by providing more value to the finding and results. Presenting the outputs in structural molding visualizes the results and inter-relationships among the elements. This study substantiates a new approach to qualitative research methodology. The innovative research method is considered by integrating the two widely used methods in research methodology, GT and ISM. This nascent and an extended GT method added values, enhanced richness in data and results and upgraded research tools by enriching qualitative research methods.

Keywords: Algorithm, Interpretive Structural Modeling, Grounded Theory, Qualitative Research.

Introduction

More than half a century has passed since the emergence of Grounded theory (GT) method. During this time, it has had many ups and downs. The GT method is a research process that involves the iterative and recursive development of theories based on primary data not relying on preconceived notions or assumptions[1]. This method is initiated by collecting a set of data about the research problem(s)/question(s). It gradually leads to the construction of theories about the research topic by collecting more data[2-4].

The GT method has been remarkably embraced and adopted by researchers and is widely used as a prevalent research methodology[5]. It also added value in the formation of data-driven theories in social sciences[6]. Since its inception, different interpretations of this method have been made and recently criticized by scholars[4]. This method has often been involved in many challenges and always been criticized and supported by researchers, since inception, and as if there is no end to the challenges ahead of GT[5,7].

On the other hand, interpretive structural modelling (ISM) is a well-established, interactive learning process and proven research methodology for identifying, examining and revealing the relationships among directly and indirectly related factors[8]. It creates intuitions into comprehensive realizations of these relationships. It also, generates a visual model of related variables and explains the intensity of driving power and the dependences power on those factors[9-11].

ISM is used in complex and subjective problems in a system by identifying the mutual interaction and relationships among the elements of the system and developing a hierarchical structure that represents these relationships through a visual model. An overview of the ISM methodology and its implementation procedure has been well discussed in the literature[8,10].

ISM is also a flexible technique that can be adapted to suit a range of different applications and contexts. Recently, its application has remarkably increased. One of the key characteristics of ISM is that it allows the creation of a visual representation of the relationships between different components of a system[8]. This can help researchers better understand the complex relationships within a system and, identify areas where improvements can be made[11,13].

Therefore, this paper endeavors to extend the GT method by integrating the ISM methodology, aiming to widen the scope of the GT from theory building to model generation. Both methods are valuable independently and have been a source of blessing and contribution to research, but their combination will bring more added values in addition to a complementary cycle of outputs and achievements. Output of the GT method is usually summarized and reported as principal components including, categories, concepts and codes which are the main constructs of substantive theory[1,2,6]. On the other hand, ISM requires a set of key variables (mainly from literature reviews or experts' opinion) as input to the analysis to reveal the relationships between them and develop a hierarchical structure of the variables[12]. In this proposed generalized GT method, its output(s) are considered as input to the ISM methodology, and it will reveal the hierarchical (structure) relationships between them.

This paper is organized as follows. A concise literature review of GT and ISM is provided in the next section. The research methodology and the hired research approach will be explained, the proposed extended GT with ISM will be demonstrated. Research limitations and constraints along with future studies will be discussed in the conclusion section.

Preliminary Literature Review: In this section, we first provide an overview of the GT method, followed by a brief description of the ISM approach. Finally, the (dis) advantages of combining these two methodologies will be discussed, highlighting how their integration can enhance research outcomes and address complex problems more effectively.

Overview of the GT Method: Grounded Theory is a qualitative research methodology that aims to develop theories or explanations of phenomena based on empirical data. Since its inception by Glaser and Strauss in the 1960s[1,2], GT has been widely embraced by researchers across various disciplines, including sociology, education, healthcare, and management. The core principle of GT is to begin with an open mind, allowing the data to guide the theory development process in an iterative and interactive manner[6]. Researchers collect and analyze data simultaneously, constantly comparing new data with existing data to identify patterns, categories, and relationships. The resulting theory is grounded in the data and reflects the experiences and perspectives of the participants[14,15].

One of the key strengths of GT is its flexibility. It can be used in both exploratory and explanatory research, making it suitable for studying complex and dynamic social phenomena where little is known about the topic[16,15]. GT is particularly valuable for generating new insights and theories that are firmly rooted in empirical data, rather than relying on pre-existing theories or assumptions[1,2]. This inductive approach allows researchers to explore phenomena in depth and from multiple perspectives, providing a rich and nuanced understanding of the research problem[3,4].

However, GT is not without its challenges. The methodology requires significant time and resources, and the analysis process can be complex and demanding[2,15]. Researchers must navigate the iterative process of data collection and analysis, which can be both time-consuming and intellectually challenging[5,6]. Additionally, GT has faced criticism for issues such as theoretical stagnation, methodological ambiguity, and challenges in ensuring rigor and transparency[3,4]. Despite these limitations, GT remains a valuable research methodology that has contributed to the development of new theories and explanations in various fields.

Overview of the ISM Approach: The ISM is a well-established methodology for analyzing complex systems and identifying relationships among interrelated factors. Developed by Warfield in the 1970s, ISM is an interactive learning process that enables researchers to uncover and visualize the direct and indirect relationships between variables, providing insights into the structure and dynamics of a system[8,11]. By creating a hierarchical model of relationships, ISM helps researchers understand the driving and dependence powers of various factors, making it particularly useful for addressing subjective and complex problems[9,11].

The ISM methodology has been extensively applied across diverse fields, including supply chain management, education, and healthcare, demonstrating its flexibility and adaptability[8,13]. One of the key strengths of ISM is its ability to generate visual representations of relationships, which can aid in identifying areas for improvement and informing decision-making processes[11,13]. Recent studies have highlighted the growing relevance of ISM in addressing contemporary research challenges, reflecting its utility in modeling and analyzing intricate systems[8].

Limitations, Advantages, and Disadvantages: Like other research methodologies, both GT and ISM come with their own set of advantages and disadvantages. Understanding these strengths and limitations is crucial for researchers to effectively apply these methods in their studies.

One of the key strengths of ISM is its ability to integrate both qualitative and quantitative aspects of a system. This makes it particularly useful for multilevel research designs where outcomes are unpredictable or complex[15]. By incorporating expert opinions and judgments, ISM can account for subjective inputs, providing a holistic view of the system and helping researchers identify inter-relationships among its elements[11,13]. This feature makes ISM highly valuable in decision-making processes, as it allows researchers to visualize complex problems and understand the implications and consequences of their choices through structured models[8].

Despite its advantages, ISM has faced criticism for several limitations. One major critique is its heavy reliance on expert judgment, which can introduce personal biases and subjective opinions into the model. This reliance may lead to inaccurate or incomplete representations of the system, limiting the usefulness of the results[15].

Additionally, the lack of transparency in the modeling process can be a barrier. The complexity of ISM and its reliance on specialized software often make it difficult for non-experts to understand or verify the results, reducing the ability of stakeholders to provide meaningful feedback[13]. Another significant limitation is scalability. As the number of elements in the system increases, the complexity of the model grows exponentially, which can compromise its accuracy and practicality[8].

Grounded Theory, on the other hand, offers several unique advantages. Its flexibility allows it to be applied across a wide range of research questions and contexts, making it suitable for exploring complex and dynamic phenomena[16]. GT is particularly valued for its ability to generate rich and detailed data analysis, enabling researchers to uncover new insights and relationships between concepts and phenomena[3]. Moreover, GT's emphasis on developing theories grounded in empirical data ensures that the findings are both relevant and applicable to real-world situations[1,6]. This methodology is especially useful when existing theories fail to explain the complexity of a problem, as it provides a systematic and rigorous process for data collection, analysis, and theory development[15].

However, GT is not without its challenges. The methodology is time-consuming and requires significant resources, as the iterative process of data collection and analysis demands considerable effort and expertise[7,15]. Another potential drawback is the risk of researcher bias, particularly during the coding and categorization stages, which can influence the outcomes of the study[14]. Additionally, presenting research findings in GT can be complex and challenging, as there are no standardized rules for identifying and presenting theories, categories, and concepts[4]. This lack of standardization can sometimes hinder the clarity and reproducibility of GT-based research.

Despite their respective limitations, both ISM and GT remain valuable tools for researchers. ISM's ability to visualize and structure complex systems and GT's capacity to generate empirically grounded theories make them highly complementary. By carefully considering their strengths and weaknesses, researchers can leverage these methodologies to address complex research problems more effectively[8,11,15]. There are multiple approaches to grounded theory but no standard rules to identify theories (incl., categories, concepts and codes) and the presentations of research findings is also not straightforward. Presenting research findings in the context of GT can be challenging and complex. This case can be solved along with ISM which is the main goal of this study. Table-1 summarize the advantages and disadvantages of GT and ISM.

Advantages of Combining GT and ISM: The integration of GT and ISM offers several advantages, leveraging the strengths of both methodologies to enhance research outcomes. GT's inductive approach excels in theory building through the generation of categories, concepts, and codes[1,2,6], while ISM provides a structured approach for modeling and visualizing relationships between variables[9,12]. By combining these methods, researchers can extend the scope of GT from theory building to model generation, thereby enhancing its applicability and impact.

For instance, the outputs of GT—such as categories and concepts—can serve as inputs to the ISM process, enabling the development of hierarchical models that reveal the structural relationships between these constructs[12,13]. This integration not only addresses some of the limitations associated with each method but also creates a complementary cycle of outputs and achievements. GT's empirically grounded insights can enrich ISM's reliance on expert input or literature-based variables, while ISM's structured and visual representation can enhance the rigor and clarity of GT's findings[3,8].

Moreover, the combined approach can provide a more comprehensive understanding of complex phenomena, enabling researchers to explore both the theoretical and structural dimensions of a research problem. This synergy can lead to more robust and actionable insights, making the GT-ISM integration a valuable tool for addressing contemporary research challenges.

Table-1: Dis/Advantages od GT and ISM.

Method	Advantages	Disadvantages
Grounded Theory (GT)	• Fosters creativity and critical thinking • A systematic approach to data analysis • Richness of data • Provides an intuitive appeal • Potential to conceptualize	• Time consuming and complex • Multiple approaches • Researcher bias and Exhaustive Process • Potential for Methodological Errors • Limited Generalizability
Interpretive Structural Modeling (ISM)	• A systematic approach to problem-solving • Efficient and precise procedure • Produce a graphical and organized model • Revealing inter-relationships among elements • The interactive learning process • Develop a structural model • Determination of the element weights	• Limiting elements/factors • Ignore least influential elements • Limited Generalizability

Methodology

Exploratory research serves as a cornerstone for understanding complex research questions, particularly in nascent fields. In this study, a qualitative exploratory approach was employed to integrate GT with the ISM. This method was chosen for its ability to combine theory-building with structured modeling, aligning with the primary objective of the research[2].

The research process began with theoretical sampling, employing a snowball approach to identify key informants. These informants included university professors, experienced business professionals, and qualitative research experts, ensuring a diverse pool of perspectives. The inclusion of these stakeholders mitigates concerns about reliability and validity, as their collective expertise provides a robust foundation for the study.

Data collection involved in-depth interviews guided by an unstructured questionnaire. This flexible tool allowed participants to share insights about the strengths, limitations, and integration potential of GT and ISM. Key topics included methodological challenges, practical applications, and the perceived value of combining these methods. The iterative nature of the data collection process ensured that emerging themes were consistently refined and validated.

Analysis of the interview data followed GT principles, with iterative coding to identify categories, concepts, and themes. The resulting constructs formed the input for the ISM phase, where a structured questionnaire was used to elicit relationships among the identified elements. These relationships were analyzed to develop a hierarchical structural model, revealing interdependencies and prioritization among the constructs.

The final step involved validation of the structural model through feedback from the informants. This iterative review process ensured that the model accurately reflected the data and addressed the research questions. The validated model, termed the *"Grounded Structural Model"* (GSM), represents a novel methodological framework that integrates GT and ISM, enhancing both theoretical depth and practical applicability.

This rigorous approach highlights the potential of GSM to address complex research questions by combining the inductive strengths of GT with the deductive clarity of ISM. The methodology not only advances qualitative research but also provides a replicable framework for future studies seeking to integrate theory-building and modeling.

Results and Discussion

The proposed extended Grounded Theory method, integrated with ISM, is illustrated through a four-stage algorithm. The GSM provides a systematic framework for combining the theory-building capabilities of GT with the structural modeling strengths of ISM. Below, we outline the four stages of the GSM process, detailing the procedural steps and their significance.

Stage I: Identify the Research Problem: The foundation of any research lies in the clear identification and definition of the research problem. This stage is critical, as it sets the direction for the entire study. While GT is a powerful tool for exploring phenomena where existing theories are inadequate, it is not always necessary to use GT in every qualitative research project. Instead, the focus should be on precisely defining the research problem to ensure clarity for all stakeholders involved. Ambiguity, vague terminology, or poorly articulated research questions can lead to misunderstandings and errors, which may compromise the validity of the study.

To avoid such pitfalls, the research problem should be broken down into key components and elements, which can then be translated into sequential and straightforward research questions. This process, known as research question formulation, ensures that the problem is well-structured and easily understandable. Once the research problem and questions are clearly defined, the next step is to identify and target the key informants—individuals with expertise and experience relevant to the research topic. These informants serve as the primary sampling units for data collection through interviews and idea exchange.

Stage II: Adopt the GT Method: In this stage, the GT method is employed to explore the research problem and develop a theory grounded in empirical data. The components and elements identified in the research questions serve as the foundation for designing the in-depth interview guidelines. Following the GT approach, interviews are conducted iteratively, with each interview being recorded, transcribed, and analyzed immediately afterward. This iterative process continues until theoretical saturation is achieved—the point at which no new codes, concepts, or categories emerge from the data.

The final output of this stage is a set of codes, concepts, and categories that collectively form the basis of a grounded theory. These outputs represent the key constructs derived from the data, providing a comprehensive understanding of the research problem. The rigor of the GT process ensures that the resulting theory is firmly rooted in the empirical data, enhancing its relevance and applicability.

Stage III: Deploy the ISM Approach: The categories generated in Stage II serve as the input for the ISM approach in Stage III. These categories are used to design a structured questionnaire, which is then administered to the key informants. The questionnaire aims to capture the mutual interactions and relationships among the categories, as perceived by the informants. The data collected from the questionnaire are analyzed using the ISM procedural analysis, which involves identifying the driving and dependence powers of the categories and mapping their hierarchical relationships.

The output of this stage is a hierarchical model that visually represents the relationships among the categories. This model, often depicted as a digraph, provides a clear and structured understanding of the research problem, highlighting the key factors and their interconnections. The ISM approach thus complements the GT method by transforming the abstract categories into a tangible and actionable model.

Stage IV: Validate the Structural Model: The final stage involves validating the structural model developed in Stage III. The draft model is shared with the key informants for review and feedback, ensuring its accuracy and relevance. This iterative and interactive process is typically conducted in a focus group setting, where informants can discuss and refine the model collaboratively. The goal is to achieve consensus on the conceptual and structural validity of the model, ensuring that it accurately reflects the relationships among the categories.

Once the model is validated, it is recommended to revisit the research questions formulated in Stage I and provide answers based on the findings. This step ensures that the research objectives are fully addressed and that the study contributes meaningful insights to the field. The final output of the GSM process is a validated structural model that integrates the strengths of GT and ISM, offering a comprehensive and actionable framework for addressing complex research problems. The algorithm and procedural steps of GSM are summarized in Table-2.

Discussion: The integration of GT and ISM into a unified methodology, termed as GSM, represents a significant advancement in qualitative research. This approach combines the theory-building capabilities of GT with the structural modeling strengths of ISM, creating a comprehensive framework for addressing complex research problems. GT, a well-established qualitative methodology, emphasizes the iterative development of theories grounded in empirical data, avoiding reliance on preconceived assumptions. Its strength lies in generating rich, nuanced, and context-specific theories that provide deep insights into social phenomena. On the other hand, ISM is a structured methodology designed to analyze complex systems by identifying and visualizing relationships among interrelated elements. It transforms unclear models into visible and actionable structural frameworks, making it particularly useful for decision-making and problem-solving.

The GSM approach leverages the outputs of GT—such as categories, concepts, and codes—as inputs for ISM, extending the analytical process beyond theory development to include structural modeling and visualization. This integration enhances the depth and richness of qualitative research while providing a practical and actionable framework for addressing complex problems. The four-stage algorithm of GSM—problem identification, GT adoption, ISM deployment, and model validation—ensures a clear and structured research process. This iterative and interactive approach allows for continuous refinement of findings based on feedback from key informants, enhancing the validity and reliability of the outcomes.

One of the key strengths of GSM is its ability to generate visual models that clearly depict relationships among variables, making it easier for stakeholders to understand and apply the findings. This visual representation is particularly valuable for practitioners and policymakers, as it provides actionable insights that can inform decision-making and strategy development. Additionally, GSM's holistic approach ensures that all aspects of the research problem are thoroughly explored, from data collection and theory development to structural modeling and validation.

This algorithm and procedural steps of grounded structural modeling are shown schematically in Figure-1.

Table-2: Four-stage algorithm for extended grounded theory deployment.

Stage	Activity	Tasks
I	Identify Research Problem	Problem definition Identification of the problem components Research question(s) formulation Determine target key informants
II	Adopt GTM	Interviews guidelines Data collection (analyze and theory development) Extract constructs of the theory (codes, concepts, categories)
III	Deploy ISM	Nominating the key elements of the theory Design questionnaire (mutual interactions) Calculate the relationships, their hierarchy and Digraph Draft conceptual model
IV	Validation	Technical (Plain) answer(s) to the research question(s) Post-review and recheck with the key informants on the final result(s) Reconfirm the validity of the conceptual model

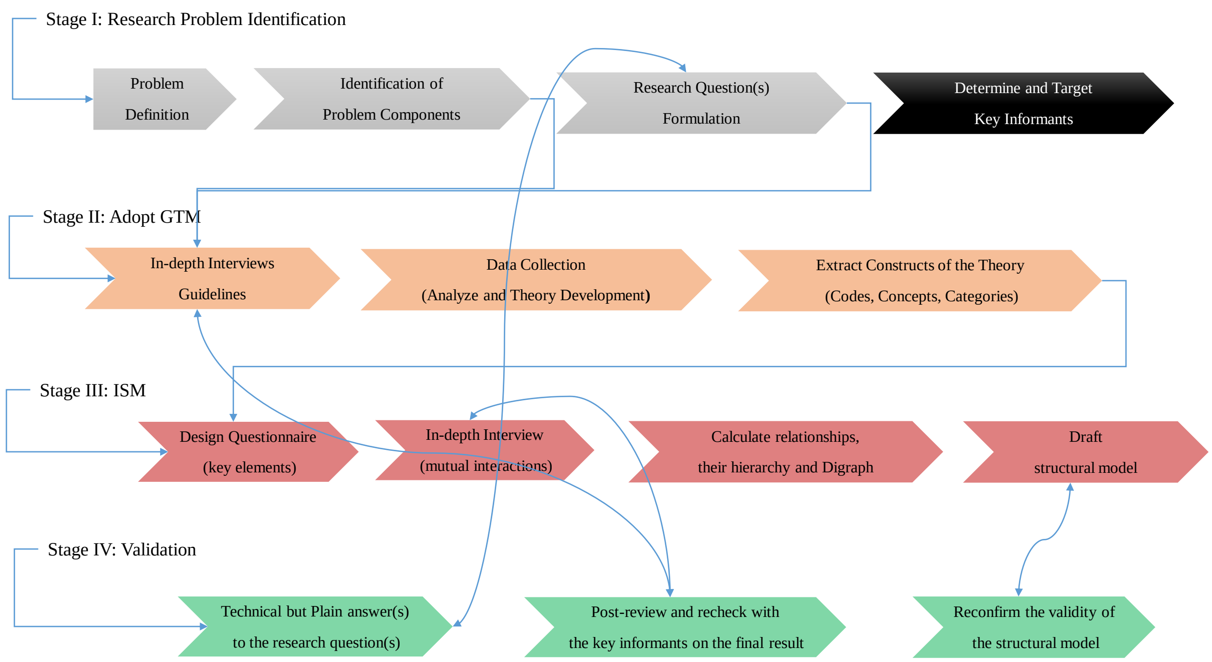

Figure-1: Procedural steps of Grounded Structural Modeling.

In conclusion, GSM represents a significant methodological innovation in qualitative research. By combining the strengths of GT and ISM, it offers a comprehensive, iterative, and actionable framework for addressing complex problems. Its ability to generate both theoretical insights and practical models makes it a valuable tool for researchers, practitioners, and policymakers. While further validation and refinement are needed, GSM has the potential to bridge the gap between theory development and structural modeling, paving the way for new insights and innovations across various disciplines.

Conclusion

In conclusion, Grounded Structural Modeling (GSM) represents a significant methodological innovation in the field of qualitative research. By combining the strengths of Grounded Theory (GT) and Interpretive Structural Modeling (ISM), GSM offers a comprehensive, iterative framework that bridges the gap between theory development and structural modeling. The integration of these two methodologies allows researchers to generate not only deep, context-specific theoretical insights but also actionable models that can inform decision-making and strategic planning.

The key contributions of GSM are its ability to produce both theoretical frameworks and practical visual models, making it a versatile tool for addressing complex research problems. Its iterative process—incorporating feedback from stakeholders—enhances the accuracy and reliability of the findings, while its structural modeling capabilities provide clear visual depictions of complex interrelationships. These models can be particularly useful for policymakers, practitioners, and researchers who require a deeper understanding of the relationships among various variables in complex systems.

However, while GSM presents a promising methodological approach, it is not without its limitations. One key challenge is its qualitative nature, which can limit the ability to generalize findings to larger populations or diverse settings. Additionally, the integration of GT and ISM requires a high level of expertise in both methodologies, which may present challenges for novice researchers. The time-consuming and resource-intensive nature of the iterative process may also limit its practical application in certain research contexts.

Despite the strengths of the GSM, several limitations warrant attention for future research and application. The qualitative nature of GSM may restrict the generalizability of its findings, particularly when applied to large or diverse populations. Additionally, the effective use of GSM demands a high level of expertise in both GT and ISM, which can be challenging for researchers with limited experience in these methodologies. The iterative and resource-intensive process involved in GSM can also be time-consuming, requiring substantial effort to refine models and validate findings. To address these challenges, future research should consider integrating quantitative validation techniques to complement the qualitative insights derived from GSM, thus enhancing the robustness and generalizability of the models. Furthermore, developing targeted training programs could increase researchers' proficiency with the methodology, thereby expanding its accessibility and applicability across various disciplines. Researchers should also explore strategies to streamline the GSM process, ensuring that it remains efficient without sacrificing the depth and rigor that define its value.

Moreover, GSM holds significant untapped potential for cross-disciplinary application. While it has primarily been explored within specific research contexts, its methodological flexibility could offer valuable insights across a range of fields such as management, policy studies, and environmental sciences. Future research should investigate how GSM can be adapted to address the unique challenges within these domains, thereby broadening its impact. As researchers from diverse disciplines seek to understand and solve complex problems, GSM could provide a systematic, structured approach that bridges theoretical development with practical, actionable models.

In summary, while GSM requires further refinement and validation, it offers an innovative and comprehensive approach to qualitative research. It serves as a valuable tool for generating theoretical insights and practical models, providing significant contributions to the field. With continued development and application, GSM has the potential to play a pivotal role in addressing some of the most complex and pressing problems in various academic disciplines and real-world contexts.

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