

The Role of Systems Engineering in Complex Project Management: A Review of Methodologies and Applications

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Abstract

This narrative review explores the critical role of Systems Engineering (SE) in Complex Project Management (CPM), focusing on the methodologies and their applications across various sectors. As projects in industries such as aerospace, defense, healthcare, and information technology grow increasingly complex, the integration of SE principles into CPM has become essential for managing these complexities. This review synthesizes existing literature, highlighting key SE methodologies, including the V-Model, Agile Systems Engineering, and Model-Based Systems Engineering (MBSE). Through detailed case studies, the review examines the application of these methodologies in real-world projects, such as the Airbus A380, the Joint Strike Fighter program, and the Da Vinci Surgical System. Critical success factors, challenges, and lessons learned from these applications are discussed, providing insights into how SE can enhance project outcomes. The review concludes with implications for theory and practice, emphasizing the need for further research into hybrid SE methodologies and the integration of emerging technologies. Practical recommendations for practitioners on effectively integrating SE into CPM are also provided.

Keywords: Systems Engineering, Complex Project Management, V-Model, Agile Systems Engineering.

Introduction

Systems Engineering (SE) and Complex Project Management (CPM) are two interrelated disciplines that have become increasingly critical in the successful execution of large-scale, multifaceted projects. Systems Engineering is an interdisciplinary approach that aims to enable the realization of successful systems. It involves defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem, including operations, cost, and schedule (Blanchard & Fabrycky, 2014). SE emphasizes a holistic perspective, integrating various engineering disciplines and considering the entire lifecycle of the system, from conception through to disposal.

Complex Project Management, on the other hand, deals with projects characterized by high levels of uncertainty, numerous interdependencies, and dynamic interfaces. These projects often span multiple industries and involve a wide range of stakeholders, making traditional project management approaches insufficient (Remington & Pollack, 2016). CPM requires methodologies that can handle intricate dependencies, shifting objectives, and the need for adaptive decision-making. The growing complexity in fields such as aerospace, defense, healthcare, and information technology has driven the need for more robust management methodologies that can address the challenges of large-scale projects.

In recent years, the complexity of projects across various sectors has increased significantly due to factors such as technological advancements, regulatory demands, and global competition. This increase in complexity necessitates the integration of SE principles into CPM to enhance the management of these intricate projects. The ability to manage complexity effectively can be the difference between the success and failure of a project, particularly in industries where projects often extend over several years and involve substantial financial investment (Shenhar & Dvir, 2007).

A review of methodologies and applications is necessary to understand how SE can be effectively integrated into CPM to manage complex projects successfully. Despite the recognized importance of SE in managing complex projects, there is a notable gap in the literature regarding a comprehensive synthesis of how various SE methodologies are applied across different industries and project types. Existing studies tend to focus on specific methodologies or industries, often neglecting a broader, comparative analysis that could provide valuable insights into best practices and common challenges.

The significance of SE in CPM cannot be overstated, as it provides a structured framework for addressing complexity through systematic planning, design, and management processes. However, the diversity of SE methodologies and the unique challenges posed by different types of complex projects create a need for a thorough examination of how these methodologies are applied in practice. Furthermore, understanding the limitations and challenges of applying SE in CPM contexts is crucial for advancing both theory and practice.

This review aims to fill the gap in the literature by providing a detailed analysis of SE methodologies and their applications in CPM. By synthesizing findings from various studies, this review will offer a comprehensive overview of the current state of knowledge, identify gaps, and suggest directions for future research.

The primary objective of this review is to explore the role of Systems Engineering in Complex Project Management, with a focus on reviewing the methodologies used and their applications across different sectors. Specifically, this review aims to:

Provide an overview of key Systems Engineering methodologies relevant to Complex Project Management.

Analyze the application of these methodologies in various industry sectors, such as aerospace, defense, information technology, and healthcare.

Conduct a comparative analysis of the effectiveness of different SE methodologies in managing complex projects.

Identify the challenges and limitations associated with the application of SE in CPM, providing insights into areas where further research is needed.

Methodology

The literature search was conducted across multiple databases, including IEEE Xplore, Scopus, Web of Science, and Google Scholar, to capture a wide range of academic and industry publications. The search was limited to articles published between 2000 and 2019 to ensure the review reflects the most recent advancements in systems engineering and complex project management.

Keywords and Search Terms:

Inclusion Criteria:

Articles that specifically discuss systems engineering methodologies in the context of complex project management.

Publications that present case studies or real-world applications of systems engineering in managing complex projects.

Peer-reviewed journal articles, conference papers, and industry reports that provide insights into the integration of systems engineering with project management.

Studies that focus on the challenges, benefits, and critical success factors associated with applying systems engineering to complex project management.

Exclusion Criteria:

Articles focused solely on traditional project management techniques without integrating systems engineering.

Studies not published in English.

Publications that did not undergo peer review or lack substantial empirical or theoretical contribution.

After retrieving the relevant articles, a descriptive analysis method was employed to categorize and synthesize the findings. This process involved the following steps:

The selected studies were categorized based on the systems engineering methodologies they discussed, the industry sectors they focused on, and the complexity levels of the projects addressed. This categorization helped in organizing the literature to draw comparisons and identify trends.

Key information was extracted from each study, including:

The specific systems engineering methodology or approach discussed.

The context in which the methodology was applied (e.g., industry sector, type of project).

The outcomes reported (e.g., project success, challenges encountered, lessons learned).

Theoretical frameworks or models employed in integrating systems engineering with complex project management.

The extracted data was synthesized to identify common themes, patterns, and gaps in the literature. This synthesis aimed to provide a holistic understanding of how systems engineering methodologies are being applied in complex project management and their impact on project outcomes.

A comparative analysis was conducted to evaluate the effectiveness of different systems engineering methodologies in managing complex projects. This analysis considered factors such as project size, complexity, industry sector, and the specific challenges addressed by each methodology.

The final selection of studies for in-depth review was based on their relevance to the research objectives, methodological rigor, and contribution to the understanding of systems engineering's role in complex project management. Studies that provided empirical evidence or detailed case studies were prioritized to ensure the review is grounded in practical applications as well as theoretical insights.

To ensure the credibility and reliability of the review, a quality assessment was performed on the selected studies. This assessment involved evaluating the methodological soundness, the validity of the findings, and the relevance of the conclusions drawn by the authors. Studies that met the high standards of methodological rigor and provided significant insights into the integration of systems engineering and complex project management were included in the final synthesis.

Theoretical Background

Systems Engineering (SE) is a multidisciplinary approach that facilitates the successful realization of complex systems. It encompasses the integration of various engineering disciplines and focuses on defining customer needs and system functionalities early in the development process. SE involves iterative cycles of requirements analysis, system design, implementation, testing, and evaluation, ensuring that all aspects of the system are considered throughout its lifecycle (Blanchard & Fabrycky, 2014).

The core principles of SE include a holistic view of systems, lifecycle orientation, and an emphasis on stakeholder needs. SE seeks to optimize the entire system, rather than just individual components, by considering all interacting elements, including hardware, software, personnel, and operational environments. This approach is particularly effective in managing the complexity inherent in modern engineering projects, where the interdependencies between various system components can lead to emergent behavior that is not easily predictable (Buede & Miller, 2016).

SE's role in managing complexity is fundamental. It provides the tools and methodologies needed to address the challenges posed by complex systems, such as uncertainty, interdependencies, and the need for flexibility. By applying SE principles, project managers can ensure that all aspects of a system are considered, reducing the risk of unforeseen issues and improving the likelihood of project success (Forsberg, Mooz, & Cotterman, 2005).

Complex Project Management (CPM) deals with projects that are characterized by high levels of uncertainty, numerous interdependencies, and dynamic interfaces. These projects often involve multiple stakeholders, extended timeframes, and significant financial investments, making traditional project management approaches inadequate (Remington & Pollack, 2016). CPM requires methodologies that can

handle the intricate dependencies, evolving objectives, and adaptive decision-making processes inherent in complex projects.

The challenges associated with CPM include the need to manage multiple, often conflicting, stakeholder requirements; the difficulty in predicting project outcomes due to the complexity of interactions between project elements; and the necessity to adapt to changes in the project environment. Traditional project management methodologies, which are often linear and prescriptive, struggle to cope with these challenges, leading to the increased adoption of more flexible and iterative approaches, such as those offered by SE (Shenhar & Dvir, 2007).

One of the key aspects of CPM is the management of uncertainty. Complex projects are often fraught with unknowns, requiring project managers to make decisions with incomplete information. SE methodologies, with their emphasis on iterative development and stakeholder involvement, provide a framework for managing this uncertainty, allowing project teams to respond to changes in requirements and conditions more effectively (Geraldi, Maylor, & Williams, 2011).

The integration of Systems Engineering with Complex Project Management is based on the recognition that SE provides the structured processes and tools needed to manage the complexity of modern projects. Theoretical frameworks that connect SE with CPM include the V-Model, Agile Systems Engineering, and Model-Based Systems Engineering (MBSE). These frameworks emphasize iterative development, continuous stakeholder involvement, and the use of models to represent system elements and interactions.

The V-Model, for example, is a SE framework that aligns well with CPM by providing a structured approach to systems development that incorporates validation and verification at each stage. This model helps ensure that the system meets its intended requirements while allowing for adjustments as the project progresses (Blanchard & Fabrycky, 2014). Similarly, Agile Systems Engineering adapts the principles of Agile development to the SE context, emphasizing flexibility, rapid iteration, and close collaboration with stakeholders (De Weck, Roos, & Magee, 2011).

Model-Based Systems Engineering (MBSE) is another key methodology that supports the integration of SE with CPM. MBSE uses models to represent system requirements, design, analysis, and verification, providing a visual and analytical framework that helps manage complexity. MBSE facilitates communication among stakeholders, supports decision-making, and enables the management of complex interdependencies within the project (Friedenthal, Moore, & Steiner, 2014).

These theoretical frameworks highlight the complementary nature of SE and CPM. SE provides the methodologies and tools needed to manage complexity, while CPM offers the project management strategies required to handle uncertainty and dynamic project environments. Together, they form a powerful approach to managing complex projects, ensuring that all aspects of the system are considered and that the project is capable of adapting to changes in requirements and conditions.

Review of Methodologies

Systems Engineering methodologies have been increasingly applied in Complex Project Management to address the challenges posed by large-scale, intricate projects. The V-Model, for instance, is widely recognized for its structured approach to systems development. It aligns system requirements with testing and validation phases, ensuring that each stage of the project is carefully planned and

executed. This methodology is particularly effective in projects where system validation and verification are critical, such as in aerospace and defense (Forsberg, Mooz, & Cotterman, 2005). The V-Model's emphasis on validation at each stage helps in managing the complexity of these projects by ensuring that all requirements are met before moving on to subsequent phases.

Agile Systems Engineering has also gained traction in CPM, particularly in industries where flexibility and rapid iteration are essential. By integrating Agile principles into the SE framework, this methodology allows for more adaptive project management, enabling teams to respond to changes in requirements and conditions quickly. This approach is particularly beneficial in IT and software development projects, where requirements often evolve during the project lifecycle (Boehm & Turner, 2004). Agile SE emphasizes collaboration with stakeholders and iterative development, which are key factors in managing the uncertainty and complexity inherent in these projects.

Model-Based Systems Engineering (MBSE) is another critical methodology in CPM. MBSE uses models to represent system requirements, design, analysis, and verification, providing a comprehensive framework for managing complex projects. MBSE is particularly effective in industries like healthcare and automotive, where systems are highly complex and involve numerous interacting components. By using models to visualize and analyze system interactions, MBSE helps project managers understand the interdependencies within the system, facilitating better decision-making and reducing the risk of errors (Friedenthal, Moore, & Steiner, 2014).

The application of SE methodologies in CPM varies across different sectors, each with its unique challenges and requirements. In the aerospace and defense industries, the V-Model is commonly used due to its structured approach and emphasis on validation and verification. These industries typically involve highly complex systems with stringent safety and performance requirements, making the V-Model an ideal choice for ensuring that all aspects of the system are thoroughly tested and validated before deployment (Blanchard & Fabrycky, 2014).

In the IT and software development sectors, Agile SE has become the methodology of choice. The rapid pace of technological change and the need for frequent updates to software systems require a flexible approach that can accommodate evolving requirements. Agile SE's iterative development process allows for continuous integration and testing, ensuring that the system remains aligned with user needs throughout the project lifecycle (Boehm & Turner, 2004). This methodology is also gaining popularity in other sectors, such as finance and telecommunications, where similar challenges of rapid change and complex systems are prevalent.

The healthcare sector has increasingly adopted Model-Based Systems Engineering due to the complexity of healthcare systems and the need for rigorous analysis of system interactions. Healthcare projects often involve a wide range of stakeholders, including clinicians, patients, and regulatory bodies, each with their own requirements and constraints. MBSE provides a framework for managing these complexities by using models to represent the system and analyze its behavior under different conditions. This approach helps healthcare organizations to design and implement systems that are both effective and compliant with regulatory requirements (Friedenthal, Moore, & Steiner, 2014).

In the automotive industry, MBSE is used to manage the complexity of modern vehicles, which integrate numerous electronic systems, sensors, and control units. The use of models in MBSE allows

engineers to simulate and test different configurations, optimizing the design before physical prototypes are built. This approach not only reduces the time and cost of development but also improves the reliability and safety of the final product (Friedenthal, Moore, & Steiner, 2014).

The effectiveness of different SE methodologies in managing complex projects varies depending on the specific requirements of the project and the industry in which it is applied. The V-Model, with its structured approach, is particularly effective in industries where safety and reliability are paramount, such as aerospace and defense. However, its rigidity can be a limitation in projects where requirements are likely to change over time.

Agile SE, on the other hand, is highly effective in environments where flexibility and rapid iteration are required. It allows project teams to adapt to changing requirements and conditions, making it well-suited for IT and software development projects. However, the iterative nature of Agile SE can be challenging in highly regulated industries, where strict adherence to predefined requirements is necessary.

MBSE provides a versatile framework that can be adapted to various industries and project types. Its ability to model and analyze complex systems makes it particularly valuable in sectors like healthcare and automotive, where understanding the interactions between different system components is critical. However, the success of MBSE depends on the availability of accurate models and the ability of project teams to interpret and act on the insights generated by these models.

Despite the advantages of SE methodologies in CPM, there are several challenges and limitations associated with their application. One of the primary challenges is the need for extensive training and expertise. SE methodologies, particularly MBSE, require a deep understanding of systems theory and modeling techniques, which can be a barrier to their adoption in organizations with limited technical expertise (Friedenthal, Moore, & Steiner, 2014).

Another challenge is the integration of SE methodologies with existing project management processes. Many organizations have established project management practices that may not align well with SE methodologies, leading to resistance to change. This is particularly true in industries where traditional, linear project management approaches are deeply entrenched.

The complexity of SE methodologies can also be a limitation. While these methodologies are designed to manage complex projects, their complexity can make them difficult to implement effectively. This is especially true in smaller organizations or projects with limited resources, where the overhead associated with SE methodologies may outweigh the benefits.

Finally, the iterative nature of Agile SE can pose challenges in industries with strict regulatory requirements. While Agile SE is designed to be flexible and adaptive, regulatory bodies often require adherence to predefined requirements and processes, which can be difficult to reconcile with the iterative approach of Agile SE (Boehm & Turner, 2004).

Applications in Real-World Projects

Systems Engineering (SE) has been applied successfully in a variety of complex project management (CPM) contexts, particularly in industries such as aerospace, defense, healthcare, and information technology. One notable example is the application of SE in the development of the Airbus A380. The A380 project, one of the most complex in the history of aviation, required the integration of numerous subsystems, each developed by different teams across multiple countries. SE methodologies,

particularly the V-Model, were instrumental in coordinating these efforts. The V-Model provided a structured approach to systems development, ensuring that each subsystem met its requirements and that the entire system functioned as intended when integrated (Muller, 2009).

In the healthcare sector, SE has been used to manage the development and deployment of complex medical devices. A case in point is the development of the Da Vinci Surgical System, a highly sophisticated robotic system used in minimally invasive surgery. The use of Model-Based Systems Engineering (MBSE) in this project allowed for detailed modeling of the system's components and interactions, facilitating the identification and resolution of potential issues early in the development process. This approach not only improved the reliability and safety of the system but also accelerated the time to market (Schindel & Smith, 2002).

The defense industry has also seen successful applications of SE in CPM. The development of the Joint Strike Fighter (JSF) program, also known as the F-35 Lightning II, is a prime example. This program involved the collaboration of multiple nations and the integration of advanced technologies across airframes, avionics, and weapon systems. SE methodologies, particularly Agile Systems Engineering, were employed to manage the complexity of the project. The iterative nature of Agile SE allowed the project teams to incorporate feedback from various stakeholders continuously, ensuring that the system met the diverse requirements of different users (Gorod, Sauser, & Boardman, 2008).

The success of SE methodologies in these projects can be attributed to several critical factors. First, the structured nature of SE, particularly as embodied in methodologies like the V-Model and MBSE, provides a clear framework for managing complexity. This structure ensures that all aspects of a system are considered from the outset, reducing the risk of unforeseen issues arising during later stages of the project. In the case of the Airbus A380, for instance, the V-Model facilitated the integration of subsystems developed by different teams, ensuring that they functioned together as a cohesive whole (Muller, 2009).

Second, the emphasis on stakeholder involvement and iterative development in SE methodologies, such as Agile SE, plays a crucial role in the success of complex projects. By continuously engaging stakeholders and incorporating their feedback, project teams can ensure that the system meets the needs of its users. This approach was particularly beneficial in the JSF program, where the diverse requirements of multiple nations had to be met. The iterative nature of Agile SE allowed the project team to adjust the system design in response to changing requirements, reducing the risk of costly rework later in the project (Gorod et al., 2008).

Another critical success factor is the use of modeling and simulation in SE. MBSE, for example, enables project teams to visualize and analyze the interactions between system components, identifying potential issues before they become critical. This approach was key to the success of the Da Vinci Surgical System, where early identification and resolution of design issues contributed to the system's reliability and safety (Schindel & Smith, 2002).

Several lessons can be drawn from the successful application of SE in these projects. One of the most important is the value of early and continuous stakeholder engagement. By involving stakeholders throughout the project lifecycle, SE methodologies help ensure that the system meets user needs and reduces the likelihood of costly changes late in the project. This lesson is particularly relevant in projects

with multiple stakeholders, such as the JSF program, where the requirements of different users must be balanced (Gorod et al., 2008).

Another lesson is the importance of rigorous modeling and simulation in managing complexity. MBSE, for example, provides a powerful tool for visualizing and analyzing system interactions, enabling project teams to identify and address potential issues early in the development process. This approach not only improves the reliability and safety of the system but also reduces the time and cost associated with development, as demonstrated in the Da Vinci Surgical System project (Schindel & Smith, 2002).

Finally, the structured nature of SE methodologies, such as the V-Model, highlights the importance of careful planning and systematic execution in managing complex projects. The success of the Airbus A380 project underscores the value of a structured approach to systems development, particularly in large-scale projects where multiple subsystems must be integrated (Muller, 2009).

These lessons underscore the importance of SE in managing the complexity of modern projects and provide valuable insights for future practice.

Discussion

The integration of Systems Engineering into Complex Project Management has proven to be a critical factor in the successful execution of large-scale, intricate projects across various industries. The literature review highlights that SE methodologies, such as the V-Model, Agile SE, and MBSE, provide structured approaches to managing the complexity inherent in these projects. These methodologies facilitate the coordination of multiple subsystems, the involvement of diverse stakeholders, and the rigorous analysis of system interactions, all of which are essential for project success (Blanchard & Fabrycky, 2014; Gorod et al., 2008).

The findings also indicate that the success of SE in CPM is largely dependent on the ability of project teams to engage stakeholders continuously and adapt to changing requirements. This adaptability is particularly evident in Agile SE, which emphasizes iterative development and stakeholder collaboration. The case studies reviewed, including the JSF program and the Da Vinci Surgical System, demonstrate that iterative feedback loops and early problem identification are key to managing the uncertainty and dynamic nature of complex projects (Boehm & Turner, 2004; Schindel & Smith, 2002).

Another significant finding is the critical role of modeling and simulation in SE. MBSE, in particular, has been shown to be highly effective in visualizing and analyzing complex systems, enabling project teams to optimize designs and mitigate risks early in the project lifecycle. The use of MBSE in the development of the Da Vinci Surgical System and in the automotive industry underscores its value in managing projects with high levels of complexity and interdependencies (Friedenthal, Moore, & Steiner, 2014).

The implications of these findings for both theory and practice are profound. From a theoretical perspective, the integration of SE into CPM provides a robust framework for addressing the challenges of complex projects. The structured nature of SE methodologies, combined with the flexibility of iterative approaches like Agile SE, offers a balanced approach to managing complexity, uncertainty, and stakeholder needs. This integration also highlights the need for further research into the development of hybrid SE methodologies that can be tailored to the specific requirements of different industries and project types.

For practitioners, the review underscores the importance of adopting SE methodologies in the management of complex projects. The success stories of the Airbus A380, the JSF program, and the Da Vinci Surgical System demonstrate that SE provides the tools and processes needed to manage complexity effectively. Practitioners should focus on early stakeholder engagement, continuous iteration, and rigorous modeling and simulation to enhance project outcomes. Additionally, organizations should invest in training and development to build the necessary SE expertise within their project teams, ensuring that they can apply these methodologies effectively.

While this review provides valuable insights into the role of SE in CPM, it also identifies several areas where further research is needed. One significant gap in the literature is the need for a more comprehensive understanding of how SE methodologies can be adapted to different industries and project contexts. Future research should explore the development of industry-specific SE frameworks that take into account the unique challenges and requirements of different sectors.

Another area for future research is the integration of SE with emerging technologies, such as artificial intelligence and machine learning. These technologies have the potential to enhance SE methodologies by providing more sophisticated tools for modeling, simulation, and decision-making. Research into how these technologies can be integrated with SE to improve the management of complex projects would be highly valuable.

Finally, there is a need for more empirical studies that evaluate the effectiveness of SE methodologies in real-world projects. While the case studies reviewed in this article provide valuable insights, more data is needed to understand the conditions under which different SE methodologies are most effective. This research could help practitioners make more informed decisions about which methodologies to adopt in their projects.

Conclusion

This review has explored the critical role of Systems Engineering in Complex Project Management, focusing on the methodologies used and their applications across various sectors. The findings highlight that SE methodologies, such as the V-Model, Agile SE, and MBSE, provide structured and flexible approaches to managing the complexity of modern projects. These methodologies facilitate the integration of multiple subsystems, continuous stakeholder engagement, and rigorous modeling and simulation, all of which are essential for project success. The case studies reviewed demonstrate that SE can significantly enhance the management of complex projects, reducing risks and improving outcomes.

The integration of Systems Engineering into Complex Project Management is not just beneficial but essential for managing the challenges of modern, large-scale projects. The structured approaches provided by SE methodologies help project teams navigate the complexity, uncertainty, and dynamic nature of these projects, ensuring that all aspects of the system are considered and that the project remains aligned with stakeholder needs. As the complexity of projects continues to grow, the importance of SE in CPM will only increase, making it a critical area for both research and practice.

For practitioners, the key to successfully integrating SE into CPM lies in adopting a structured yet flexible approach to project management. Early and continuous stakeholder engagement, iterative development, and rigorous modeling and simulation should be central to the project management process. Organizations should also invest in building SE expertise within their project teams, ensuring that they

have the skills and knowledge needed to apply these methodologies effectively. By doing so, practitioners can enhance their ability to manage complex projects successfully, reducing risks and improving project outcomes.

References

- Blanchard, B. S., & Fabrycky, W. J. (2014). *Systems Engineering and Analysis* (5th ed.). Pearson.
- Boehm, B., & Turner, R. (2004). *Balancing Agility and Discipline: A Guide for the Perplexed*. Addison-Wesley.
- Buede, D. M., & Miller, W. D. (2016). *The Engineering Design of Systems: Models and Methods* (3rd ed.). John Wiley & Sons.
- De Weck, O., Roos, D., & Magee, C. (2011). *Engineering Systems: Meeting Human Needs in a Complex Technological World*. MIT Press.
- Forsberg, K., Mooz, H., & Cotterman, H. (2005). *Visualizing Project Management* (3rd ed.). John Wiley & Sons.
- Friedenthal, S., Moore, A., & Steiner, R. (2014). *A Practical Guide to SysML: The Systems Modeling Language* (3rd ed.). Morgan Kaufmann.
- Geraldi, J., Maylor, H., & Williams, T. (2011). Now, let's make it really complex (complicated): A systematic review of the complexities of projects. *International Journal of Operations & Production Management*, 31(9), 966-990.
- Gorod, A., Sauser, B., & Boardman, J. (2008). System-of-systems engineering management: A review of modern history and a path forward. *IEEE Systems Journal*, 2(4), 484-499.
- Muller, G. (2009). Systems engineering research methods. In *Handbook of Systems Engineering and Management* (2nd ed.). John Wiley & Sons.
- Remington, K., & Pollack, J. (2016). *Tools for Complex Projects*. Gower.
- Schindel, W. D., & Smith, V. (2002). Results of applying a families-of-systems approach to systems engineering of product line families. *Systems Engineering*, 5(4), 312-330.
- Shenhar, A. J., & Dvir, D. (2007). *Reinventing Project Management: The Diamond Approach to Successful Growth and Innovation*. Harvard Business Review Press.