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TESE DE DOUTORADO

MANAGING URGENT PROJECTS

(GERENCIANDO PROJETOS URGENTES**)**

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MANAGING URGENT PROJECTS

Tese submetida ao Programa de Pós-Graduação em Engenharia de Produção da Universidade Federal do Rio Grande do Sul como requisito parcial à obtenção do título de Doutor em Engenharia de Produção, na área de concentração em Sistemas de Produção.

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Managing Urgent Projects

Esta Tese foi julgada adequada para a obtenção do título de Doutor em Engenharia de Produção e aprovada em sua forma final pela Orientadora e pela Banca Examinadora designada pelo Programa de Pós-Graduação em Engenharia de Produção da Universidade Federal do Rio Grande do Sul.

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Dedication (Dedicatória)

To my father, in memory, from whom I learned the principles and values that guide my life. To my beloved children, Théo, Nina, and Lara, to whom I dedicate all my work, my sweat, and my life.

(Ao meu pai, em memória, de quem aprendi os princípios e valores que norteiam a minha vida. Aos meus amados filhos, Théo, Nina e Lara, a quem dedico todo meu trabalho, meu suor e minha vida.)

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“Time is your most valuable asset.”

(O tempo é o seu bem mais valioso.)

Jim Rohn (1930-2009) was an American entrepreneur, author, and motivational speaker known for his contributions to the field of personal development.

RESUMO

A Gestão de Projetos Urgentes é pouco explorada no campo de conhecimento do gerenciamento de projetos, apesar da reconhecida importância quando demandados por desastres naturais, pandemias, guerras, ou falhas de infraestrutura e construção civil, por exemplo. Foram identificadas lacunas como a ausência de uma definição, variabilidade na interpretação da urgência, falta de uma estrutura conceitual, pesquisas insuficientes em contextos disruptivos e escassez de estudos de caso em projetos altamente urgentes. Primeiramente, realizou-se uma Análise Léxico Semântica e uma Busca Sistemática da Literatura para analisar o termo "urgente". Em seguida, combinamos Revisão Sistemática da Literatura com abordagem Bola de Neve, mineração computacional de texto e Latent Dirichlet Allocation (LDA) para analisar a gestão de projetos urgentes. Desenvolvemos um Modelo Teórico de análise da urgência em projetos, caracterizando e definindo os Projetos de Alta Intensidade Sensíveis ao Tempo, validado empiricamente pelo estudo de caso de um projeto de Inovação Aberta extremamente urgente durante a pandemia da COVID-19. Também, analisamos riscos temporais em megaprojetos de mapeamento terrestre. As descobertas revelaram as interpretações da urgência, identificando cinco conceitos chaves e características em quatorze áreas temáticas (por exemplo, riscos, stakeholders e equipes). Um novo Modelo para Análise de Urgência e Velocidade Econômica em Projetos é introduzido, oferecendo uma compreensão baseada em urgência, duração, velocidade e custos. Identificou-se trinta e dois riscos em projetos urgentes de Inovação Aberta, sendo um inaceitável. Além disso, princípios para a gestão de projetos urgentes foram organizados em 18 temas. Esta pesquisa contribui para o domínio do gerenciamento de projetos ao fornecer definição e estrutura conceitual para projetos urgentes, estabelecendo uma base teórica sólida para estudos futuros. Ela oferece insights sobre a gestão da urgência, formula um Modelo Unificado para a tomada de decisões em projetos e integra a análise de riscos ao gerenciamento de projetos de Inovação Aberta urgente e de megaprojetos de mapeamento terrestre. Ao final, a criação de um guia para gerenciar projetos urgentes serve como uma ferramenta em contextos ágeis e sensíveis ao tempo. Portanto, esta Tese avança a compreensão teórica e prática do gerenciamento de projetos urgentes, oferecendo contribuições valiosas para pesquisadores e profissionais de gerenciamento de projetos.

Palavras-chave: Gestão de Projetos, Projetos Urgentes. Projetos Inesperados. Projetos Emergenciais. Projetos Arriscados. Projetos Disruptivos. Urgência. Emergência. Tempo. Velocidade. Agilidade.

ABSTRACT

The Management of Urgent Projects is little explored in the project management body of knowledge, despite its recognized importance when required by natural disasters, pandemics, wars, or infrastructure and civil construction failures, for example. Gaps were identified, such as the absence of a definition, variability in the interpretation of urgency, lack of a conceptual framework, insufficient research in disruptive contexts, and a scarcity of case studies in highly urgent projects. First, a Lexical Semantic Analysis and a Systematic Literature Search were conducted to analyze the term "urgent." We then combined a Systematic Literature Review with a Snowball approach, computational text-mining, and Latent Dirichlet Allocation (LDA) to analyze the management of urgent projects. We developed a Theoretical Model for analyzing urgency in projects, characterizing and defining High Intensity and Time Sensitivity Projects, empirically validated by the case study of an extremely urgent Open Innovation project during the COVID-19 pandemic. We also analyze temporal risks in terrestrial mapping megaprojects. The findings revealed the interpretations of urgency, identifying five key concepts and characteristics in fourteen thematic areas (for instance, risks, stakeholders, and teams). A new Model for Urgency Analysis and Economic Speed in Projects is introduced, offering an understanding based on urgency, duration, velocity, and costs. Thirty-two risks were identified in urgent Open Innovation projects, one of which was considered unacceptable. In addition, principles for urgent project management were organized into 18 themes. This investigation contributes to the project management domain by providing a definition and conceptual framework for urgent projects, establishing a solid theoretical foundation for future studies. It offers insights into urgency management, formulates a Unified Model for project decision-making, and integrates risk analysis into the management of urgent Open Innovation projects and terrestrial mapping megaprojects. In the end, creating a guide for managing urgent projects serves as a tool in agile, time-sensitive contexts. Therefore, this Thesis advances the theoretical and practical understanding of urgent project management, offering valuable contributions for researchers and project management professionals.

Keywords: Project Management. Urgent Projects. Unexpected Projects. Emergency Projects. Risky Projects. Disruptive Projects. Urgency. Emergency. Time. Speed. Agility.

PREFÁCIO

Ao longo da história sempre enfrentamos desafios que exigiram respostas extremamente rápidas, seja em pandemias, atos de terrorismo, ou em grandes desastres naturais. Esses acontecimentos evidenciam a urgência relacionada à gestão de projetos voltados para a sobrevivência e a prosperidade face às grandes adversidades. Tais desafios exigem mobilização de tempo, recursos físicos, conhecimento e do poder interior de cada ser humano. A capacidade de adaptação, de colaboração e de resposta a esses acontecimentos refletirá a nossa capacidade para enfrentar situações extraordinárias, por meio da gestão de projetos urgentes para a preservação e o avanço da sociedade.

Nesse contexto, esta Tese é um convite para reconhecer e se aprofundar na gestão de projetos urgentes como um campo de estudo essencial no contexto moderno, que se situa na intersecção entre a necessidade humana, a excelência em gestão extremamente ágil e o entendimento do nosso maior mistério, o tempo. Através dela, buscamos não apenas desenvolver definições, modelos teóricos e frameworks para responder a crises, mas também aprender com a adaptabilidade, a perspicácia e a colaboração humanas que emergem nos momentos mais desafiadores.

Cada projeto urgente que estudamos dos extraordinários autores anteriores a esta Tese, a cada estudo de caso, e a cada estratégia que propomos, reflete histórias de indivíduos, gestores, comunidades e organizações que se levantaram frente à adversidade. Ao focar nesta área de estudo, abrimos caminho para a forma como nos apoiamos e elevamos uns aos outros em momentos decisivos. Este trabalho é, portanto, um tributo à indomável capacidade humana.

Por isso, estudar a gestão de projetos urgentes vai além da academia. Cada projeto estudado materializa a essência de nossa capacidade coletiva e individual. Cada entrega extremamente urgente nos lembra que, mesmo nas ocasiões mais inesperadas, difíceis e sombrias, somos capazes de alcançar feitos extraordinários. Esta Tese é a consolidação dessa capacidade, um reconhecimento de que, quando unidos por um alinhamento de objetivos, não há desafio grande demais para superarmos.

PREFACE

Throughout history, we have faced challenges that have required extremely quick responses, whether in pandemics, acts of terrorism, or major natural disasters. These events highlight the urgency of managing projects aimed at survival and prosperity in the face of great adversity. Such challenges require the mobilization of time, physical resources, knowledge, and the inner power of each human being. The ability to adapt, collaborate, and respond to these events will reflect our ability to face extraordinary situations by managing urgent projects to preserve and advance society.

In this context, this Thesis is an invitation to recognize and delve deeper into the management of urgent projects as an essential field of study in the modern context, which lies at the intersection between human need, excellence in extremely agile management, and the understanding of our greatest mystery, time. Through it, we seek not only to develop definitions, theoretical models, and frameworks for responding to crises but also to learn from the human adaptability, acumen, and collaboration that emerge in the most challenging moments.

Each urgent project we study from the extraordinary authors prior to this Thesis, each case study, and each strategy we propose reflects stories of individuals, managers, communities, and organizations that rose up in the face of adversity. By focusing on this study area, we pave the way for supporting and lifting each other up in decisive moments. This work is, therefore, a tribute to indomitable human capacity.

Therefore, studying the management of urgent projects goes beyond academia. Each project studied materializes the essence of our collective and individual capacity. Each extremely urgent delivery reminds us that, even in the most unexpected, difficult, and darkest of times, we are capable of achieving extraordinary feats. This Thesis is the consolidation of this capacity, a recognition that, when united by an alignment of objectives, there is no challenge too great for us to overcome.

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Table 1.1 - List of abbreviations and terms.

Abbreviations	Terms
2EW	Employee Engagement and Well-being
ACF	Adaptability, Change, and Flexibility
ADM	Agile Decision-Making
AI	Artificial Intelligence
AN	ANVISA Risks
ANVISA	Agência Nacional de Vigilância Sanitária (National Health Surveillance Agency)
ARA	Agility, Risk, and Adaptability
BCR	Benefit-Cost Ratio
BRL	Brazilian Real
C	Project Cost
C1, C2, …	Concept 1, Concept 2, …
C2PA	Closure and Post-Project Analysis
Cat	Category
Close	Closing Phase
COM	Communication
CON	Conformity
COO	Coordination
COPEL	Companhia Paranaense de Energia (The State of Paraná Energy Company)
COSO	Committee of Sponsoring Organizations of the Treadway Commission
COVID-19	Coronavirus Disease 2019
CPCNs	Construction Project Cooperation Networks
CPRM	Companhia de Pesquisa de Recursos Minerais (Geological Service of Brazil)
CUA	Context and Urgency Analysis
D	Duration, Time Span
DHN	Diretoria de Hidrografia e Navegação (Directorate of Hydrography and Navigation)

Abbreviations	Terms
DL	Deep Learning
DSA	Delivery Selection and Acceleration
DSG	Diretoria de Serviço Geográfico (Directorate of Geographical Service)
DSM	Digital Surface Models
DTM	Digital Terrain Models
E	Exclusion
EDGV	Especificações Técnicas para Estruturação de Dados Geoespaciais Vetoriais (Technical Specifications for Structuring Vector Geospatial Data)
EQ	Public Equipment Risks
Exec	Execution Phase
FA	Financial Assessment
FAB	Força Aérea Brasileira (Brazilian Air Force)
FC	Framework Categories
GPT	Generative Pre-trained Transformer
GRQ	General Research Question
GRU	GRU Project
HR	Human Resources
HRO	High Reliability Organisations
IBGE	Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics)
IJMPB	International Journal of Managing Projects in Business
IM	Institutional Image Risks
Init	Initiation Phase
IP	Intellectual Property Risks
ISKM	Information Systems and Knowledge Management
IT	Information Technology
JHTMR	The Journal of High Technology Management Research
KIOM	Knowledge, Information, and Organizational Management
KPI	Key Performance Indicators
LCA	Life Cycle Assessment
LD	Leadership

Abbreviations	Terms
LDA	Latent Dirichlet Allocation
LO	Logistics Risks
LSA	Lexical Semantic Analysis
LTM	Leadership and Team Management
M&C	Monitoring and Controlling Phase
DSM	Digital Surface Model
DTM	Digital Terrain Model
NLG	Natural Language Generation
NLP	Natural Language Processing
NLTK	Natural Language Toolkit
NOCs	No Objection Certificates
NPV	Net Present Value
NR	Narrative Review
OD	Organizational Dynamics
OI	Open Innovation
OPE	Operation
PA	Partnership Risks
PBOs	Project-Based Organizations
PDF	Portable Document Format
PE	People Risks
PF	Project Foundations
PJ	Project-related Risks
Plan	Planning Phase
PM	Project Management
PMACI	Performance Monitoring, Assessment, and Continuous Improvement
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMJ	Project Management Journal
PMOL	Performance Management and Organizational Learning
Post-P	Post-Project Phase
PPC	Planning and Production Control
PPE	Personal Protective Equipment

Abbreviations	Terms
PR	Production Risks
Pre-P	Pre-Project Phase
PRT	Price Rate Table
QGIS	Quantum Geographic Information System
QH	Quadruple Helix
R&D	Research and Development
RFM	Resource and Financial Management
RGB	Red, Green, Blue (color model)
RI	Risk Index
RMA	Resource Management and Allocation
ROI	Return on Investment
RQ	Research Question
RUM	Risk and Uncertainty Management
S2C	Stakeholder, Communication, and Collaboration
SA	Sanitation Risks
SAAPI	Sistema Aerotransportado para Aquisição e Pós-processamento de Imagens Digitais (Airborne System for Acquisition and Post-processing of Digital Images)
SAR	Synthetic Aperture Radar
SIPAM	Sistema de Proteção da Amazônia (Amazon Protection System)
SIVAM	Sistema de Vigilância da Amazônia (System for the Surveillance of the Amazon)
SLAR	Side-Looking Airborne Radar
SLR	Systematic Literature Review
SLS	Systematic Literature Search
SNW	Snowball Approach
SRQ	Specific Research Question
STR	Strategy
T&D	Training and Development
T1, T2, …	Theme 1, Theme 2, …
TBC	Time-Based Competition
TD	Team Dynamics
TEC	Technology

Abbreviations	Terms
TN	Technological Novelty
TSM	Time and Speed Management
TTO	Technology Transfer Offices
U	Urgency, degree of urgency, Level of Project Urgency
UPE	Urgent Project Essentials
V	Velocity, Speed of Execution
WFA	Word Frequency Analysis

SUMMARY (SUMÁRIO)

1. INTRODUCTION

This Ph.D. Thesis explores the challenges of Managing Urgent Projects, characterized by critical time constraints. By understanding "urgency," developing the definition of "urgent projects," and conducting a literature review, we discovered management challenges, concepts, characteristics, themes, approaches, and relevant variables to the study and understanding of urgent projects. Through empirical case studies, we gained a deeper understanding of how we can deal with these types of projects, considering the primacy of the temporal dimension. This research presents new conceptual and theoretical propositions, contributing to the advancement of state of the art in project management and its practical application in critical, extreme, and urgent scenarios. By integrating theoretical frameworks and models, empirical studies, and computational analyses, this Thesis seeks to offer a framework to guide project management professionals through the challenges of managing under tight deadlines and high-pressure conditions, contributing significantly to the field of project management.

1.1. CONTEXTUALIZATION

Complexity (Brady and Davies, 2014; Davies and Mackenzie, 2014) is one of the main reasons for a project's failures (Mirza and Ehsan, 2017). Projects become complex due to various challenging factors that make them difficult to manage (Figure 1.1). Some of these factors include the *size or scale* of the project (Flyvbjerg, 2014; Vidal et al., 2011; Xia and Chan, 2012), its *structures and functions* (Xia and Chan, 2012), the level of *experience with technology* (Bosch-Rekveldt et al., 2011; Xia and Chan, 2012), the *similarity* among projects (Kardes et al., 2013; Xia and Chan, 2012), *scope cost overruns* (Mirza and Ehsan, 2017), and *temporal urgency* (Mirza and Ehsan, 2017; Morris and Hough, 1987; Remington and Pollack, 2008; Shenhar and Dvir, 2007; Xia and Chan, 2012).

The urgency in a project's schedule is paramount when considering project complexity. Shenhar and Dvir (2007) and Williams (2005) identified "pace" as a type of complexity where the urgency and criticality of time goals demand distinct managerial structures and attention (Geraldi et al., 2011). Remington and Pollack (2008) introduced temporal complexity as a type of complexity. Xia and Chan (2012) considered urgency one of the dimensions used to measure project complexity. Furthermore, Mirza and Ehsan (2017) proposed schedule complexity as one of the categories to achieve a project execution complexity index. In essence, urgency is crucial in measuring and understanding a project's complexity, acting as an intersection between two knowledge domains within project management – complexity and urgency.

However, despite its significance, there remains a lack of research dedicated explicitly to urgent projects. Nachbagauer (2022) explored disaster management and fast-response organizations to provide insights into managing such projects. Zidane et al. (2018) studied a superfast urgent project in the telecommunications infrastructure sector. El-Anwar and Aziz (2014) focused on an integrated urban-construction planning framework for slum upgrading projects. Wearne (2006) was the only one to go specifically on managing unexpected urgent projects, while McDonough and Pearson (1993) studied the impact of perceived urgency on project performance. Wearne and White-Hunt (2014) explored case studies on managing urgent and unexpected projects. Therefore, within the management domain, only a few papers and one book address the unique challenges of urgent projects.

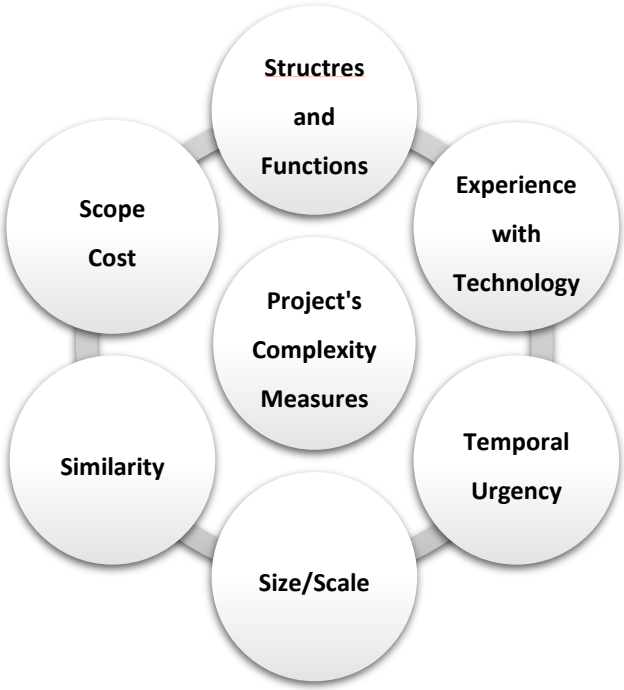

Figure 1.1 - Graphic representation of the complexity measures for projects, positioning the temporal urgency within this field. Based on Xia and Chan (2012).

Urgent and unexpected projects are uncommon in business and government sectors (Wearne and White-Hunt, 2014). When they arise, they become the highest priority in an organization's portfolio, garnering attention from executive managers and sponsors (Wearne and White-Hunt, 2014). One significant example of this was the COVID-19 (Coronavirus Disease) pandemic, which increased project complexity and a sudden shortage of human resources (Zhu et al., 2022). Dealing with health emergencies requires managing urgent projects and shining a spotlight on several aspects of the process. It included examining the sense of

urgency at the individual level (Kotter, 2008; Ligthart et al., 2016) and the importance of meeting urgent deadlines (Leung et al., 2016). At the broader project level, managers faced challenging tests, such as selecting the right timing and speed, which are essential skills in management (Nachbagauer, 2022). Therefore, in the specific theme of urgent project management.

Nachbagauer (2022) emphasizes that urgent projects demand immediate attention and action due to their critical nature. A high level of uncertainty characterizes these projects, necessitating quick decision-making and coordination. Managing the urgency requires understanding the dynamics of event time, enabling effective enactment and management of urgent projects. The right time or speed selection in urgent project management becomes crucial for successful outcomes. Moreover, Zidane et al. (2018) highlight that urgent projects require completion within significantly shorter durations than similar projects. While no specific definition exists, they differentiate between unexpected and urgent projects, emphasizing the need to understand the challenges and strategies employed in managing time-constrained projects effectively. Wearne (2006) describes urgent projects as those that arise unexpectedly, demanding immediate action due to new business opportunities, sudden threats, or the need to restore severely damaged assets. In such scenarios, instant acceptance of cost risks is often demanded, with speed becoming a primary concern over cost considerations.

However, the papers differ in their specific focus. While some papers explore understanding event time dynamics (Nachbagauer, 2022), others highlight the significance of managing time constraints (Zidane et al., 2018). Furthermore, Wearne (2006) emphasizes the unexpected nature of urgent projects and explores factors influencing decision-making and stakeholder engagement in high-pressure scenarios. Handling urgent projects is not just about reacting swiftly. However, it also requires a deeper understanding of how to manage them effectively. These sudden challenges push managers and teams to their limits (Zidane et al., 2018), demanding quick decision-making and precise execution (da Penha and ten Caten, 2023b). The topic of urgent project management holds significance in different industries, given that unforeseen crises and time-sensitive tasks can arise at any moment. Therefore, managing urgent projects represents a unique theme that demands attention and research (da Penha and ten Caten, 2023b, 2023a).

1.2. RESEARCH PROBLEM, QUESTION, AND OBJECTIVES

1.2.1. Research Problem

The literature on urgent project management reveals gaps that hinder our understanding and advancement of this domain, such as *the lack of a standardized definition for urgent projects within the management literature* (Zidane et al., 2018). This absence makes it challenging to analyze and develop a comprehensive Project Management Theory related to urgency. *Depending on the authors' interpretation, the term urgent can be used with different degrees of urgency* (Wearne and White-Hunt, 2014, p. 9). It is aggravated by the *increased use of the term urgent with different interpretations in the scientific literature* after the beginning of the Coronavirus pandemic (da Penha and ten Caten, 2023b; Mirri et al., 2020). Moreover, there is no *theoretical framework for characterizing an urgent project in the context of the project management literature*, expressing a consolidated theory of the subject. It highlights the pressing need for a clear and universally accepted definition of urgency in project management research to facilitate discussions and advancements in the field.

In the context of urgent project management, *urgency* plays a vital part in facilitating organizational change (Fredberg and Pregmark, 2022) and influencing the selection of delivery methods (Bingham et al., 2018). This urgency has brought attention to *speed* when dealing with urgent projects, such as infrastructure and telecommunication (Zidane et al., 2018). Projects characterized by urgency often involve high risks, demanding technical requirements, and tight schedules (Zhi et al., 2018). In the context of temporal risks, e.g., the COVID-19 pandemic has forced humanity to face the unique challenge of time urgency and technological changes (Azeem et al., 2022) in their projects.

In recent studies, authors have explored diverse theoretical perspectives to address urgent challenges, such as disaster management and fast-response organizations (Nachbagauer, 2022). These perspectives shed light on synchronous and diachronic timing, offering valuable insights into how to handle critical situations. Also, in the context of disaster (and crisis) management, the research of De Waard and Kalkman (2022) synthesizes extreme context studies in project management journals, which gives an overview of the subject. In the technological dimension of urgent projects, some authors studied sophisticated technological solutions to inspect construction projects during pandemics, such as blockchain (Lu et al., 2022) and time reduction based on autonomous drones (Wrycza et al., 2017). However, despite these isolated approaches

and valuable contributions, there is yet to be a specific consolidated theory that exclusively addresses urgent project management challenges.

This Thesis focuses on exploring the challenges faced by managing urgent projects within the vast Brazilian territory. The effectiveness of the stakeholders, such as the University, Industry, Government, and Armed Forces, depends heavily on making quick and accurate decisions in a country that covers approximately 8,515,767 km^2 of territory (Martins and James, 2020) and 5.7 million km^2 of maritime area (Brazilian Navy, 2024). To achieve unexpected and unpredictable tactical or emergency objectives, Brazilian managers must have the speed to plan and execute urgent projects in this extensive area, making project management a vast and crucial task.

In spite of the high need for immediate projects during the challenges of the COVID-19 pandemic, their management continues to be a challenge. The work's objective is to enhance the capacity of Brazil and the world to deal with future urgent projects, which are vital for tactical and emergency operations. By exploring project management challenges and identifying potential obstacles, this research seeks to pave the way for more effective strategies that contribute to the successful execution of urgent projects. The significance of this research lies in its potential to reinforce the capacity of our people to respond promptly to critical situations in the vast expanse of Brazilian territory. By addressing the gaps and challenges in urgent project management, the study aims to contribute valuable insights and strategies to enhance the effectiveness of the Government, Universities, Industries, Armed Forces, and Civil Society in responding to critical situations across the vast Brazilian Theater of Operations.

During the initial component of our research exploration, we encountered a scarcity of studies on urgent project management. This scarcity was evident in two distinct areas: geographical and industrial sectors. Specifically, no studies were found to have been conducted in Latin America, indicating a geographical gap. Similarly, there was a significant dearth of research within the industrial and government sector gap. Moreover, a comprehensive analysis revealed an overarching gap in understanding practical approaches to managing urgent projects effectively. This gap encompassed several aspects of project management, suggesting a need for further investigation. It poses the question: How can we comprehend and address this issue in the context of Latin America? Our exploration underscored the limited academic attention devoted to this theme, to urgent project management in Latin America, and the combination of civilian and military stakeholders.

1.2.2. Research Questions

The General Research Question (GRQ) of this Thesis emerges from an analysis of the context and the research problem at hand. We are faced with the following Research Question:

GRQ: How to manage urgent projects?

This question serves as the cornerstone of our investigation, focusing on the perspective of dealing with time-sensitive projects.

1.2.3. Specific Research Questions

In order to answer the General Research Question (GRQ) thoroughly, we developed 7 (seven) specific research questions that could guide the assessment, thus presented separately in each chapter of the Thesis as individual research articles. Each question targets a unique aspect of urgent project management, covering conceptual definitions, literature review, computational analyses, theoretical model formulation, empirical case studies, and practical framework development.

1.2.3.1. First Specific Research Question

Chapter 2: Conceptualizing Urgent Projects. The first block of this research (Article 1) focuses on conceptualizing “urgency” and “urgent projects.” It analyzes the meanings and interpretations of an urgent project to achieve this aim. The following Research Question has been reached to achieve a more profound understanding of the subject.

Research Question 1 (RQ 1): What is an urgent project?

Effectively addressing the challenges of managing urgent projects requires a clear conceptual framework for what is urgent and a definition of an "urgent project." Understanding the nature and characteristics that distinguish a project as urgent allowed us to establish conceptual aspects relating to the management of these projects and provide the necessary foundations for developing subsequent chapters. However, a research gap remains regarding an unclear understanding of urgent project management.

1.2.3.2. Second Specific Research Question

Chapter 3: Literature Review on Managing Urgent Projects. The second block (Article 2) analyzes the urgent project management domain from the literature point of view. This time, we focused on identifying and describing urgent projects’ core concepts and their characteristics, categorizing them into key themes, and presenting the future challenges related

to urgent project management research. To gain a better comprehension of the topic, we have formulated the following Research Question.

Research Question 2 (RQ 2): What are the core concepts, characteristics, and main themes identified in the literature on managing urgent projects?

Managing urgent projects represents a complex challenge due to time pressure, elevated risks, and the need for swift responses. This chapter combined a Systematic Literature Review with a Snowball approach to analyze the management of urgent projects. This chapter served as a theoretical foundation and provided the research gaps for subsequent chapters. Therefore, the research gap described in Article 1, regarding the unclear understanding of urgent project management, is addressed in Article 2 through a Literature Review to identify concepts and themes in the management of urgent projects.

1.2.3.3. Third Specific Research Question

Chapter 4: A computational Text-Mining Approach to Analyze Urgency. The third block (Article 3) applies computational text-mining, including Word Frequency Analysis (WFA) and Latent Dirichlet Allocation (LDA), to analyze urgency in academic literature. This time, we focused on identifying key words and themes, offering new insights into the complex nature of urgency. To achieve an understanding of the subject, the following Research Question has been reached.

Research Question 3 (RQ 3): How is urgency articulated within the academic domain of urgent project management, and what insights can computational text-mining reveal about the thematic and conceptual patterns in the literature?

This chapter offers a data-driven perspective on urgency, analyzing dimensions and implications as discussed in academic texts. The research gap in Article 2, related to the need for a comprehensive understanding of urgency in project management, is addressed in Article 3 by employing computational text-mining to discover and confirm thematic and conceptual patterns associated with urgency. Therefore, it confirms and enlarges the thematic findings of the previous chapter.

1.2.3.4. Fourth Specific Research Question

Chapter 5: The Unified Project Urgency and Economic Speed Analysis Model. The fourth block (Article 4) seeks to develop a Unified Theoretical Model for analyzing urgency in project management. Article 4 builds on the ideas in Article 3 to establish a theoretical model on the

topic. It explains urgency, duration, velocity, and costs, providing a structure to guide managerial actions. The following Research Question is used.

Research Question 4 (RQ 4): How do variations in the degree of urgency influence the project duration, speed, and costs within the domain of project management?

This model is an analytical theoretical framework developed for managerial decision-making characterizing Time-Sensitive High-Intensity Projects. Based on the foundations of Chapter 3, this theoretical model explores variables not covered in the previous two chapters, complementing the topics covered.

1.2.3.5. Fifth Specific Research Question

Chapter 6: Challenges and Risks in Urgent Open Innovation Projects. The fifth block (Article 5) empirically investigates the Quadruple Helix model's potential to accelerate an urgent Open Innovation project. Examining the life cycle of the superfast project developed during the COVID-19 pandemic in Brazil reveals complex interactions among Government, Academia, Industry, and Civil Society stakeholders while shedding light on the many risks arising from their dynamic collaboration. It builds the following Research Question.

Research Question 5 (RQ 5): How can urgent Open Innovation projects be executed in the context of the Quadruple Helix model considering stakeholder dynamics and the risk involved?

This chapter investigates the dynamics of Open Innovation in an urgent project, with a focus on the collaboration among the Brazilian Army, an Academic Institution, Industry, and Civil Society. It provides empirical evidence for Time-Sensitive High-Intensity Projects, and identifies the main challenges faced during this interaction and the risks associated with cooperation among diverse stakeholders. Therefore, the research gap in Article 4 regarding the practical application and empirical evidence of the theoretical model is answered in Article 5.

1.2.3.6. Sixth Specific Research Question

Chapter 7: Temporal Risk Management in Land Mapping Projects. The sixth block (Article 6) focuses on temporal risk management and urgency in these megaprojects, using the "Amazon Radiography" project as a case study. The study identifies, categorizes, and prioritizes the main risks observed in each phase of megaproject management, classifying them according to the project objectives. It builds the following Research Question:

Research Question 6 (RQ 6): How do temporal risks affect urgency and completion schedule in large land mapping projects, and what strategies can help mitigate these temporal impacts?"

Based on the methodological structure of the previous chapter, this chapter concentrates on identifying and analyzing the main challenges and risks encountered by the Brazilian Army in managing megaprojects, emphasizing those related to territorial mapping, highlighting and prioritizing risks with temporal impact and urgency. It explores factors such as decision-making under pressure, efficient resource allocation, coordination among different units, and adaptation to dynamic and unpredictable scenarios. Therefore, this article addresses research gaps not addressed in the previous chapter.

1.2.3.7. Seventh Specific Research Question

Chapter 7.1: A guide to assist project managers in time-sensitive projects. The final block (Article 7) developed a practical framework to guide the management of time-sensitive projects. This article consolidates the research gaps identified in previous articles, offering an applicable guide. It takes the theoretical foundations, case studies, risk management strategies, and theoretical models from Articles 1 to 6 and translates them into actionable principles for project managers. As such, it directs to the following Research Question:

Research Question 7 (RQ 7): What would be an approach for project managers to handle urgent projects with tight deadlines at project phases?

This chapter compiles principles and practical implications categorized into topics related to urgent project management, such as financial aspects, stakeholder involvement and communication, time, resources, risk, uncertainty and knowledge management, adaptability, leadership, and organizational change, among others. Practical propositions from the literature provide a pragmatic contribution for professionals in the field of project management. Therefore, to answer the General Research Question (GRQ), we created a guide for managing urgent projects, which serves as a tool in agile and urgent contexts.

1.2.4. Objectives

The main objective of this Thesis is to investigate the challenges of managing urgent projects and develop a framework that can be used as a roadmap for managing similar projects in the future. Based on the Research Questions, this research aims to, respectively:

(i) This chapter aims to present the context and meaning of research on urgent project management. It summarizes the Thesis, presents the challenges faced in managing urgent

projects, and justifies investigating this domain of knowledge. Additionally, Research Questions are presented, outlining what will be explored in subsequent chapters.

(ii) The objective of Chapter Two (Article 1) is to analyze and discuss *the conceptual and contextual nuances of urgency* and explore and clarify the concept of urgent projects, explicitly examining the meanings and nuances of the word "urgent" as well as the challenges, and diverse perspectives of urgency in the context of project management. It also seeks a definition of urgent projects.

(iii) The objective of Chapter Three (Article 2) is to review the literature on managing urgent projects. The chapter aims to identify relevant themes, strategies, and approaches by examining existing research articles. The goal is to establish a solid theoretical base that serves as a basis for subsequent chapters and the urgent project body of knowledge, guiding research topics in this domain.

(iv) Chapter Four (Article 3) aims to provide insights into how urgency is addressed in urgent project management based on computational text-mining. The study seeks to reveal patterns and themes associated with urgency based on a computational approach and confirm the thematic findings interpreted in the Systematic Literature Review.

(v) Chapter Five (Article 4) aims to develop an analytical understanding of urgency based on variables not addressed in the Systematic Literature Review, integrating levels of urgency, speed, duration, and cost in project management. The research seeks to develop a theoretical model synthesizing the existing literature on urgent project management based on these variables. This literature synthesis is the theoretical basis for the following empirical study, adding knowledge to these critical variables concerning Time-Sensitive High-Intensity Projects.

(vi) Chapter Six (Article 5) aims to explore the challenges and risks arising from Open Innovation projects with high urgency. By investigating the dynamics of collaboration among the Brazilian Army, University, Industry, and Civil Society in an urgent project, the chapter seeks to identify the obstacles that can arise in such contexts. Additionally, the goal is to understand the risks associated with the diverse stakeholder involvement in urgent Open Innovation initiatives and provide empirical evidence for Time-Sensitive High-Intensity Projects.

(vii) Chapter Seven (Article 6) explores the relationship between identified risks that have temporal impacts and the urgency of completing land mapping projects, focusing on developing mitigation strategies to manage these risks. Therefore, it aims to identify and analyze the

Brazilian Army's challenges when managing territorial mapping projects. The chapter aims to provide insights to enhance the management of urgent projects within the military context, thus addressing research gaps not addressed in the previous chapter.

(viii) Chapter Eight (Article 7) aims to answer the General Research Question on managing urgent projects. To do this, based on the results of the previous chapters, we propose a structured approach that helps project managers lead through the complexities and, often, unpredictability of urgent projects, especially those that require rapid movement between the phases of the project. As such, this chapter summarizes the findings and develops a practical framework with principles and themes to guide project management professionals.

(ix) Chapter Nine aims to close this Thesis by presenting and discussing theoretical propositions on urgent project management. By synthesizing relevant concepts and insights from existing research and our findings, the chapter aims to help further project management knowledge and theory. The objective is to present a discussion with new theoretical insights that can be tested in future research and practical applications in managing urgent projects. In this sense, it discusses and theorizes about the levels of urgency of projects and proposes a general theoretical model that could help analyze these projects in the future.

1.3. JUSTIFICATION

Emergent threats with catastrophic impacts on safety, survival, and freedom often go unnoticed, and humanity may overlook their potential severity. Risks such as Artificial Intelligences, new pandemics, global warming, and genetically engineered bioweapons pose significant dangers to our existence. Evaluating these risks' levels involves considering their probability and potential impact (Guertler and Spinler, 2015). While some of these risks are known to the scientific community, they require expert analysis to assess their severity and potential consequences (Global Challenges Foundation, 2017).

Take, for example, the COVID-19 pandemic that emerged unexpectedly after 2019. Despite being considered highly unlikely, it highlighted looking more closely at the impact as part of the risk equation. Some global catastrophic risks could lead to the loss of almost all 8 billion people, leaving humanity in a state from which recovery seems insurmountable. Other risks, such as disruptive climate change or the use of genetically modified biological weapons, could leave small areas of humanity to recover eventually.

Understanding, preparing for, and mitigating these risks is of utmost importance, especially when survival in a disruptive context is at stake, as argued by De Waard and Kalkman (2022). As these risks affect all of humanity, it is crucial to conduct more research that draws

insights from the domain of urgent project management. By doing so, we can better inform the public and private sectors about these risks and guide the formulation of effective policies to address them.

In this context, this research on urgent project management brings several benefits. Firstly, it provides an in-deep understanding of the foundations of urgent projects, bolstering the theoretical background for academic research in this field. Secondly, it offers a valuable theoretical framework for managing urgent projects, facilitating future analyses, and spurring further academic research. Thirdly, it advances the knowledge surrounding "the capability to alternate between a deterministic and non-deterministic project management paradigm," as proposed by De Waard and Kalkman (2022). Fourthly, it contributes a model for analyzing urgent projects, offering new theoretical insights. Lastly, it provides a more nuanced understanding of managing urgent projects, paving the way for more effective project management in critical and time-sensitive situations.

1.4. RESEARCH DESIGN

To answer the General Research Question and achieve its objectives, a series of methods were planned and implemented that combined answers to the General Research Question of this Thesis. It follows a strategy with a *focal phenomenon or concept* observable in real life but not adequately addressed in the literature (Jaakkola, 2020), the *urgent projects*. At the same time, it uses flexible pattern matching for exploration and theory development, combining deduction with induction in logic (Bouncken et al., 2021). As presented in the research objectives of the Thesis, the aim is to expand the focal phenomenon to develop definitions, concepts, and theoretical references. Ultimately, the aim is to present theoretical and practical propositions that help manage urgent projects in the future.

The research was separated into seven distinct methodological blocks to achieve these objectives, each employing specific methods, techniques, and frameworks to explore and understand urgency in project management. First, a Lexical Semantic Analysis and a Systematic Literature Search were conducted to analyze the term "urgent." We then combined a Systematic Literature Review with a Snowball approach, computational text-mining, and Latent Dirichlet Topic Modeling to analyze the management of urgent projects. We developed a Theoretical Model for the analysis of urgency in project management, introducing the concept of “High-Intensity Time-Sensitive Projects,” empirically validated by the case study of a highly urgent Open Innovation project during the COVID-19 pandemic. In the end, we summarize the

findings from the literature of this Thesis into principles for managing urgent projects organized into themes and phases of the project life cycle.

1.4.1. Methods, Techniques, and Framework of the First Block (Article 1)

Once the Research Question is known, the first block (Article 1) is structured to understand the concept of urgency within the context of project management. It is grounded in the Theory Synthesis presented by Jaakkola (2020). It employs a conceptual strategy to explore "urgent projects." The procedure is separated into three primary steps, each tackling Specific Research Questions using various methods.

First, the Lexical Semantic Analysis (LSA) explores the meaning of "urgent." LSA (Almarwaey and Ahmad, 2021; Aslam and Chaman, 2020; Vanhove, 2008) analyzes the meanings and nuances of "urgent" as presented in Collins, Oxford, Cambridge, and Collins Cobuild dictionaries. It aims to establish a foundational understanding of urgency by examining its linguistic and semantic aspects.

The second step is the Systematic Literature Search (SLS) as presented by Xiao and Watson (2019). It investigates how urgency is contextualized within the management literature. SLS is a two-part approach involving a comprehensive keyword analysis to study the frequency and context of "urgent" and "urgency" in scientific articles, followed by extracting definitions of urgent projects from these articles. The aim is to understand the application of urgency in project management and to identify definitions of "urgent projects" within top-tier management research.

The third research step defines and conceptualizes "urgent projects" by integrating findings from steps one and two. It combines semantic insights from dictionaries with the contextual findings from the literature search to define "urgent projects" precisely. The goal is to create a conceptual framework for pressing projects that combines practical and theoretical viewpoints. The two methods prevent a concept from being accepted in a given domain but rejected in another (Almarwaey and Ahmad, 2021), allowing a double-level view.

Therefore, this first methodological block utilizes a mix of Lexical Semantic Analysis and Systematic Literature Search to understand the lexical meaning of "urgent" and how this term is used and defined within the domain of project management literature. The final step uses conceptual integration (Jaakkola, 2020) to combine these findings and propose a comprehensive definition of "urgent project."

1.4.2. Methods, Techniques, and Framework of the Second Block (Article 2)

The second block (Article 2) is a combination of a Systematic Literature Review (SLR) based on Xiao and Watson (2019) and a Snowball approach (Hauge et al., 2021) aimed at codifying the characteristics of urgent project management and categorizing them into themes for a comprehensive understanding of the subject matter. The process involves several steps, from initial literature search to data extraction, analysis, synthesis, and the presentation of findings.

First, the Literature Review. It uses the Scopus database up until February 2024. The Search Strategy employed strings (i) "urgent" OR "urgency," AND "project*" in management literature for a narrow domain and (ii) "urgent project*" in general literature for a broader domain. The Initial Results are 10,931 documents, narrowed down through exclusion criteria focusing on relevance, context, and quality, ending with 395 potential studies. The exclusion criteria applied to identify articles related explicitly to this Thesis or that offer insights into urgent project management resulted in 71 documents for full-text analysis. The Second Quality and Eligibility Assessment was further narrowed to 62 papers through detailed analysis. The Snowball approach is utilized to expand the literature database, adding 43 documents from referenced papers. This leads to a final database of 105 documents after full-text review and exclusions.

Step 2 is the Data Extraction, Analysis, and Synthesis. Data Extraction adopted inductive coding to identify and extract data systematically (Carroll et al., 2013; Dixon-Woods, 2011; Xiao and Watson, 2019), developing types, characteristics, themes, and core concepts. Data Analysis and Synthesis utilized a framework synthesis to structure the coding of the literature into key knowledge areas (themes), building a conceptual and theoretical framework of urgent project management from the coded characteristics.

Finally, the Results and Discussion Step. The results and discussion are presented together, identifying key characteristics, themes, concepts, and gaps within each theme in the literature and suggesting future challenges for research. It synthesizes related literature (Xiao and Watson, 2019) to conceptualize the topic holistically. This literature review functions as a self-contained piece, subsets of which are used as background theories for the following chapters.

1.4.3. Methods, Techniques, and Framework of the Third Block (Article 3)

The third block (Article 3) involves a computational text-mining approach to analyze the concept of urgency within the academic literature on project management based on the database from the previous block. This methodological block incorporates several steps, leveraging a variety of computational tools and techniques to extract, preprocess, analyze, and interpret textual data from academic files. Through computational text-mining, thematic analysis, and an Artificial Intelligence based approach, the research seeks to create a comprehensive grasp of the concept of urgency within the field of project management.

The first step is Data Extraction, Preprocessing, Structuring, and Output. The Data Extraction automatically extracts sentences containing "urgent" or "urgency" from PDF files using Python and libraries such as PyPDF2 and Pandas. Data Preprocessing followed, reading text content, identifying targeted sentences, and concatenating text for analysis. Data Structuring storing extracted information in a DataFrame sorted by publication year and exported as an Excel file. Data Verification and Analysis took place as manual dataset verification against original PDFs to ensure data integrity, with irrelevant rows removed for clarity.

Step 2 is Word Frequency Analysis (Keywords Analysis). Data Preprocessing involved cleaning text by removing punctuation, converting to lowercase, removing stopwords, tokenization, and lemmatization. Data Analysis is a frequency analysis of words in the "Urgent Sentence" dataset, visualized through a bar chart and word cloud.

Step 3 is Topic Modeling (Thematic Analysis). The model's Latent Dirichlet Allocation (LDA) training is used to uncover thematic structures, with visualization and coherence scores to determine the optimal number of topics (Blei et al., 2003).

Step 4 is the Topic’s Interpretation. Qualitative Analysis used ChatGPT-4, a large language model part of the GPT (Generative Pre-trained Transformer) architecture (Ren et al., 2021; Vaswani et al., 2017), which utilizes Deep Learning techniques to understand and generate human-like text, and external sources for iterative analysis and interpretation of identified topics. Generation of Independent Responses and Comparative Analysis used independent generation and comparison of interpretations to assess consistency and accuracy. Synthesis of Interpretations uses the integration of consistent themes and insights from the comparative analysis into a final set of interpretations.

This third block stands out for its data-based approach to textual analysis, utilizing quantitative (frequency analysis, topic modeling), Artificial Intelligence, and qualitative

(interpretative analysis) techniques to explore the notion of urgency in project management literature. The process is designed for reproducibility and validation, with steps to ensure data integrity and the reliability of findings.

1.4.4. Methods, Techniques, and Framework of the Fourth Block (Article 4)

This methodological block (Article 4) unfolds in two parts, each with a distinct focus, designed to understand and model the dynamics of urgency in project management, particularly how urgency interacts with speed, cost, and duration in projects. It combines a literature review with theoretical modeling to explore, articulate, and illustrate the analytical dynamics of urgency in project management.

First, the Literature Synthesis. The objective was to establish a theoretical basis by exploring the literature database from previous blocks on project urgency and its interaction with the key dimensions of this article: speed, cost, and duration. The results of this literature synthesis are presented in the background theory section of the article.

Step 2 is Theoretical Model Formulation. The aim is to develop a unified model representing the interactions among project urgency, execution speed, total cost, and duration in urgent projects. The Variable Definition identified and defined the variables of interest (Urgency U, Duration D, Speed V, and Cost C) with constraints ensuring non-negativity. Then, there is Model Development. The General Urgent Projects Analysis Model formulates abstract mathematical functions to capture the relationships among variables, focusing on the rate of achieving project objectives (speed) and its significance in urgent projects. The Economic Speed Model Extends the General Model by incorporating cost implications (Wearne and White-Hunt, 2014), highlighting the financial considerations of varying project speeds. Finally, the Unified PRoject Urgency and Economic Speed Analysis Model (or simply PRUES model) integrates the General and Economic Speed Models into a comprehensive framework, offering a quadrant-based visualization to underscore the interplay among urgency, speed, cost, and duration.

The approach moves from a broad literature synthesis to the focused development of a unified model, aiming to provide an understanding of how urgency impacts and is impacted by project speed, cost, and duration.

1.4.5. Methods, Techniques, and Framework of the Fifth Block (Article 5)

This block (Article 5) employs a methodological approach combining case study analysis (Yin, 2018), risk assessment and analysis (Li et al., 2018; Raftery, 2003; Sanchez-Cazorla et

al., 2016), and theoretical framework development to research an urgent Open Innovation (OI) project within the context of the COVID-19 crisis. The methodology is structured into three parts, each contributing distinct insights and analysis towards understanding and managing urgent projects in a Quadruple Helix (QH) model. It provides a view of the dynamics among stakeholders, risk management, and theoretical implications in the context of urgent innovation during crises.

First, the Case Study Analysis. The objective is to gain insights into the dynamics, characteristics, and lifecycle of an urgent agile project through an empirical case study (Yin, 2018). The Data Collection was conducted through interviews with leadership positions across the four helices: Academia, Society, Government, and Industry. The Analysis Approach used inductive analysis (Gioia et al., 2013) focusing on emergency initiatives for PPE development in Brazil and tracking the super rapid formation of the QH model. The outcomes present a detailed timeline of project development, identification of key dimensions of the QH model, and development of a visual framework illustrating the project's lifecycle and stakeholder interactions.

Next, the Risk Assessment and Analysis. The objective is to identify and analyze potential risks associated with the urgent project from stakeholders' perspectives across each helix. The Data Collection used semi-structured interviews to gather perceptions of risks and their impacts (Dryhurst et al., 2020; Duan et al., 2020). Risks were identified (Markmann et al., 2013) and categorized, with their probability and impact assessed through qualitative and semi-quantitative methods (Cagliano et al., 2012; Ni et al., 2010). The outcome is the development of a risk matrix (Li et al., 2018; Ni et al., 2010) to visualize (Qazi and Akhtar, 2018) and prioritize risks (Cagliano et al., 2012), analysis of internal vs. external risks (Richert and Dudek, 2023), and suggestions for risk mitigation strategies based on project lifecycle and stakeholder interactions.

Third, the Framework Development. The objective is to advance the theoretical framework of the Quadruple Helix model (Pirlone et al., 2020) by integrating risk management principles based on the empirical data gathered from the case study and risk analysis. We examine and refine the framework, focusing on the micro-dynamics of Open Innovation (Yun and Liu, 2019). The outcome is a novel framework that enriches the understanding of urgent OI processes, integrating risk analysis with the QH model to map the micro-dynamics of OI and provide a comprehensive view of project management in urgent contexts.

1.4.6. Methods, Techniques, and Framework of the Sixth Block (Article 6)

The sixth block employs an approach combining qualitative data collection, risk assessment and analysis, and developing mitigation strategies for terrestrial mapping projects. The research design is characterized by its approach to identifying, assessing, and addressing risks in a large-scale, innovative technology project. This method unfolds in three distinct parts.

First is the Data Collection for Risk Identification. The objective is to gather perspectives on perceived risks in the Amazon Mapping Project through qualitative interviews. We conducted interviews across different project roles, such as managers and area coordinators. The question script was designed to probe the challenges and risks at the project lifecycle phases. The interviews were carried out via videoconference, recorded, and transcribed for analysis.

Part 2 is the Risk Assessment and Analysis. The objective is to assess the probability, and temporal and urgency impacts of identified risks using structured interviews and to visualize these risks through a risk matrix (Qazi and Akhtar, 2018). It re-engaged interviewees to evaluate the probability and impact of each identified risk using a defined scale. Next, it constructed a risk matrix to visualize and prioritize risks based on their assessed impact and probability (Li et al., 2018), employing a multiplication formula for risk index calculation (Ni et al., 2010).

Finally, Part 3 is the Development of Mitigation Strategies (da Penha et al., 2024). The objective is to propose strategies for mitigating high-priority risks in terrestrial mapping projects. It developed mitigation plans targeting each high-priority risk, focusing on mitigating risk likelihood and minimizing impact.

Using a risk matrix for visualization and prioritization, followed by formulating targeted mitigation strategies, provides a practical approach for managing temporal risks in complex mapping projects. This methodological approach offers a blueprint for temporal risk management in similar large-scale mapping projects and its impacts on the degree of urgency of the megaproject.

1.4.7. Methods, Techniques, and Framework of the Seventh Block (Article 7)

The last methodological block (Article 7) uses the previous results (from blocks 1 to 6) and revisits the entire literature database of this Thesis, from the Systematic Literature Search (block 1), through the Systematic Literature Review combined with the Snowball approach (block 2), theoretical discussion related to urgent project themes, such as Stakeholders and Crisis Management theory (block 3), and articles related to urgency, crises and emergencies

(block 5). From this, it synthesizes the initially fragmented literature on the topic (da Penha and ten Caten, 2023b, 2023a) and proposes a practical framework for managing urgent projects. The synthesis aims to extract, collate, and analyze data from the selected literature and this research to develop a comprehensive guide for managing urgent projects. To achieve this, inductive coding was used for systematic data extraction, leading to the identification of themes and principles. It then conducted a synthesis into graphical frameworks structured around key areas of knowledge to organize the coding of the literature. Finally, we offer a detailed guide to managing urgent projects.

1.5. THESIS STRUCTURE

The structure of the Thesis is presented in the research framework (Figure 1.2), which outlines the flow of the Ph.D. Thesis aimed to address the General Research Question of how to manage urgent projects. The overall flow provides a structured progression of the Thesis, from identifying the research gap and the Research Question, literature review to empirical studies and, finally, developing a practical framework for managing urgent projects. This research consists of a paper-based Thesis structured in 9 (nine) chapters: an introduction, 7 (seven) articles, and a conclusion. It is separated into 4 (four) main modules: exploratory and planning component, conceptual component, empirical component, and framework development component.

In the exploratory and planning component, the Thesis identifies research gaps, formulates the Research Question on the management of urgent projects and develops the structured approach to the research, with the division into chapters that, although conceptually interconnected, can be read independently.

In the conceptual component of the Thesis, Article 1 starts by providing a Lexical Semantic Analysis and Literature Search to define "urgent projects," laying the conceptual groundwork. Following this, Article 2 performs a Systematic Literature Review and a Snowball approach to capture urgent project characteristics, themes, and future challenges. Article 3 uses computational text-mining to uncover critical themes related to urgency, establishing a foundation for exploring new variables and themes. Building on this, Article 4 formulates a theoretical model, proposing a unified approach.

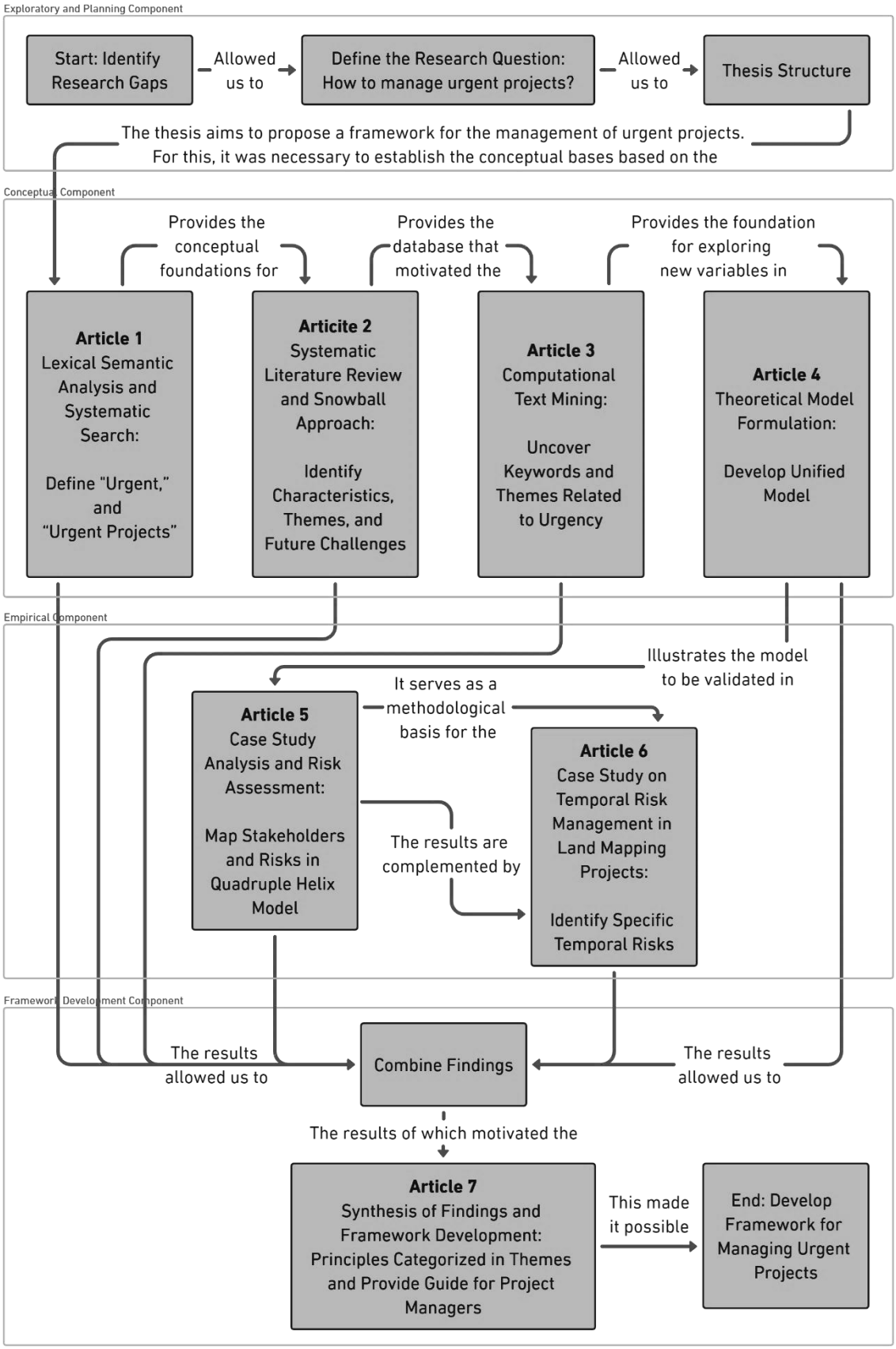

Figure 1.2 - Research framework, from identifying the research gap to developing the framework for managing urgent projects.

The research moves into an empirical component with Article 5, which involves a case study analysis and risk assessment. This article validates the previously developed model mapping the stakeholders and risks within the Quadruple Helix Model, serving as a methodological foundation for the next paper. Article 6 presents a case study focusing on temporal risk management in land mapping projects, identifying specific temporal risks. This empirical investigation contributes to the overall research objective.

In the framework development component of the Thesis, the ultimate objective is to create a structure for handling time-sensitive projects by incorporating information from all studies. This effort culminates in Article 7, which synthesizes principles across themes to provide a guide for project management professionals. The end result of the Thesis is a unified framework for managing urgent projects. This structure gives logic and connection between the articles and allows novel findings on urgent project management.

1.5.1. Chapter One

Chapter One is this Thesis Introduction. It begins with problem identification. First, the Thesis contextualization positions the urgency domain and its relationship with the complex project management research field. It provides an overview of the specific challenges encountered in handling time-sensitive projects. Next, it identifies the Thesis' research problem and the research gaps, where the Thesis begins. The introduction emphasizes the critical importance of managing urgent projects within the Brazilian context. Then, it presents General and Specific Research Questions and the primary and specific aims, which serve as the foundation for the subsequent chapters. It follows the justification and benefits of this research, the research design, and, finally, this Thesis structure (Figure 1.2) to address the Research Question.

1.5.2. Chapter Two (Article 1)

Chapter Two is a conceptual paper (Article 1). It addresses the lack of a clear definition and understanding of "urgent projects" in project management, highlighting that existing research has not adequately clarified what makes a project "urgent." To bridge this gap, the research utilizes Theory Synthesis. It starts with a focus on Lexical Semantic Analysis (LSA) to understand the term "urgent," a Systematic Literature Search (SLS) to explore how urgency is applied in management literature and integrating these findings to define "urgent project." The methodology allows for an in-depth examination of urgent projects' semantical and practical aspects. This chapter's main contributions are identifying a wide range of

interpretations of urgency, alongside a detailed discussion of the challenges and qualitative factors significant for managing urgent projects. It also outlines inconsistencies and consistencies in the current academic discussions on the topic. In the end, this chapter concludes with a definition and conceptualization of urgent projects.

1.5.3. Chapter Three (Article 2)

The Systematic Literature Review is executed in Chapter Three (Article 2). It focuses on the absence of a consensus on the theoretical boundaries and core concepts of managing urgent projects. Despite the theme's importance, a comprehensive and current literature review on urgent project management was lacking. This paper combines a Systematic Literature Review (SLR) with a Snowball approach to codify characteristics of urgent project management, categorizing them into themes for a comprehensive understanding. It aims to clarify essential concepts and understand how urgent projects are managed from the scientific literature's perspective. The investigation identified 396 publications, refined this to 105 relevant studies, and highlighted six characteristics of urgent projects and 69 management characteristics across 14 themes, such as risk, stakeholders, and teams.

Note that Articles 1 and 2 are closely related, as both seek to improve understanding of urgent projects within the scope of project management. While Article 1 reveals a more precise conceptualization of urgent projects, Article 2 reviews existing literature to gather urgent project management characteristics and approaches, thereby advancing theoretical and practical understanding of the field. Furthermore, the paper initiates a discussion on urgent project concepts. It outlines 26 future challenges in the field, emphasizing the need for a deeper understanding of urgency and its management.

1.5.4. Chapter Four (Article 3)

This chapter (Article 3) continues the analysis of the previous chapter, assessing aspects of managing urgency in projects within the project management literature, this time acting in the gap of computational analysis of textual data. Current research has not utilized computational techniques to analyze the concept of urgency. To fill this void, the study employs text-mining methods, specifically Word Frequency Analysis and Latent Dirichlet Allocation (LDA), to examine academic writings. The analysis includes 105 academic documents from Chapter Three (the database from the literature review), extracting 1353 sentences with the terms "urgent" or "urgency," covering the literature from 1973 to 2022. A total of 4440 preprocessed words were analyzed, revealing key terms such as "unexpected," "time," and

"stakeholder." Additionally, LDA identified twelve distinct themes related to managing urgent projects.

Note that while Word Frequency Analysis in Article 3 provides a quantitative basis by identifying which terms are most prevalent in the corpus of urgent projects, it complements the Lexical Semantic Analysis (Article 1), which offers qualitative insights into the meanings and nuances of urgency. Articles 2 and 3 are also closely connected, as they both focus on improving the understanding of urgency in projects. While Article 2 analyzes existing literature to identify key features and themes of urgent project management, Article 3 adopts a data-driven approach, thus complementing and extending the conclusions of Article 2 with new insights derived from the publications database academics on the topic. The primary contribution of this chapter is the advancement of project management knowledge through a novel, data-driven exploration of urgency in projects.

1.5.5. Chapter Five (Article 4)

This chapter (Article 4) addresses variables not explored in previous chapters. It focuses on the insufficiently explored impact of urgency on project management, particularly the lack of a theoretical model that integrates urgency with essential variables of speed, duration, and cost. Previous research has not elucidated the interaction among these variables, leaving a gap in the understanding and management of High-Intensity and extremely Time-Sensitive Projects introduced, discussed, and theorized in this chapter.

To address this, the paper employs a dual-method approach, beginning with a literature search of key articles from the Scopus database to understand the interactions of these four variables of interest. It then proceeds to formulate a Unified Theoretical Model, named the Unified PRoject Urgency and Economic Speed Analysis Model (PRUES model). This model offers a mathematical and theoretical basis designed to assist in managerial decision-making by delineating the relationships between urgency, project duration, speed, and costs.

The contribution of this chapter lies in developing an abstract theoretical model that enhances the theoretical foundations of urgent project management presented in previous chapters. It introduces the “High-Intensity Time-Sensitive Projects” concept, offering theoretical insights for academics and analytics for project management professionals. At the end of the article, there remains a research gap regarding the empirical evidence of the theoretical framework in the management of extremely urgent projects, which is answered in the following chapter.

1.5.6. Chapter Six (Article 5)

This chapter (Article 5) empirically analyzes a High-Intensity and Extremely Time-Sensitive Project. To this end, it addresses the gap in understanding how the Quadruple Helix model — involving Government, Academia, Industry, and Civil Society — can support extremely urgent Open Innovation projects, as occurred during the COVID-19 pandemic crisis in Brazil. Current research lacks empirical evidence on the complex interactions and risks of such collaborations in emergencies. The study employs a mixed-methods approach, including case study analysis, risk assessment, and theoretical framework development, to analyze the project's lifecycle, focusing on trust, collaboration, communication, and agile practices among stakeholders. It also conducts risk analysis, identifying thirty-two risks across diverse domains, categorizing them based on severity, and offering a novel framework for managing urgent innovation projects within the Quadruple Helix context.

Article 5 reinforces the concepts of urgency presented in Article 1, nonetheless highlighting the project's work intensity that requires immediate attention and action due to critical or urgent circumstances. Furthermore, it explores in depth the three essential concepts presented in Article 2; delves deeper into the central topics of current literature presented in Article 3, namely time, stakeholder's urgency, and risks; and validates the High Intensity and Time Sensitive Projects modeled in Article 4. The main contributions are the empirical exploration of stakeholder collaboration in crisis situations, identifying and managing associated risks, and developing a risk mitigation framework for guiding urgent Open Innovation projects. Therefore, Articles 4 and 5 relate to each other by exploring the management of highly time-sensitive projects. These articles provide a comprehensive overview of managing High-Intensity, extremely Time-Sensitive Projects, from theory to practical application.

1.5.7. Chapter Seven (Article 6)

This chapter (Article 6) addresses the challenge of managing temporal and urgent risks in large territorial mapping projects, an unexplored area in current research, especially in megaprojects such as "Amazon Radiography." Existing literature primarily focuses on the scientific and technological risks of radar imaging, neglecting the project management risks that can impact the schedule and urgency of these gigantic endeavors. The methodology employs a qualitative approach, gathering data through interviews and document analysis to understand risk perceptions among project participants. The study's main contributions are:

offering a new view on temporal risk management in the context of megaprojects and proposing risk mitigation strategies based on temporal impacts and the urgency of terrestrial mapping megaprojects.

This article explores another case study, focusing on temporal risk management within the project, which can change the project's urgency. With this, the article explores the different degrees of urgency within the project, as explored in Article 1, and the concept of Dynamic Urgency, presented in Article 2. Thus, this article empirically explores a case in which the project was not designed to be urgent. However, urgent final and intermediate deadlines make the team feel that they are constantly working on (expected/foreseen) urgent projects.

Notice that Articles 5 and 6 are related by their focus on managing large-scale projects under conditions of urgency. Project risk management helps identify and prioritize risks that may arise due to time constraints. While Article 5 explores stakeholder collaboration and innovation in an urgent project within the Quadruple Helix model, Article 6 explores aspects of risk management not explored in the previous article, highlighting strategies to mitigate temporal risks in large-scale territorial mapping projects, thus complementing discussions on project management strategies under urgent conditions.

1.5.8. Chapter Eight (Article 7)

This chapter (Article 7) addresses the gap in project management literature concerning the lack of a designed approach for managing urgent projects with immediate action requirements and time-sensitive deadlines. Current research primarily focuses on methodologies such as Waterfall and Agile, leaving a void in strategies designed explicitly for expedited projects. The article combines the conclusions of the literature and this Thesis, synthesizing the practical principles used in managing urgent projects. The main contribution of this paper is developing a novel framework designed to manage the complexities of time-sensitive projects. This framework encompasses principles and practical implications, organized into 18 themes: financial management, stakeholder engagement, communication, time and resource allocation, risk and uncertainty management, adaptability, leadership, and organizational change. Furthermore, it discusses the dilemmas faced in managing urgency. This paper is written for project management professionals, enabling them to enhance their capabilities to execute projects within strict deadlines, providing original value and practical insights in the urgent domain of project management.

1.5.9. Chapter Nine

The concluding chapter of the Ph.D. Thesis summarizes the main conclusions of the research, addresses the research objectives presented in the introduction and in the articles that make up this Thesis, and highlights its contributions to the field of project management. The chapter describes the development of the Thesis, from the definition of urgent projects to the identification of management strategies in different contexts. This synthesis integrates conceptual and theoretical models, case studies, and a practical guide to managing urgent projects. Furthermore, this chapter shows the main research limitations and challenges for future research, which involve urgent project management at the individual, project, and portfolio levels.

2. ARTICLE 1: UNDERSTANDING URGENT PROJECTS: UNRAVELING MEANINGS AND MANAGEMENT CHALLENGES

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Abstract:

This paper addresses the research gap concerning the definition and understanding of "urgent projects." The aim is to clarify the conceptual underpinnings and implications of the term "urgent" in project management. Utilizing Lexical Semantic Analysis, the article investigates the meanings attributed to the word “urgent.” Then, a Systematic Literature Search was conducted, exploring 378 studies, and focusing on 65 that are most relevant. Through this methodological framework, the research spans the semantic nuances and practical considerations associated with urgent projects. Results indicate a range of interpretations of urgency, as well as a set of challenges and qualitative aspects to managing urgent projects. The paper identifies both inconsistencies and consistencies in the existing academic discourse. Finally, by offering a refined definition, the study serves as a point of reference for both researchers and practitioners.

Keywords:

Urgent Projects; Urgency; Project Management; Time Management; Speed

Article 1

Understanding Urgent Projects: Unraveling Meanings and Management Challenges

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ABSTRACT: This paper addresses the research gap concerning the definition and understanding of "urgent projects." The aim is to clarify the conceptual underpinnings and implications of the term "urgent" in project management. Utilizing Lexical Semantic Analysis, the article investigates the meanings attributed to the word “urgent.” Then, a Systematic Literature Search was conducted, exploring 378 studies, and focusing on 65 that are most relevant. Through this methodological framework, the research spans the semantic nuances and practical considerations associated with urgent projects. Results indicate a range of interpretations of urgency, as well as a set of challenges and qualitative aspects to managing urgent projects. The paper identifies both inconsistencies and consistencies in the existing academic discourse. Finally, by offering a refined definition, the study serves as a point of reference for both researchers and practitioners.

Keywords: Urgent Projects; Urgency; Project Management; Time Management; Speed

RESUMO: Esta pesquisa aborda a lacuna acadêmica a respeito da definição e compreensão de "projetos urgentes." O objetivo é esclarecer as bases conceituais e implicações do termo "urgente" em gestão de projetos. Utilizando Análise Semântica Lexical, investiga-se vários significados atribuídos a palavra "urgente." Subsequentemente, uma Busca Sistemática da Literatura é realizada, examinando 378 estudos e focando nos 65 mais relevantes para a pesquisa. Por meio desse arcabouço metodológico, este artigo abrange as nuances semânticas e considerações práticas associadas a projetos urgentes. Os resultados indicam uma gama de interpretações de urgência, bem como um conjunto de desafios e aspectos qualitativos para gerir projetos urgentes. O artigo identifica tanto inconsistências quanto consistências no discurso acadêmico existente. Finalmente, ao oferecer uma definição refinada, o estudo serve como um ponto de referência para pesquisadores e profissionais.

Palavras-chave: Projetos Urgentes; Urgência; Gerenciamento de Projetos; Gerenciamento de Tempo; Velocidade

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2.1. INTRODUCTION

The emergence of projects under unforeseen circumstances, precipitated by catastrophic events, has been observed in various moments of recent history. Notable examples include: (i) The devastating rupture of a dam in Brumadinho, Brazil, in January 2019, resulting in a tragic loss of over 250 lives; (ii) The unprecedent COVID-19 pandemic, which inflicted more than 35,231 documented deaths in Italy, as of August 13, 2020, as reported by Mirri et al. (2020), and millions more worldwide; and (iii) The fateful 9/11 terrorist attack that compelled the initiation of the projects to sift, secure, and remove 1.6 million tons of rubble, dangerous structural elements, and other debris to search for survivors of the New York World Trade Center tragedy, as studied by Wearne (2006) and presented by Wearne and White-Hunt (2014).

Such extreme contextual events often serve as catalysts for urgent projects. Nonetheless, there is no consensus on the definition of urgent projects in the management domain (Zidane et al., 2018). Wearne and White-Hunt (2014) and Nachbagauer (2022) discuss the subjective nature and social construction of urgency. Thus, the term "urgent" can be subject to varying interpretations depending on the individual authors' perspective and the nuances of everyday language. The need for swift action is frequently highlighted as a defining characteristic of urgent projects (Wearne, 2006; Wearne and White-Hunt, 2014; Nachbagauer, 2022), but the standards used to evaluate "immediacy" across diverse project categories have not been sufficiently researched. Hence, a thorough exploration of the concept of urgent projects necessitates careful consideration.

Considering the contextual relevance of the topic (such as the rupture of a dam, pandemics, and terrorist attack), and the absence of a technical consensus on the definition of an urgent project, *our hypothesis posits that the term "urgent project" in the scientific literature would be interpreted from different points of view so that the authors understand the meaning of what is urgent, leading to varying understandings of its underlying implications*. To fill this gap of unprecise comprehension and seeking to discern how urgent projects differ from conventional designs, the following Research Question (RQ) is reached in the conceptual field: *What is an urgent project?* In response, this conceptual article aims to meticulously examine the term "urgent project" as a focal concept not adequately addressed in the existing literature (Jaakkola, 2020), promoting a more cohesive and coherent understanding of such projects.

To achieve this aim, we employ two complementary approaches: (i) Lexical Semantic Analysis (LSA); and (ii) Systematic Literature Search (SLS). By following these methods, we aim to provide reliable insights into the concepts of "urgency" and "urgent projects," by examining the conceptual nuances of urgency and refining its definition to align with scientific perspective in the project management domain. As "urgent" is a common knowledge word and not a specific scientific concept, we specifically opted for LSA due to its inherent connection among language usage, individuals' worldviews, and attitudes (Almarwaey and Ahmad, 2021). Moreover, LSA offers fundamental principles (or conceptual truths) of what is urgent, a notion equally pertinent in the management domain. The SLS gives context in which the word "urgent" is used in the management body of knowledge. It focused on the top-tier management scientific literature.

The fusion of the LSA and SLS facilitates the development of a cogent argument for comprehending the focal concept, and crafting a precise (unambiguous) definition of the term suitable for the project management context and the broader management domain. Our approach analyzes the existing concept of the term "urgent" (and "urgency") in dictionaries, as well as previous definitions and concepts of "urgent project" from the top scientific literature. This integrative process gives complementary value (Jaakkola, 2020) enriching the conceptualization of urgent projects. We combine these levels of understanding to develop a solid conceptual foundation in the field of urgent project management. Our focus lies in the purposeful conceptualization of urgency itself within the context of projects and in building a conceptual definition for urgent projects, not in the conceptualization of projects, which has already been extensively explored in an extensive body of knowledge.

This conceptual paper contribution enriches the management literature in several key aspects. Firstly, it synthesizes diverse conceptual perspectives, shedding insights into the essence of a projects' urgency. Secondly, the Lexical Semantic Analysis offers insights into the meanings and nuances of "urgent," enabling a consistent approach in dealing with varying degrees of urgency within urgent projects. Third, the Systematic Literature Search identifies challenges, diverse perspectives, and management approaches in addressing the critical nature and high uncertainty inherent in urgent projects. Fourth, this research formulates a concept elucidating urgent projects' nature, finely positioning the conceptual definition within the management domain. This work pushes the frontiers of Project Management Theory by offering valuable insights to practitioners and researchers in managing and studying urgent projects.

2.2. RESEARCH METHOD

The foundation of our research design is grounded in the Theory Synthesis presented by Jaakkola (2020), which presents a comprehensive approach to concept exploration. The planning stage has delineated the conceptual research strategy, elucidating how and why the methods and concepts were selected to answer the Research Questions (RQ). Our study aims to have a deeper conceptual understanding surrounding urgency within a project context, an aspect that has received inadequate attention in the existing literature. To achieve this, we employ a conceptual approach, from the initial steps of concept selection to the ultimate theoretical inferences.

The conceptual approach, as per Jaakkola (2020), starts from a focal phenomenon that is observable but not adequately addressed in the literature. Through a selection and examination of literature that engages the concept, we discern and explicate aspects that contribute to our conceptualization (Jaakkola, 2020). With a clear logical sequence for the conceptualization of an urgent project, we search for meaning and previous definitions on the subject to the data analysis.

The conceptual approach is structured into three distinct steps, as enumerated in Table 2.2. The first step involves elucidating the fundamental principles of what is "urgent." Based on the linguistic resources, we explore and analyze the characteristics and connotations of the term "urgent." By analyzing the various perspectives, we build a groundwork for the subsequent analyses. The second step investigates the top-tier scientific literature perspective of what is urgent within the projects' contextual domain, exploring the utilized keywords, and investigating the definition of urgent projects. This exploration aids in situating our concept amidst existing project management theoretical frameworks. Finally, the last step culminates in a conceptual synthesis, postulating the core tenets of urgent projects, therefore, inferring the fundamental idea of what is an urgent project.

Table 2.2 - Research Design: Research steps, General and Specific Research Questions, and specific research aims.

Research Steps	General and Specific Research Questions	Specific Aims
Step 1: Lexical Semantic Analysis in Dictionaries.	SRQ1: What is the meaning of urgent?	It searches and discusses the behavior of the string "urgent."
Step 2: Systematic Literature Search in Top management scientific articles.	SRQ2: What keywords are used in the management research field in the context of urgency?	It performs keyword analysis based on the incidence of the terms "urgent" and "urgency" in titles and abstracts to understand the use of the words.
	SRQ3: What is the definition of an urgent project in the management literature?	It searches for the behavior of the strings "urgent" or "urgency," and "urgent project."
Step 3: Urgent Project Definition combining SLS and LSA.	RQ: What is an urgent project?	It develops the general definition of an "urgent project" based on steps one and two.

2.2.1. Step 1: Lexical Semantic Analysis

The analysis begins by collecting data from various dictionaries that provide meanings of the word "urgent," although the concept of meaning itself is abstract (Aslam and Chaman, 2020). In this case, the dictionaries used are Collins British and American English, Oxford, Cambridge, and Collins Cobuild. In order to address the Specific Research Question 1 (SRQ1), the data collection is grounded on the lexical semantics of

the English language, with the central tenet that the meaning of a word can only be captured in its relation to the meaning of other words (Engelberg, 2011).

In the pursuit of comprehending the concept of "urgent," this part draws upon the Lexical Semantic Analysis (LSA) - (Almarwaey and Ahmad, 2021; Aslam and Chaman, 2020; Vanhove, 2008). It was chosen because no lexical semantic study explicitly addresses the word "urgent," and the lack of a precise urgent project definition in the top scientific management literature, as observed by Zidane et al. (2018). To address this void, the data analysis to the SRQ1 followed the method presented by Almarwaey and Ahmad (2021). We focused on the key aspect of the definition within Lexical Semantic Analysis and its ability to explore the nuances of the term "urgent."

This investigation delves into their definitions of the words and explores their associated meanings in dictionaries and linguistic nuances (Almarwaey and Ahmad, 2021), despite theories of lexical decomposition assume that lexical meanings are complex (Engelberg, 2011). This analysis intends to fully understand the concept and pursuit go beyond boundaries of conventional dictionary interpretation attempting to bridge the gaps by aligning practical, conceptual, and theoretical perspectives. This guides how to think about urgency in the next steps of the research.

2.2.2. Step 2: Systematic Literature Search

The Systematic Literature Search (SLS) is based on Xiao and Watson (2019) and divided into two parts.

The first one aims to explore the keywords employed in the management research field, elucidating the context of urgency, linked to the Specific Research Question 2 (SRQ2). Performing a comprehensive keyword analysis, with a particular emphasis on the frequency of the terms "urgent" and "urgency," thereby gaining valuable insights into their contextual application, and to the urgent project management discussion. It analyses data from titles and abstracts.

The second part aims to extract the urgent project definition in the management literature from a practical and/or theoretical perspective (SRQ3) based on the full-test analysis, thus being more specific on the conceptualization of urgency within project management. In addition, it aims to dissect the different authors' points of view of what constitutes an urgent project. Such an approach improves our understanding, unraveling its core tenets and significance in the management domain.

In this pursuit of knowledge, we searched the scientific papers repository from Scopus database until July 2023. Utilizing the literature identification presented by Xiao and Watson (2019), we conducted the search within the article titles, abstracts, and keywords, employing the strings "urgent" OR (boolean operator) "urgency," in conjunction with the logical operator AND with the term "project*." The asterisk " * " replaces multiple characters in a word, endowing our search with the ability to find not only the term "project" itself but also its variations, such as "projects" and "projected", among others. It resulted in 10,931 documents.

In conducting the first quality and eligibility assessment, we focused on the top scientific journals. As a result, it excludes conference papers, reviews, books and book chapters, editorials, notes, short surveys, letters, conference reviews, abstract reports, data papers, erratum, and reports from consideration. The preliminary list of the search query had 6,719 publications. This commitment to maintaining the top scientific journals ensures the credibility of the findings.

Upon the application of the inclusion criterion, we exclusively retain the corpus of the management literature, encompassing business, management, and accounting. The duplicated (one reprinted) and retracted articles were excluded, resulting in a refined set of 378 potential studies for the initial database. We have successfully obtained the complete references, including authorship, year of publication, title, abstract, and the respective publication name for further evaluation.

In screening for inclusion, we conducted screening procedures to identify articles pertinent to our research. Firstly, from the title-abstract analysis of these articles, the papers that failed to cite one of the strings were excluded (exclusion 1 – E1). Following this step, it left 311 relevant articles. Moving forward, we searched and investigated the strings "urgent," "urgency," "project," and "urgent projects" (exclusion 2 – E2). This involved identifying and exploring the usage and context of the words. Our approach led us to not include the studies when: (i) the word "urgent" appeared without an explicit connection to the word "project" within the title or abstract (e.g., contextualizing and closing the research); or (ii) the word project was used in an unrelated context. As a result of this criterion, several articles were deemed irrelevant and were excluded from our analysis. After applying these procedures, it left 91 deemed relevant studies for full-text quality assessment. To ensure accuracy and quality in our analysis, we employed additional relevance and availability criteria (exclusion 3 – E3). As a result of this evaluation, the final list had 65 articles for title-abstract keyword analysis to further evaluate the studies' quality and eligibility.

Data extraction and analysis for the first part of the SLS (SRQ2) was conducted with a focus on the keyword analysis. The selected papers were carefully reviewed, and a data matrix was developed, considering the incidence and context of the strings "urgent" and "urgency" in the management literature, specifically focused on titles and abstracts. This approach has enabled us to explore the prevalence and various contexts surrounding "urgent" and "urgency" in the management literature, and their implications.

In the second part of the examination (SRQ3), a meticulous assessment of quality and eligibility was undertaken. Articles exclusively focused on urgent projects were retained. Through a full-text analysis (exclusion 4 – E4), 4 (four) articles specifically addressing urgent projects within the management research field were selected. The process of data extraction and analysis identified the most comprehensive literature with the examination of the full articles, aiming to accurately define an urgent project. This research did not search for words that do not precisely qualify the project. The findings of the investigation are discussed in the specific section.

2.2.3. Step 3: Integrating Current Understanding

The third step of this research dedicates to defining and conceptualizing an urgent project following the framework presented in Figure 2.3. The combined methods avoid having an accepted concept in a particular domain but being rejected in another (Almarwaey and Ahmad, 2021), thereby it can provide a double-level insight. To address our Research Question, the conceptual definition strategy draws upon the precision of the words' semantics presented in dictionaries (so-called denotative meaning, i.e., the literal meaning of words), combined with the denotative meaning of the data analysis of the literature from scientific databases. Thus, it crafts a precise conceptualization that aligns both practical and theoretical perspectives.

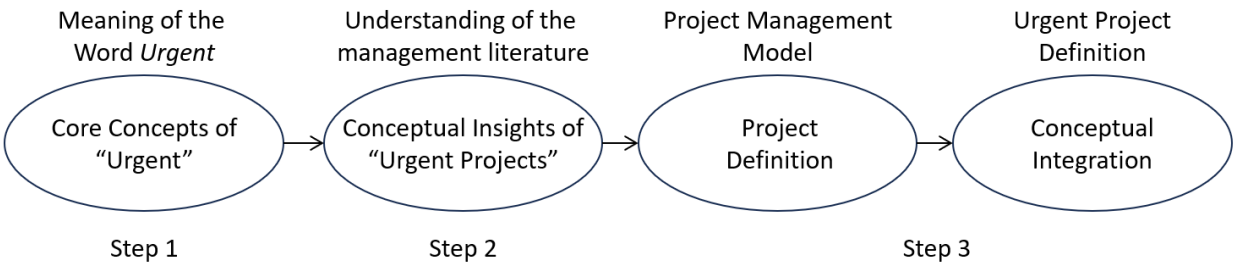

Figure 2.3 - Framework to define urgent project.

Based on the findings of the Lexical Semantic Analysis, we compare the meanings of "urgent" as presented by the dictionaries and their nuances for the term. It looks for

patterns and recurring concepts related to the word "urgent." This semantic part is essential to examine the meanings and nuances of the word "urgent," based on commonalities and core concepts to understand and contextualize the term "urgent project" from the level of the words to the level of a technical management definition answering the Research Question (RQ). It implies establishing a new conceptual frame of reference for what is urgent (Figure 2.3) then contextualizing the findings associated with urgent projects within the project management domain.

To integrate the current understanding within the management domain, we turn our attention to the repository of knowledge on this subject. Next, we use the more relevant project management framework emerged from the literature review to give the project context necessary for this conceptual research. In this manner, it uses conceptual integration across multiple views to answer the Research Question, while offering a concept based on previously unconnected pieces (Jaakkola, 2020).

For a comprehension of the concepts at hand, the context and the discourse are essential for the meaning of words (Aslam and Chaman, 2020; Vanhove, 2008). Hence, we combined the two data collections, from the Systematic Literature Search and the Lexical Semantic Analysis, along with the project management definition to craft a contextualized definition of an "urgent project." By initially anchoring the concept in the meaning of the term "urgent," we progress to the conceptual framework of the broader notion of "urgent projects." Finally, the urgent project definition serves as fundamental ideas, or pivotal constructs, within the project management domain.

2.3. RESULTS

The results explore the terms "urgent" and "urgent projects," considering their various interpretations as complementary approaches. Ultimately, these analyses are combined with a project management perspective, facilitating the definition and concepts of urgent projects. Our research explores various conceptualizations of the phenomenon to answer the Research Question and subsequently present our arguments, as presented by (Jaakkola, 2020). Table 2.3 presents the meanings of "urgent" in English dictionaries, keywords related to the meanings, core concepts, and implications.

2.3.1. Results of the Lexical Semantic Analysis

The Lexical Semantic Analysis (LSA) of the word "urgent" involves an exploration of its various meanings and nuances as presented in dictionaries (SRQ1). From the definitions of the Collins British and American English, Oxford, and Cambridge dictionaries, it is evident that "urgent" (adjective) means "very important and needing attention immediately" (Cambridge Dictionary, 2020), which "needs to be dealt with or happen immediately" (Oxford University Press, 2021). Going further, important means necessary (Cambridge Dictionary, 2021a), which means needed to achieve a particular result (Cambridge Dictionary, 2021b). Also, "requiring or compelling speedy action or attention" (Collins Dictionary, 2022). Therefore, from these dictionaries, urgent means (*strict definition*) *very important* (Cambridge Dictionary, 2020) *that needs to happen immediately* (Oxford University Press, 2021), *requiring speedy action* (Collins Dictionary, 2022) *in order to achieve a particular result* (Cambridge Dictionary, 2021b).

Nonetheless, there is a subtle variation in understanding when contrasting the "earnest and persistent" nature of urgency captured in British to the "haste" and "insistent" aspects in American English. Furthermore, there is a variation in understanding across dictionaries related to the importance in contrast to the necessity. The concept of importance is explicitly recurrent in definitions provided by Cambridge ("very important," and "especially before anything else, because important"), but implicitly recurrent in definitions provided by Collins and Oxfords dictionaries, both signifying "immediate attention or action." The term "urgent" implies an essential or necessary quality, wherein there is no optional or discretionary considerations, therefore,

it means that it is crucial and cannot be dismissed. Furthermore, as presented in Cambridge Dictionary (2021a), important means necessary, therefore, the concepts of importance and necessity are intertwined, culminating in the idea (core concept) of "Cruciality."

Table 2.3 - Meanings of "urgent," keywords, core concepts, and implications.

Dictionary	Meaning of "urgent"	Keywords	Core Concepts	Implications
Collins British English	"requiring or compelling speedy action or attention."	Requiring or compelling	Cruciality	If something is urgent, it requires prompt attention or action in its earnest and persistent nature.
		Speedy Action; Speedy Attention.	Speed	
	"earnest and persistent."	Earnest; Persistent.	Cruciality	
Collins American English	"calling for haste, immediate action, etc."	Haste	Speed	If something is urgent, it requires haste, compelling action, and insistent attention.
		Immediate Action	Time-Sensitivity	
	"compelling or requiring immediate action or attention."	Requiring or compelling	Cruciality	
		Immediate Action; Immediate Attention.	Time-Sensitivity	
	"imperative; pressing."	Imperative; Pressing.	Cruciality	
	"insistent or earnest in solicitation."	Earnest	Cruciality	
Collins Cobuild	"it needs to be dealt with as soon as possible."	Necessity	Cruciality	If something is urgent, time-critical action is required.
		As soon as possible	Time-Sensitivity	
Oxford Learner's	"that needs to be dealt with or happen immediately."	Necessity	Cruciality	If something is urgent, it requires immediate attention and resolution.
		Happen Immediately	Time-Sensitivity	
	"showing that you think that something needs to be dealt with immediately."	Necessity	Cruciality	
		Immediately	Time-Sensitivity	
Cambridge	"very important and needing attention immediately;" "needing immediate attention."	Very Important	Cruciality	If something is urgent, it needs attention immediately or very soon, before all else, because it is important.
		Need attention Immediately	Time-Sensitivity	
	"needing attention very soon, especially before anything else, because important."	Need attention; Important.	Cruciality	
		Very soon	Time-Sensitivity	
		Before anything else	Priority	

The divergences in understanding become apparent when comparing the strict interpretation with other meanings of what is urgent in the Collins Cobuild and the Cambridge Dictionaries (Table 2.3). They present the meaning of the word "urgent" in the everyday language shifting from "immediately" to "as soon as possible" or "very soon," respectively. This discrepancy holds practical implications for communication and comprehension. However, "immediate" denotes something that needs to be done or addressed without any delay, right away, or instantly. On the other hand, "as soon as possible" and "very soon" indicate that the action or task should be completed as quickly as it can be reasonably managed. Therefore, it acknowledges that some time may be needed to organize or complete the task.

From this Time-Sensitivity analysis, "immediate" suggests an extremely high level of urgency, emphasizing the need for instant action. It covers a sense of emergency or criticality. On the other hand, "as soon as possible" and "very soon" give a sense of urgency but allow a more flexible timeframe, recognizing that there may be practical considerations, and the task should be completed as quickly as realistically achievable. *This analysis conceptually and more realistically indicates different degrees of urgency*. Adverbs such as "extremely," "very," or "slightly" can be used to capture the time-sensitive need for action, depending on the urgency level.

Therefore, *"urgent" refers to something that is of highest importance, requiring immediate or as soon as possible attention and action, with a sense of criticality and nonnegotiability.* The term encompasses the intertwined concepts of importance and necessity, signifying the core essence of "Cruciality" in accomplishing the objectives. *The strict interpretation denotes instant action without any delay, similar to a sense of emergency, while the everyday language meanings acknowledge varying degrees of urgency, allowing for practical considerations in completing the task within the most realistic timeframe possible.* Finally, this analysis suggests a *strict definition* of what is "urgent" and that *urgency indicates the core concepts of Time-Sensitivity, Cruciality, Priority, and Speed, as well as the new concept of degree of urgency.*

2.3.2. Results of the Systematic Literature Search

Through the examination of the 378 potential studies, a refinement process led to a final selection of 65 articles, chosen for their relevance and significance for title-abstract analysis. This investigation reveals varying terms emphasizing urgency and yields insights into individual and qualitative aspects of urgency within projects (SRQ2). Notably, the researchers employ different terms to emphasize urgency. The term "urgent project" is manifested 15 (fifteen) times, followed by "urgent need" and "sense of urgency" six times each. Additionally, the term "urgent unexpected" emerges three times, suggesting its relevance to the subject. All other terms, such as "urgent action" and "perceived urgency," appear only once each, making them comparatively rare in the literature.

Consequently, this exploration generates two insights: (i) *The relevance of urgency at the individual level*, precisely encapsulating the concept of "sense of urgency" and "perceived urgency;" and (ii) *The qualitative aspect of urgency in the context of a project* qualifies and characterizes *necessity* ("urgent need"), and *expectancy* ("urgent unexpected"). Interestingly, the occurrence of the term "urgent project" appears to be mutually exclusive with "urgent need," signaling one more insight in conceptualizing urgent projects. This fact can (as presented in dictionaries) indicate different degrees of urgency related to projects from the scientific authors' point of view.

Strikingly, analyzing the concept of expectancy, the papers reveal a prevalent usage of "urgency" in the context of expected projects (Leung et al., 2016; Økland et al., 2018), which do not necessarily imply immediate action. They commonly use the word "urgency" focusing only on the meaning "as something to be done," which brings the aspect of an urgency to an expected work or action necessary to be done as soon as possible or even belatedly, e.g., as presented by El-Anwar and Aziz (2014). In their respective studies, Wearne and White-Hunt (2014) and Zidane et al. (2018) shed light on

the feasibility of fast-tracking projects that are both urgent and expected, and emphasize that the crucial factor enabling the fast-tracking of such projects is the presence of "known knowns." In summary, the literature affirms that *an urgent project embodies a time-sensitive pursuit arising from specific circumstances or constraints*. The interpretations of urgency showcase the interplay between time-sensitive considerations (ranging from immediate and prompt initiation to a more measured or belated approach), and expectations (expected or unexpected) inherent in urgent projects.

Table 2.4 - Relevant studies: Sources and urgent project implications.

Sources	Urgent Project Implications
(Nachbagauer, 2022)	Urgent projects demand immediate attention and action due to their criticality and high uncertainty, often occurring in complex and risky situations.
(Zidane et al., 2018)	Due to unexpected circumstances or business opportunities, urgent projects must be completed in significantly shorter durations.
(Wearne, 2006)	Managing urgent projects requires rapid acceptance of cost risks, top management involvement, and attention to stakeholders' interests.
(McDonough and Pearson, 1993)	The perceived level of urgency attributed to an urgent project can significantly impact the actions taken and influence project performance.
(Popa et al., 2011)	Urgent projects involve swift action, risk identification, and effective emergency management.
(El-Anwar and Aziz, 2014)	The integrated planning framework prioritizes and accelerates delivery of urgent slum upgrading projects based on each zone's current condition.
(Sun and Xu, 2011)	An urgent reconstruction project implies substantial investment and the need for an efficient post-disaster reconstruction system.
(Aram and Javian, 1973)	Urgent projects are high-priority endeavors that demand immediate attention and are characterized by their time-sensitive nature.
(Bingham et al., 2018)	Project urgency strongly influences the choice of the selection of project delivery methods.
(Hensmans, 2015)	Reciprocal sensegiving facilitates quick employee acceptance of urgent strategic change.
(Pan et al., 2010)	Urgent projects address prioritized service problems to enhance customer perceptions and expectations.
(Ren et al., 2018)	Urgent projects negatively impact inter-project communication and knowledge transfer in project-based organizations (PBOs).
(Sun et al., 2019)	Urgent projects in CPCNs drive knowledge transfer but require careful planning to avoid negative impacts.
(Tang et al., 2015)	Urgent projects have high importance and short completion times, with increasing costs as completion time extends.
(Xia and Chan, 2012)	Urgent projects with unrealistic schedules significantly increase project complexity, necessitating more resources and causing frequent design and construction changes, posing challenges for effective project management.
(Yim et al., 2015)	Urgent projects are prevalent in rework scenarios with significant time pressure or tight deadlines.

The term "urgent project" was manifested 15 (fifteen) times in titles and abstracts. The full-text analysis resulted in the identification of four main articles (McDonough and Pearson, 1993; Nachbagauer, 2022; Wearne, 2006; Zidane et al., 2018) which deal in more depth with the topic of urgent projects. Table 2.4 presents these papers, including data on the source, and urgent project implications. The findings reveal two articles published in the Project Management Journal (PMJ), with the remaining two originating from the International Journal of Managing Projects in Business (IJMPB) and The Journal of High Technology Management Research (JHTMR). Despite the limited number, it emphasizes the relevance of the PMJ in addressing this subject.

In urgent projects, Nachbagauer (2022) points out the immediate attention and action they demand due to their critical nature. These projects are characterized by a high level

of uncertainty and require rapid decision-making and coordination. They often arise in complex and risky scenarios such as disaster management, fast-response organizations, and innovation projects. In contrast, Zidane et al. (2018) argue that urgent projects must be completed in a significantly shorter duration than a similar project owing to unexpected circumstances or business opportunities. These projects require an entirely different project management approach, can be challenging to manage, require quick decision-making, and may involve high levels of risk. However, success for an urgent project is often measured by its timely delivery rather than its post-project evaluation. Wearne (2006) further elaborates that urgent projects emerge unexpectedly, necessitating immediate action to address new business opportunities, sudden threats, or severely damaged assets. Managing these projects involves quickly accepting cost risks, top management involvement, attention to stakeholders' interests, and trust in oral commitments. The urgency factor outweighs the cost of working at maximum speed when initiating them. McDonough and Pearson (1993) suggest that the perceived level of urgency for an urgent project, as seen by the corporation or project team, can impact the actions taken and influence project performance.

Similarities among the studies also suggest that urgent projects are characterized by high-priority status, but not all high-priority projects are urgent (Aram and Javian, 1973). Popa et al. (2011) emphasize the need for risk assessment and effective management of emergency situations. Aram and Javian (1973) stress that urgency is directly related to time sensitivity and the requirement for timely success. Bingham et al. (2018) highlight how urgency significantly influences the selection of project delivery methods. The implications of urgent projects on stakeholders and employees are also explored. Tang et al. (2015) demonstrate the importance of short completion times and their impact on project costs. Hensmans (2015) discusses the need for rapid strategic change in response to high stakes and time pressures on employees, proposing the use of reciprocal sense giving to gain acceptance effectively.

Popa et al. (2011) and Pan et al. (2010) both emphasize the importance of communication with stakeholders in urgent projects. Popa et al. (2011) mention the need to communicate with stakeholders during risk assessment, while Pan et al. (2010) highlight the significant implications of urgent projects for service improvement, which directly impact customers' perceptions and expectations. Aram and Javian (1973) and Tang et al. (2015) both focus on the importance and priority of urgent projects. Aram and Javian (1973) state that urgent projects require immediate attention and are considered high-priority. Tang et al. (2015) discuss the implications of urgency, emphasizing that urgent projects are characterized by high importance and a need for short completion times.

However, there are some contradictions in dealing with urgent projects. Such projects are characterized by high uncertainty (Nachbagauer, 2022) and demand quick decision-making (Zidane et al., 2018) at the same time. Managing uncertainties while making rapid decisions becomes a critical challenge. Furthermore, Nachbagauer (2022) and Zidane et al. (2018) contradict in the differing reasons for the urgency of these projects and in the perception of the time-sensitivity concept; Nachbagauer (2022) highlights the immediate attention required, while Zidane et al. (2018) emphasize the need for shorter durations. Wearne (2006) points out that the cost of working quickly is not a factor in deciding to initiate them, while Zidane et al. (2018) emphasize the challenges and high-risk nature of urgent projects. Therefore, Wearne (2006) and Zidane et al. (2018) present different perceived drawbacks of urgency, applying different perspectives on the decision-making process. However, in the telecommunications industry, as presented by Zidane et al. (2018), this was aimed because the telecommunication project expected four times the return on the investment. The sooner the service was introduced to the market, the sooner it would generate income. Zidane et al. (2018) also present that success for an urgent project is defined by its timely delivery. However, this success might not be reflected in its post-project evaluation. According to Bingham et al. (2018), the urgency of a project can significantly impact the selection of project delivery methods. Notice that the

characteristics of urgent projects may vary across different research studies and authors, leading to potential inconsistencies in understanding.

Contradictions in the research emerge concerning the effects of urgency on knowledge transfer. Ren et al. (2018) find that high time pressure negatively affects inter-project communication and knowledge transfer in project-based organizations (PBOs). However, Sun et al. (2019) suggest that urgency in Construction Project Cooperation Networks (CPCNs) positively influences knowledge transfer, promoting a greater willingness to share learning experiences and skills among network members. They propose that plans must be developed to mitigate the negative effects of rushed schedules and allow sufficient construction time for optimal knowledge transfer. Moreover, some studies focus on specific urgent projects, such as slum upgrading El-Anwar and Aziz (2014) and earthquake reconstruction Sun and Xu (2011), highlighting their unique challenges and requirements.

Therefore, as described by multiple researchers, they share common *characteristics*, such as: (i) *Critical Nature*: Urgent projects tend to arise unexpectedly, and the criticality of these projects demands immediate attention and action, necessitating a sense of urgency in their management. Despite their critical nature, urgent projects may lead to rework projects and entail high time pressure or tight deadlines (Yim et al., 2015). (ii) *Management Challenges*: Managing urgent projects requires a unique approach focused on rapid decision-making, coordinated actions, top management involvement, consideration of stakeholders' interests, and reliance on oral commitments. These factors contribute to the project's accelerated momentum and timely delivery, a critical measure of success in urgent projects. *A defining characteristic of urgent projects is the need for completion within significantly shorter durations compared to similar non-urgent projects*. The urgency factor outweighs concerns about the cost of working at the maximum possible speed, emphasizing the importance of swift execution. (iii) *Rapid Response Risk Management*: Urgent projects often emerge in complex and risky scenarios characterized by high levels of uncertainty and potential risks. They often involve risk assessment to effectively manage emergency situations, such as natural disasters (Sun and Xu, 2011).

2.3.3. Defining Urgent Projects

This research aims to establish a unified conceptualization of "urgent projects" within the context of project management. Despite the deep literature analysis on the subject, it becomes evident that the specific papers lack a precise definition of an urgent project. It suggests that all previously studied urgent projects are necessary but insufficient to define and conceptualize an urgent project. By analyzing the meanings and nuances of the term "urgent" and exploring its application to urgent projects, we aim to establish a comprehensive understanding of these projects.

Both the Lexical Semantic Analysis (LSA) of the word "urgent" and the Systematic Literature Search (SLS) on urgent projects explore the many-sided meanings and nuances of "urgent," ranging from the immediate need for action to the consideration of degrees of urgency.

The strict definition of "urgent" signifies *very important that needs to happen immediately, requiring speedy action in order to achieve a particular result*, as presented in dictionaries. Urgent projects, as suggested in the Literature Search, demand immediate attention due to their critical nature and high uncertainty, as well as management challenges that often require accelerated momentum and rapid decision-making, coordination, and risk management. Challenges in urgent project management include short project durations, resource allocation, communication, and decision-making under time constraints. While there are some contradictions in defining urgent projects across different studies, *the prevailing understanding is that they involve time-sensitive pursuits that may require immediate action and completion as quickly as reasonably possible*.

The analysis of Lexical Semantic Analysis and Literature Search reveals some contradictions in the understanding of urgent projects. While LSA suggests that urgent

projects may imply different degrees of urgency depending on the context, SLS emphasizes the immediate attention and action demanded by urgent projects due to their critical nature. Moreover, LSA indicates that "as soon as possible" and "very soon" allow for a more flexible timeframe in completing tasks, while SLS mentions that urgent projects require an entirely different project management approach with swift execution. The contradictions highlight the complexities in defining urgent projects; and differing perspectives surrounding urgent projects, which may vary across different studies and authors.

To establish a precise definition and conceptualization of urgent projects, we integrate the outcomes of previous analyses (the meanings and nuances of the word "urgent" in dictionaries and the relevant studies related to urgent projects, their characteristics, challenges, and impact on project management) with a widely accepted definition of projects. According to the SLS, we chose the Project Management Institute (PMI) definition because it appears as the more prominent bibliography on the theme. For them (PMI, 2017), projects are temporary efforts undertaken to create a single product, service, or result.

In a simple combination of the terms "urgency" and "projects," it is possible to develop *a stricter definition of an urgent project as:*

A temporary effort that needs to happen according to the degree of urgency, and be executed as fast as possible to create a product, service, or result.

However, this simplistic definition lacks the contextual framework from the Systematic Literature Search that reveals common themes, such as the critical nature and high uncertainty associated with urgent projects. The Lexical Semantic Analysis also discusses the various nuances of urgency, including the need for immediate attention and action. These similarities, combined with the project definition, acknowledge the challenges and complexities of managing urgent projects, emphasizing the importance of quick decision-making, coordination, and attention to stakeholders' interests. All these results combined give us a general understanding of what is an urgent project (RQ), as shown below. *An urgent project can be conceptualized as:*

A time-bound effort to achieve a specific and critical objective that requires immediate attention and action according to the degree of urgency, rapid decision-making, and coordination due to its high level of cruciality. Urgent projects often arise in complex and risky scenarios, such as disaster management, fast-response organizations, and innovation projects, or unexpectedly, necessitating rapid action to address new business opportunities, sudden threats, or severely damaged assets. The urgency factor in urgent projects outweighs concerns about the cost of working at the maximum possible speed when deciding to initiate them, emphasizing the significance of achieving results promptly. These projects are considered by high level of uncertainty, complexity, and risks. The challenges specific to urgent project management include dealing with improvisation, and fragmentation while maintaining focus on the project's scope and objectives. Stakeholder management is crucial in urgent projects, as their interests and involvement play a vital role in the project's success. It involves relying on oral commitments to achieve accelerated momentum and timely delivery. Success for an urgent project is primarily measured by its timely delivery rather than its post-project evaluation, acknowledging the need for quick action to meet pressing deadlines or capitalize on time-sensitive opportunities.

From this general understanding of what is an urgent project, in a short summary, an urgent project is a time-bound initiative that demands immediate attention, rapid decision-making and coordination to address critical and time-sensitive requirements and achieve specific outcomes promptly.

2.4. PARTIAL CONCLUSIONS

This paper aimed to study the term "urgent project" as a focal concept. As hypothesized, *our research presents that the term "urgent project" manifests diverse interpretations from different points of view so that the authors understand the meaning of what is urgent*. The concept of *degrees of urgency* has been recognized, highlighting varying levels of intensity associated with urgent projects. While there is no formal definition or conceptualization for the degree of urgency in the management domain, the analysis has illuminated the inherent nuances and contextual flexibility within the concept. The literature on urgency emphasizes the crucial role of time-sensitive events, potential risks, and consequences in understanding urgency, while also acknowledging the contextual and field-specific nature of urgency. Additionally, the analysis of selected articles has shed light on the *time-sensitivity* of urgent projects, indicating that urgency can encompass different time frames, depending on the projects' complexity and specific requirements. Urgent projects demand a unique management approach characterized by swift decision-making, coordination, risk management, and stakeholder involvement, with a primary focus on timely delivery.

This paper presents a conceptual foundation for analyzing urgent projects effectively, thereby reducing the lack of consensus found in the definition presented by Zidane et al. (2018). The novel contribution of this study lies in advancing the knowledge of urgent projects, serving as a pivotal starting point for further conceptual development in this domain. By exploring the complexities involved in managing urgent projects, the research provides valuable insights for both practitioners and researchers in the project management field, fostering a deeper comprehension of this specialized area and opening new avenues for understanding its nuances.

The scope of this research has some limitations that deserve attention. First, the constraints posed by the limited scope of dictionaries, as well as the subjectivity in its interpretations, and cultural and linguistic variations. Additionally, the lack of considerations of large language databases. To augment the rigor of our conclusions, limitations are also related to the necessity to expand the finding based on more scientific databases. We must recognize the difficulties posed by the different interpretations of what is urgent or not, being a challenge in analyzing literature. Another concern pertains to the fact that the definition of the urgent project presented is not sufficient and generalizable to well conceptualize urgent projects in general. As such, it needs refinements to foster a more robust understanding of the subject.

3. ARTICLE 2: MANAGING TIME-CRITICAL PROJECTS: LITERATURE REVIEW AND FUTURE CHALLENGES

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Abstract:
In the event of major catastrophes, such as terrorist attacks, natural disasters, biological weapons, or pandemics, there is a high probability that urgent projects, programs, and portfolios will be needed to mitigate the consequences. Despite the practical importance, there is still no technical or theoretical consensus on urgent projects, their boundaries, concepts, and most relevant themes. Therefore, we aim to investigate urgent projects by identifying and exploring concepts and understanding the scientific literature's point of view on how urgent projects are managed. The research design combines a Systematic Literature Review and a Snowball approach (backward search) to synthesize findings. We identified 366 publications and then narrowed the list to 105 relevant studies until February 2024. The findings include urgent projects coded characteristics: (i) 8 (eight) characteristics (e.g., unexpected urgency and timing speed) categorized within three concepts; and (ii) 69 (sixty-nine) characteristics (e.g., commitment-innovation relationship and operational flexibility behaviors) categorized into 14 (fourteen) themes (e.g., human resources and teams, stakeholders' urgency, communications, suppliers, scope, quality, integration, financial, knowledge, risks, and health and safety). This research contributes to the project management domain by synthesizing the top scientific literature on urgent project management themes, a novel discussion on the concepts of urgent projects, and the 33 (thirty-three) future challenges in the urgent project management research field. We provide the foundations of managing urgent projects as a central point to spur academic research on this topic and to help future research about urgent project management.

Keywords:
Urgent Project, Emergency Project, Unexpected Project, Speed, Time, Schedule, Urgency, Systematic Review

Article 2

Managing Time-Critical Projects: Literature Review and Future Challenges

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Abstract: In the event of major catastrophes, such as terrorist attacks, natural disasters, biological weapons, or pandemics, there is a high probability that urgent projects, programs, and portfolios will be needed to mitigate the consequences. Despite the practical importance, there is still no technical or theoretical consensus on urgent projects, their boundaries, concepts, and most relevant themes. Therefore, we aim to investigate urgent projects by identifying and exploring concepts and understanding the scientific literature's point of view on how urgent projects are managed. The research design combines a Systematic Literature Review and a Snowball approach (backward search) to synthesize findings. We identified 366 publications and then narrowed the list to 105 relevant studies until February 2024. The findings include urgent projects coded characteristics: (i) 8 (eight) characteristics (e.g., unexpected urgency and timing speed) categorized within three concepts; and (ii) 69 (sixty-nine) characteristics (e.g., commitment-innovation relationship and operational flexibility behaviors) categorized into 14 (fourteen) themes (e.g., human resources and teams, stakeholders' urgency, communications, suppliers, scope, quality, integration, financial, knowledge, risks, and health and safety). This research contributes to the project management domain by synthesizing the top scientific literature on urgent project management themes, a novel discussion on the concepts of urgent projects, and the 33 (thirty-three) future challenges in the urgent project management research field. We provide the foundations of managing urgent projects as a central point to spur academic research on this topic and to help future research about urgent project management.

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3.1. INTRODUCTION

Urgent projects are crucial when unexpected catastrophic events happen, such as: (i) The rupture of a dam causing more than 250 deaths, as occurred in the municipality of Brumadinho, Brazil, in January 2019, that imposed, e.g., projects and operations of search and rescue, and evaluation of other dams; (ii) The coronavirus (COVID-19) pandemic that imposed, e.g., field hospitals projects (Chen et al., 2021; Luo et al., 2020); or (iii) The 9/11 terrorist attack that imposed the sifting and removal project of the New York World Trade Center pile of debris (Wearne, 2006; Wearne and White-Hunt, 2014, pp. xiii and 89). It is instinctive to understand these examples as urgent projects. Da Penha and ten Caten (2023b) sought to solve the gap regarding the lack of consensus on the urgent project definition presented by Zidane et al. (2018). However, *urgent project* is not a technical term in the literature; the term "urgent" can be used with different degrees of urgency (Wearne and White-Hunt, 2014, p. 9), depending on the authors' interpretation; and no theoretical framework or literature review exists about urgent project management (da Penha and ten Caten, 2023b).

Previous research on urgent projects studied the project speed (da Penha et al., 2024; da Penha and ten Caten, 2023a; Zidane et al., 2018), the reasons behind the urgency, and

how to manage the project urgently (Gonçalves et al., 2023; Zidane et al., 2018); and unexpected urgent projects (Wearne, 2006; Wearne and White-Hunt, 2014), for instance. Zidane et al. (2018) explored the management challenges involved in delivering a telecommunications infrastructure project in a much shorter duration than a similar project (Zidane et al., 2018). Other researchers (Wearne, 2006; Wearne and White-Hunt, 2014) discuss case studies of a new business opportunity, action to avoid a disaster, restoration of badly damaged assets, large-scale work for search-and-rescue after a disaster (Wearne, 2006), saving assets under threat, finding survivors, and recovering evidence of victims (Wearne and White-Hunt, 2014), and more recently the urgent projects in the context of humanitarian organizations (Gonçalves et al., 2023).

Seeking to fill the gap on how urgent projects are managed, this article is guided by the following research question: *How to manage urgent projects?* This paper addresses this exploratory question based on a Systematic Literature Review, which can identify and summarize the existing body of knowledge, providing concepts, themes, and characteristics to work as a foundation for advancing the topic of urgent project management. Therefore, from theoretical and practical perspectives, this research intends to expand the Project Management Theory by identifying concepts and key knowledge areas for urgent project management and synthesizing and discussing the results. In order to accomplish this objective, a Systematic Literature Review (SLR) was combined with a Snowball approach (backward search) to reach the relevant literature on this topic. As a result, the synthesis of findings points out and discusses bridges between concepts and presents the urgent project management literature by themes, characteristics, and descriptions to help future urgent project analyses and research. The findings also present 26 (twenty-six) gaps as challenges that can help future research questions.

This paper is interested in the real sense of urgency (Kotter, 2008), characterized by a deep determination to win, a vigilant lookout for opportunities and hazards, and a commitment to moving and winning as soon as possible. As presented by the author, this urgency is not about frantic, anxiety-driven activity (which Kotter identifies as false urgency), but rather about a gut-level determination to progress on crucial issues (da Penha and ten Caten, 2023b) every day. True urgency is driven by the belief that action on important issues is required immediately, prioritizing challenges central to success or survival. It is a blend of thought and emotion, aiming to generate a compelling desire to take meaningful action immediately.

This study adds to the body of knowledge on project management by: (i) Identifying and describing urgent projects' core concepts and their characteristics; (ii) Identifying and synthesizing 69 urgent project management characteristics categorized into 14 (fourteen) urgent project management knowledge areas (themes); and (iii) Presenting 33 (thirty-three) future challenges related to urgent project management research. This study contributes to a conceptual and theoretical framework that can be analyzed and tested by the academic community. It also helps prioritize research paths based on the characteristics presented.

This paper is structured to guide the reader through synthesizing literature on managing urgent projects. Following this introduction, the subsequent section delineates the research design, describing the Systematic Literature Review and the Snowball technique employed to capture the existing knowledge. Sections 3.3 and 3.4 show results and discussions, presenting the conceptual framework that outlines the core concepts of such projects and the theoretical framework that identifies and categorizes the characteristics across thematic areas for managing urgent projects. The conclusion synthesizes the insights from the review. It also acknowledges the current study's limitations and suggests avenues for future research.

3.2. RESEARCH METHOD

Guided by the research question (*How to manage urgent projects?*), the authors tailored a Systematic Literature Review (SLR), based on Xiao and Watson (2019), followed by a

first-order Snowball approach, based on Hauge et al. (2021), to codify relevant characteristics of urgent project management, and then categorized it in themes. It aims to summarize, analyze, and synthesize related literature (Xiao and Watson, 2019) to develop a holistic conceptualization of the subject.

This research method is organized in two steps. The following subsection presents literature search and evaluation (Step 1), followed by a subsection on data extraction, analysis, and synthesis (Step 2). Figure 3.4 visually describes the process of conducting a Systematic Literature Review combined with the Snowball approach to develop a conceptual and thematic framework for managing time-sensitive projects, from the initial literature search and framework development to presenting future challenges.

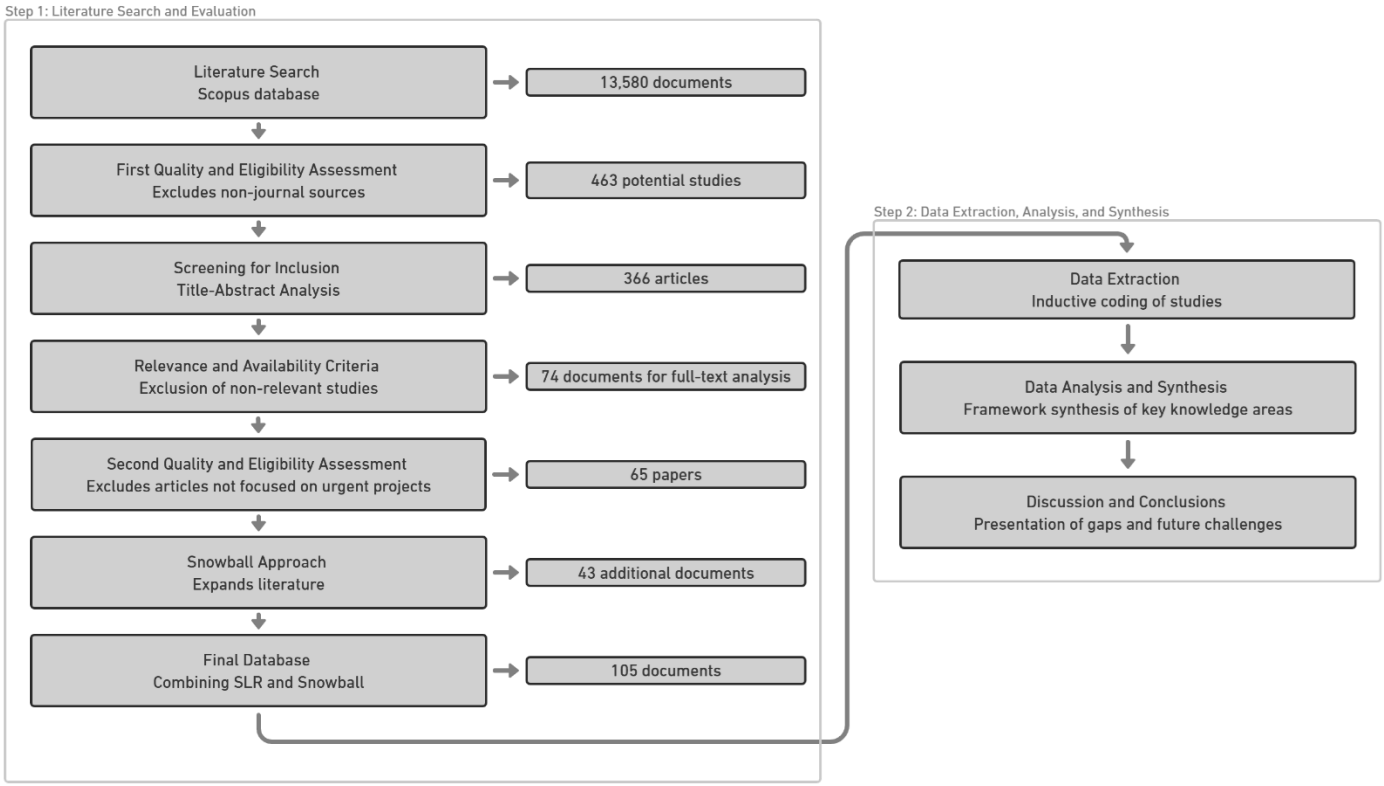

Figure 3.4 - Systematic Literature Review and Snowball approach process flowchart.

3.2.1. Step 1: Literature Search and Evaluation

The search was carried out using the Scopus scientific database in a time window from the beginning of the database until February 2024. The SLR balanced exhaustiveness and precision searching for the strings: (i) "urgent" OR "urgency," AND "project*" in the management literature (i.e., narrow domain); and (ii) "urgent project*" in the general literature (i.e., broader domain). The asterisk (*) replaces multiple characters in a word (e.g., project* finds projects, and projected). The result of the literature identification in the narrow domain was 13,519 documents, while the result in the broader domain contained 61 articles. Thus, 13580 documents.

The first Quality and Eligibility assessment required top scientific journals. Therefore, it excluded conference papers, reviews, books and book chapters, editorials, notes, short surveys, letters, conference reviews, abstract reports, data papers, erratum, and reports. The result in the narrow domain contained 8,395 articles. The inclusion criteria in the narrow domain (Business, Management, and Accounting) listed 429 potential studies with reference (author, year, title, abstract, and publication name). The

first quality and eligibility assessment in the broader domain included 34 articles. Final result: 463 articles.

In the Screening for Inclusion, the title-abstract analysis excluded papers that (exclusion 1) did not cite one of the strings (e.g., Zhan and Pan, 2020); where (exclusion 2) the word "urgent" appears disconnected from the word "project" in the title or the abstract (e.g., contextualizing and closing the research), or they use the word "project" with another meaning (e.g., design, or plan), e.g., "…to rear project dynamic imagery…" (Gonzalez et al., 2020); where the word "urgent/urgency" is not related to a project, e.g., "… sense of urgency to prompt change" (Poblete et al., 2022), and "the urgency of the problem stated in the paper…" (Miskewitz et al., 2017). A retracted article was excluded, resulting in 366 articles.

The Relevance and Availability criteria (exclusion 3), kept articles about urgent projects, or that could transfer insights to urgent project management, e.g., e-inspections during the COVID-19 pandemic (Lu et al., 2022), increasingly complex projects and urgent labor shortage caused by the pandemic (Zhu et al., 2022), or Key Performance Indicators - KPI (Wu et al., 2020) that could indicate the scale of the urgency. We also excluded papers that, although contained specifically the term "urgent project," were not relevant to this research, e.g., in the Yoon et al. (2019) research about the discursive formation and neoliberal subjectivity. After a careful review, a total of 13 studies were excluded (e.g., Salcedo et al., 2019; Xie et al.,2022; Yang and Cheng, 2020); and one magazine article (Peters, 2013) remaining. It was not possible to obtain the full text of 18 studies (e.g., Athmaram et al., 2019; Ripley, 2004). Some of them, for example, were due to the platform's payment requirement. The result was 74 documents for full-text analysis.

In the Second Quality and Eligibility assessment (exclusion 4), it is essential to show what was not considered an urgent project. It excluded articles that create a feeling of urgency to capture the reader's attention, not literally a threat, opportunity, or crisis. As a result, 65 papers were included in the detailed analysis.

The Snowball literature approach (Hauge et al., 2021), or backward search (Xiao and Watson, 2019), uses first-order references from articles to expand the list of relevant studies, thus, connecting the dots for a more readable synthesis of findings (Jin and Wang, 2016; Teoh et al., 2021). Although the first Quality and Eligibility assessment eliminated the books in exclusion 1, some relevant books were found in the first-order references, which is why they were included in the synthesis of results. For example, books by Weick and Sutcliffe (2015), Kotter (2008), and Wearne and White-Hunt (2014). The Snowball approach resulted in 55 documents. Table 3.9 (Appendix 3A) presents the references selected in the Snowball approach from the articles in the SLR that were included in the data matrix.

Combining the SLR (68 articles) and the Snowball (55 documents), and excluding the duplicates, the selected literature yielded 114 final documents for complete text analysis. We further excluded nine documents during the full-text study as they were irrelevant to urgent project management. As such, the final database was 105 documents.

3.2.2. Step 2: Data Extraction, Analysis, and Synthesis

The data extraction adopted inductive coding to identify and extract data from the studies. The codes became types and characteristics that allowed the authors to cluster and analyze information. This process was done interactively until no more code could be extracted from the complete analysis. This interactive process was executed to exhaustion to present conclusions and generalizations based on coded themes and concepts (Xiao and Watson, 2019).

The data analysis and framework synthesis (Xiao and Watson, 2019) of the knowledge areas (themes) structure the coding from the literature (Carroll et al., 2013; Dixon-Woods, 2011; Xiao and Watson, 2019). In order to gather what could characterize an urgent project, this research builds conceptual and theoretical frameworks of urgent project management from the coded characteristics to develop concepts and themes.

Based on the relevant literature collection, it was possible to gather how urgent projects are managed and build a theoretical framework offering insights for future analysis and research of urgent projects.

We decided to present the results and discuss them together. Aiming to facilitate reading, we separated these results and discussions into two parts: conceptual framework and theoretical framework. All results presented below assume that there is a true sense of urgency, as presented by Kotter (2008), therefore, a focused, powerful, and positive force that compels individuals to act decisively on essential matters. This research identified gaps and challenges within each theme.

3.3. CONCEPTUAL FRAMEWORK

The review and analysis revealed 8 (eight) characteristics collapsed within 3 (three) urgent projects' concepts to conceptualize an urgent project. It expands the core concepts of what is urgent, presented by da Penha and ten Caten (2023b). We explore the concepts of *priority* and *speed* in-depth and describe the *expectation* concept as presented in Table 3.10, Appendix 3B.

3.3.1. Concept 1: Project Expectation

There is a level of expectancy for any project. Concept 1 explores the spectrum of project expectations, distinguishing between *unexpected and expected urgencies*, and their implications.

3.3.1.1. Unexpected or Unforeseen Urgency

Something unexpected surprises us because we were not expecting it (Oxford University Press, 2021b), i.e., we did not know it would happen (Cambridge Dictionary, 2021). However, the term can appear in the literature with other similar meanings, such as that the event was never thought of previously (Wearne and White-Hunt, 2014, p. 17), e.g., unforeseen client's bankruptcy (Geraldi et al., 2010); or that the event was thought of but the possibility of it happening was not allowed for (Wearne and White-Hunt, 2014, p. 17), e.g., crisis management in the construction industry (Hällgren and Wilson, 2008; Söderholm, 2008), or the COVID-19 pandemic, a known event but seen as a very low probability of happening that was treated as unexpected. Further related reference can be seen in: Project management of unexpected events (Söderholm, 2008; Weick and Sutcliffe, 2008).

3.3.1.2. Expected or Foreseen Urgency

They are less obvious urgent projects when working with commercial or public projects, e.g., in product development, that follow a time-pacing strategy in competitive markets, as presented by Eisenhardt and Brown (1998). According to the authors, time pacing enforces a constant sense of urgency (Kotter, 2008) in meeting deadlines and focuses individuals on a shared set of objectives. According to Wearne and White-Hunt (2014) and Zidane et al. (2018), if the project is urgent and expected/foreseen, it is simple to expedite because much of the necessary information is already known. In urgent public projects, for instance, Økland et al. (2018) present the urgency to provide additional school capacity because of the beginning of the school year. These findings reinforce the importance of pace suggested by Shenhar and Dvir (2007) and Williams (2005) as a type of project complexity because the different structures and managerial focus are needed for time goals of urgency and criticality (Geraldi et al., 2011).

Additionally, time restrictions can be imposed to keep a project on schedule, giving a sense of urgency (Sullivan and Beach, 2009). As presented by Kotter (2008), it is possible to create a high sense of urgency among enough people to achieve more than would have been thought possible implementing large-scale changes. As presented in the book, there are tactics to create true urgency that can be applicable in a foreseeable urgent project.

3.3.2. Concept 2: Project Priority

Concept 2 explores the nuances of project priority, examining how *time urgency* and *dynamic urgency* influence project deadlines, and management.

3.3.2.1. Time Urgency

Urgency in a project denotes the time constraint for the timely completion of project goals (Ren et al., 2018, 2019). The literature shows urgency as a characteristic of the project, such as complexity and uncertainty (Jugend et al., 2014), or similarity (Ren et al., 2019). At the individual level, time urgency refers to the pressure that project team members feel to finish the project task within a set timeframe, influencing how they act (Zhou et al., 2020). In this context, the pressure is generally analyzed regarding the effects on projects' schedule, safety, and performance (Assaad et al., 2020; Liu et al., 2022). For instance, Assaad et al. (2020) identified inappropriate schedule pressure as a project risk in the construction industry; Mohammadi and Tavakolan (2019) cite the pressure caused by contractual deadlines or clients; and Sullivan and Beach (2009) describe the scheduling pressure in NASA culture on the eve of the Columbia space shuttle accident.

3.3.2.2. Dynamic Urgency

Urgency can change throughout the project's lifecycle. There are two situations presented in the literature.

First, projects' urgency can change over time because of unpredictable situations. For instance, the health care research projects to deal with a pandemic or a mountaineering expedition that was interrupted by unforeseen inclement weather (De Waard and Kalkman, 2022; Musca et al., 2014). Sometimes, the project was not designed to be urgent; however, urgent final and intermediate deadlines give the team the feeling that they are constantly working on (expected/foreseen) urgent projects due to the urgency intrinsic to the project.

Second, the opposite situation happens when the urgency that worked as a trigger to initiate the project does not exist anymore, and the project changes from urgent to conventional. It even ends because there is no reason to keep it or simply because of the complacency (Kotter, 2008); therefore, if the project loses the urgency after it starts. E.g., Musca et al. (2014) show that the redefinition of future actions and the reaffirmation of the team's cohesion allowed a new understanding of the situation and a change in the project's direction of action.

3.3.3. Concept 3: Project Speed

The sense of urgency (Kotter, 2008) works as a motivational force to achieve speed. Because of the fast delivery, it is evident that speed matters when managing an urgent project. Speed is crucial to accelerate decisions to support projects' agility to gain a competitive advantage (Zidane et al., 2018), and it is usually related to the project speed performance to be on schedule (Zidane et al., 2018). Concept 3 addresses this central role of project speed, emphasizing how urgency acts as a catalyst for rapid decision-making and execution to enhance agility, maintain competitive advantage, and ensure on-schedule delivery.

3.3.3.1. Work Intensity

The literature presents insights into work intensity in the context of construction project participants, pandemic response, and telecommunications projects.

Leung et al. (2016) highlight insights to understand a more common expected urgent project management, that the construction project participants always work on rigid and urgent deadlines, increasing the intensity of their effort. However, it creates a stressful situation playing an essential role in construction projects cost-estimation participants, as well as calculating the organization's profit margin (Leung et al., 2016).

managing work intensity could lead to better performance outcomes, potentially affecting delivery speed.

In the context of unexpected urgent projects, da Penha et al. (2024) present a case study in Brazil where the work intensity on the project was extremely high, driven by the urgent need to provide face shields to healthcare professionals during the COVID-19 pandemic. They present factors contributing to the intensity of work and increased project delivery speed: *agile mindset*; *rapid iterations*; *collaboration across stakeholders* from government, academia, industry, and civil society; use of *digital communication tools*; *external pressures*; and *high stakes*. The project achieved a lifecycle of only 11 days, demonstrating how intense focus and collaboration can dramatically increase delivery speed.

The project to expand an existing telecommunications network in Algeria, presented by Zidane et al. (2018), was also characterized by a high work intensity. This intensity was primarily due to the project's ambitious timeline, which aimed to compress what would typically be a two-year delivery schedule into just three months. The project's urgency and tight deadline necessitated extraordinary efforts from all involved, including the management team, contractors, and other stakeholders. The project's approach to overcoming barriers, mobilizing resources, and receiving stakeholder support under tight constraints showcases how high work intensity can significantly enhance project delivery speed.

3.3.3.2. Timing Speed

In a high level of urgency, the project can achieve "maximum" speed because the leaders and the team already have a high level of skills to be tested during the urgency (McDonough and Pearson, 1993). Leaders do not need the team's learning curve, and the organization does not need leadership development. Leaders need to be ready for extremely urgent projects. Because of experience and skills, leaders and teams can eliminate unnecessary tasks. In the context of speed, timing is a critical factor in urgent projects (Nachbagauer, 2022). The paper emphasizes event time to understand better that selecting the right time or speed (i.e., *timing*) is not simply an externality. For instance, acting quickly in high-risk scenarios is especially important to prevent disasters (Sullivan and Beach, 2009). The problem is balancing decision quality against decision speed (Collyer et al., 2010).

3.3.3.3. Speed Management

There are layers of speed to be selected during the project management, e.g., applicable to: (i) Initiation, how fast you decide to start (Nachbagauer, 2022; Wearne and White-Hunt, 2014, p. 23); (ii) Execution and Implementation, how fast you develop, produce, and deliver (da Penha et al., 2024; Wearne and White-Hunt, 2014, p. 32; Zidane et al., 2018); (iii) Innovation, how innovative you can be (Fredberg and Pregmark, 2022; McDonough and Pearson, 1993; Mitcheltree, 2023; Wang et al., 2016), how can you improvise faster (da Penha et al., 2024; Fredberg and Pregmark, 2022; Zidane et al., 2018); and (iv) Timing, the strategies to accelerate decisions (Azeem et al., 2022; Zidane et al., 2018), when to run the right initiatives (Nachbagauer, 2022), tools, technologies, and techniques (Lu et al., 2022; Wang et al., 2019), when to change the strategy (De Waard and Kalkman, 2022; Lu et al., 2022; Nachbagauer, 2022), when to challenge the team (Azeem et al., 2022; Mohammadi and Tavakolan, 2019; Zidane et al., 2018). Therefore, it shows an *urgent project management mindset based on speed* (fast start, development and delivery, expansion, and timing decisions). Consequently, it is a vital concept in highly urgent projects.

3.3.3.4. Speed-Reflection Balance

At the individual level, as presented by Kotter (2008), acting with urgency does not always imply running around, creating stress for others; for instance, it would be related

to *false urgency*, characterized by activities driven by anxiety or frustration. The author explains that patience is an integral part of *true urgency*. The concept of *urgent patience* suggests that while it is vital to act swiftly and decisively, there is also a need for patience in ensuring actions are thoughtful and practical, not rushed in a way that leads to mistakes or overlooks essential considerations. *Urgent patience* is about maintaining a balance—recognizing when to speed up and when to slow down for reflection and careful decision-making. In other words, it is a *pacing strategy*.

Within this context of pacing strategy, Nachbagauer (2022) discusses the role of social constructionism in the perception of time scarcity and urgency within organizations (Du Gay, 2016; Granqvist and Gustafsson, 2016; Lundin and Söderholm, 1995). The author suggests that organizations differ in their approach to urgency: some accelerate activities, while others opt for a more tempered approach, each with its own set of challenges (Du Gay, 2016; Granqvist and Gustafsson, 2016; Wajcman and Dodd, 2017). Nachbagauer (2022) states that project managers must be aware that time and urgency are socially constructed and can be actively managed. It suggests the possibility of a more relaxed management style, emphasizing patience and waiting even in urgent situations (Söderholm, 2008).

3.4. THEORETICAL FRAMEWORK

The review and analysis of the studies revealed 69 (sixty-nine) core characteristics and 14 (fourteen) Urgent Project Management Themes (as summarized in Table 3.11, Appendix 3C), categorized as *human resources and teams*, *time*, *stakeholders' urgency*, *risks*, *costs*, *suppliers*, *scope*, *quality*, *integration*, *knowledge*, *communications*, *financial*, *health and safety*, and *innovation*.

3.4.1. Theme 1: Human Resources and Teams Management

Project Resources Management includes Human Resources, referred to as Team Resources, and Physical Resources. Theme 1 encompasses Human Resources and Teams Management, highlighting the challenges in *team selection*, *commitment*, *innovation*, *group dynamics*, *expecting the unexpected*, *operational flexibility*, *accuracy*, *speed*, *highly skilled teams*, *intensity*, *consistency*, *leadership skills*, *performance*, *short-term urgent mindset*, *productive drive*, and *destructive frenzy*. Table 3.12 (Appendix 3D) presents the human resources and team management characteristics when working on urgent project management.

3.4.1.1. Team Selection

Selecting and hiring people to work on urgent projects is challenging because of the psychological and time pressures (Conte et al., 1995; De Waard and Kalkman, 2022). For example, in post-disaster housing contexts, it is essential to consider a quick selection based on technical and management skills, adapting to the socio-cultural dynamics of the community during project execution (Tauber, 2015). Competency modeling tools can help compose a competent and committed team (von Meding et al., 2016). These studies are reinforced by Campbell et al. (2021), who studied nine emergency response projects during the COVID-19 pandemic. In this case, the mechanisms used to streamline the projects included, among others: *selecting and incorporating*; and direct commissioning with *experienced and trusted local researchers*. Notice that, as presented by De Waard and Kalkman (2022), experience is a key selection criterion for an urgent project. However, the authors (De Waard and Kalkman, 2022) highlight that responses often emerge spontaneously in disrupted contexts, e.g., with *improvised and self-organized teams*. Da Penha et al. (2024) present these collaborative teams in the context of a fast Quadruple Helix formation.

3.4.1.2. Commitment-Innovation Relationship

Multiple scholars have contended that commitment is essential for teams operating in extreme contexts (De Waard and Kalkman, 2022; Melkonian and Picq, 2010). Mitcheltree (2023) understands that commitment and speed of innovation increase when trust is combined with an ongoing inter-company understanding of project roles, capabilities, and purposes. The article discusses overcoming complacency through a shared sense of urgency (Kotter, 2008), akin to the necessity for innovative and committed team members highlighted by Zidane et al., 2018. In order to be superfast, team members must be innovative and committed, with numerous ideas to contribute and complete engagement (Zidane et al., 2018).

In turn, to get full involvement, the project management team cannot be distracted by any other work (Wearne and White-Hunt, 2014). It mirrors the underlying theme of creating a true sense of urgency, as presented by Mitcheltree (2023) and Kotter (2008). It reinforces the idea that individuals facing emergencies and crises tend to exhibit heightened dedication and a wealth of insights to contribute (Loosemore, 1998). This description finds a parallel in the examination of complacency and urgency by Mitcheltree (2023). Although the article explicitly addresses complacency in innovation projects, the general principle that high-pressure situations can increase commitment and creativity is a shared theme. This dedication seems to ensure that team members are focused and fully engaged in the innovation project, minimizing distractions that could lead to complacency. At the same time, it seems to discard the understanding of McDonough and Pearson (1993) of having a perception of an urgent project for the corporation but not urgent for the project team.

Kotter (2008) argues that complacency can hinder the establishment of organizational dedication and initiative, particularly in times of critical change. Complacency is feeling content with the current situation but not recognizing any possible risks or necessity for change. Kotter's analysis suggests that this state can significantly destroy commitment.

3.4.1.3. Group Dynamics

In the extreme context, De Waard and Kalkman (2022) highlight two inhibiting group dynamics: groupthink and growing commitment. In group thinking, the origin of several disasters, e.g., the Challenger and Columbia (Dimitroff et al., 2005) and the Mt Everest disaster of 1996 (Hällgren, 2010), a culture of absence of (openness to) criticism stands out, generating an illusion of unanimity, since the internal pressure of the team prevents/inhibits the expression of doubts (Dimitroff et al., 2005; Hällgren, 2010). This groupthink can eventually lead to an ever-increasing commitment to a narrow understanding that is impossible to escape, even if it quickly leads to disaster. However, quick and efficient decisions, potentially leading to groupthink, can have advantages in extreme contexts where there is nothing to discuss about urgency (Dimitroff et al., 2005; Hällgren, 2010). Therefore, a contradictory situation presented by the literature is that, in extreme conditions, it seems to depend on the managers' or leaders' experience and intuition.

Time pressure can intensify specific group dynamics, such as increased groupthink, which can lead to a greater focus on reaching consensus quickly, often at the expense of careful evaluation of alternatives (Sullivan and Beach, 2009).

Mitcheltree (2023) researches the sense of urgency for innovation realization, specifically on complacency asymmetries in inter-organizational relations. The asymmetries are presented based on the drivers: *trust*, *competence*, *risk*, *understanding of the role*, and *project intention*. According to the article, the sense of urgency (Kotter, 2008) in the context of product innovation is linked to the challenge of overcoming complacency among partners in interfirm projects. The article treats the sense of urgency as a uniformly understood and shared concept among project participants. It presents how complacency acts as a barrier to the sense of urgency for the speed of innovation (innovation achievement). The research identifies reasons behind gaps in urgency among project

stakeholders, showing how these gaps negatively affect the sense of urgency and, consequently, the speed of innovation. The study builds on Kotter's ideas (Kotter, 2008) about *complacency* and urgency, highlighting that complacency is often rooted in a feeling of contentment or self-satisfaction associated with an ignorance of potential dangers or problems. It presents how *trust* is a significant dimension in creating a sense of urgency. The sense of urgency, as explored in the article, is framed as the antithesis of complacency.

3.4.1.4. Expecting the Unexpected Mindset

Within some projects, teams, managers, top managers, or even the organization have the mindset of expecting the unexpected. For instance, Bechky and Okhuysen (2011) present that for handling surprises in commercial and noncommercial situations by SWAT and film crews. De Waard and Kalkman (2022) demonstrate that a hazardous situation, like a mountain climbing trip, can quickly turn chaotic if the weather suddenly worsens, necessitating a prompt shift in the behavior of the team members. In risk contexts, teams focus on competence, where each member benefits from extensive (collective) training in different and complementary areas (Melkonian and Picq, 2010). This collective competence develops action patterns that harmonize collective improvisation (De Waard and Kalkman, 2022).

Additionally, Mitcheltree (2023) discusses teams being prepared for unexpected changes, suggesting a mindset that anticipates and adapts to sudden shifts, thus maintaining flexibility and innovation under pressure. As presented by de Waard et al. (2014), for example, a military task force in action is constantly in flux, expecting the unexpected. It must continually respond to evolving local situations to maintain or regain control, regularly deal with intelligent adversaries who actively seek to sabotage its missions, and always react quickly to outsmart the enemy.

3.4.1.5. Operational Flexibility Behaviors

Operational Flexibility is the capacity of organizations to incorporate (behavioral) modifications into current structures and processes (Ligthart et al., 2016). There are some dimensions of the analysis of flexible behavior, such as *trust* between project members, *sense of urgency*, and the *disposal of resources* (Ligthart et al., 2016), *team autonomy*, and *the ability to handle emerging issues* (de Waard and Kramer, 2008; Zidane et al., 2018). Ligthart et al. (2016) studied flexibility behaviors within inter-organizational projects in the context of the production of a complex vessel, showing that trust, sense of urgency, and resources enable operational flexibility behaviors; and they presented that positive experiences in previous interactions and expectations of possible future collaboration positively influence these three dimensions. This perspective is reinforced by da Penha et al. (2024). Additionally, Ren et al. (2019) show that project urgency affects the social relations between project teams, such as communication, trust, and reciprocity.

However, project participants' time constraints reduce facilitators' beneficial impact on operational flexibility because the practitioners want to complete their objectives first (Ligthart et al., 2016). For some people, the sense of urgency can break the thinking patterns of a conventional project into new behavior patterns and assumptions that are tested throughout the urgent project. The flexible approach of adaptive methods, with incremental deliveries, allows for continuously adapting decisions throughout the planning and execution of the project (Zidane et al., 2018). The project team has been given autonomy to expand and prioritize as needed, contributing to flexibility (Zidane et al., 2018). Ligthart et al. (2016) propose that, within inter-organizational projects, the various time dimensions are essential for understanding flexibility behaviors. With increased adaptability in the team, the likelihood of delivering a relevant and successful outcome is higher (Collyer et al., 2010; De Waard and Kalkman, 2022).

3.4.1.6. Accuracy-Speed Management

The vision of embracing uncertainty is linked to managing project velocity (Gonçalves et al., 2023; Zidane et al., 2018). According to Azeem et al. (2022), during an urgent situation, project teams feel pressured because it increases the chances of errors, which, in turn, increases the chances of new risks because of the shortening of the timelines. It encourages teams to focus more on minor improvements and reducing errors (Azeem et al., 2022). The writers emphasize the typical response when dealing with time constraints: spending more money and resources, cutting corners on quality, or possibly overwhelming resources, all of which introduce new risks due to the shortened deadline.

The Schedule Compressing Techniques (PMI, 2017b, p. 215; Zidane et al., 2018) analysis leads us to an imprecise situation of achieving accuracy and speed simultaneously, depending on the degree of urgency. Therefore, teams can seek incremental improvements for error reduction or accept errors in high-speed projects or emergencies. Urgency can act as a double-edged sword, simultaneously spurring and hindering change (Fredberg and Pregmark, 2022). The accuracy-speed management avoids the ripple effects of schedule pressure (Table 3.12), as presented by Assaad et al. (2020) and Sullivan and Beach (2009). At the same time, the authors determined the circumstances in which urgency can result in innovative and effective results.

3.4.1.7. Highly Skilled Teams Management

There is no way to manage a really urgent project without understanding its complexity. Projects with a high degree of urgency need to be executed with people who already know and understand what to do, have managers' autonomy, and can quickly gain new competencies required in potentially threatening situations (De Waard and Kalkman, 2022). At the same time, it is possible to simplify project complexity so that the project can be managed. Nachbagauer's (2022) research presents that coordination is best accomplished by organizational improvisation and fragmentation. It is possible to achieve expansion speed with decentralized leadership (Vahanvati, 2018), and a balance between planning and adaptation (De Waard and Kalkman, 2022).

As an example, da Penha et al. (2024) documented how a total of four managers (from industry, university, society, and Armed Forces) were able to develop and deliver a new Open Innovation product in 11 days that covered 470 cities and 498 institutions and hospitals, and benefited thousands of health professionals on the front line in 8 different Brazilian States during the COVID-19 pandemic. Because project managers cannot predict possible challenges in advance, decision-making is based on facts and experiences; it requires critical and analytical judgment (Zidane et al., 2018). With project execution being performed by highly skilled professionals, the urgent complex projects became simpler as managers could focus their attention on the essential tasks.

During times of crisis, competence (exceptional skill, knowledge, and experience) is frequently recognized for preventing catastrophe or the absence of it blamed for causing one (Sullivan and Beach, 2009). The authors underscore the necessity for organizations to have highly skilled teams that are capable of managing complex operations, learning from past failures, and innovating solutions.

3.4.1.8. Intensity-Consistency Relationship

Depending on the extreme context, there is a switch in work balance related to urgent projects. In practice, technical and management skills come from long-term preparation. They are tested in urgent projects, as presented by da Penha et al. (2024). For example, De Waard and Kalkman (2022) present that, in disrupted contexts, the main focus is on the human resource dynamics in which individuals self-organize and improvise. Because there is no time to solve the weaknesses, the weaknesses of the projects are treated by the fast entrance of a new stakeholder with a previous trust dynamics relationship (Zidane et al., 2018). An adverse risk is that the rework can intensify due to the rush to complete the task, which increases production pressure even more. Although boosting speed and

working hours can improve productivity, it only shortens the project duration in the short term (Mohammadi and Tavakolan, 2019).

This can generate and amplify adverse effects with the ripple effects of schedule pressure, including fatigue, decreased morale, and reduced productivity (Assaad et al., 2020). Zidane et al. (2018) also shed light on exhaustion and stress because the project practitioners worked 18 hours a day, seven days a week, for three months at extreme intensity. However, one consequence is that the project team involved can be overburdened carrying out multiple tasks in parallel can result in potential errors or consequences (Azeem et al., 2022). Therefore, what seems to work on urgent projects is the highly skilled professionals' intensity over the consistency and persistence skills of executing a typical project. The high intensity of work matters, for example, in an emergency project; thus, it is the opposite of a conventional project. A highly urgent project is unbalanced from the beginning to achieve intensity to deliver superfast results.

3.4.1.9. Leadership Skills and Performance Relationship

In order to manage highly skilled people in stressful situations, project managers and directors need to be highly skilled and competent. De Waard and Kalkman (2022) point out that specific leadership skills stimulate organic improvisation and adaptation, reinforcing previous research from Zidane et al. (2018), Wearne (2006), and McDonough and Pearson (1993). Unexpected urgent work can demand the improvement of top management (Wearne, 2006). Zidane et al. (2018) highlight the importance of choosing a senior project manager with a long experience in similar projects, good company knowledge, and strong administrative skills.

McDonough and Pearson (1993) studied the perceived urgency in the performance of projects, suggesting that, in greater perceived urgency, the performance was positively related to the use of familiar technologies and negatively related to the leader's human relations skills. At the same time, McDonough and Pearson (1993) highlight that "for less urgent projects:" (i) "a positive relationship that approached significance was found between the leader's human relations skill and performance;" and (ii) "a significant negative relationship was found between the project leader's technical skill and performance." That suggests that the higher the urgency, the more highly skilled and competent the managers should be, with more practical hard skills and less motivational soft skills. Finally, Zidane et al. (2018) also present that the manager successfully coordinated team members from various companies and cultures by selecting a full-time, experienced project manager with technical, leadership, managerial, and administrative skills; therefore, being the central axis to manage the speed and shorten the duration of the project.

Managing highly skilled teams capable of managing complex operations and fostering an expecting-the-unexpected mindset can be crucial for navigating high-risk environments (Sullivan and Beach, 2009). Kotter (2008) implicitly suggests that one leadership skill in continuously changing environments is a strong sense of urgency, which has considerable implications for performance and successful change. The author also highlights the difference between constructive true urgency and destructive false urgency. In voluntary projects, the impact of the project completion rate appears to depend on the project's urgency (Urrea and Yoo, 2023). Urgent projects are only completed successfully with the help of skilled volunteers. On the contrary, inexperienced volunteers tend to be more efficient when tackling projects that are not time-sensitive.

3.4.1.10. Short-Term Urgent Mindset

Zidane et al. (2018) explore how the project management team (primarily from the contractor's perspective) recognized potential opportunities. In high-priority projects, the project manager has full authority regarding project management. Therefore, it is entirely up to the project manager to handle the stress and interruptions regarding tactical and operational decisions and plans (Zidane et al., 2018). Despite the project deadlines, the

product managers focus on understanding the problem (e.g., technical requirements and design) and not on the delivery time target. It looks like a very good short-term and long-term strategy to entirely focus on the consciously present time, not the target time.

In a super-rapidly changing environment, the practitioners do not know what will happen and what they should do next; therefore, they need to have a short-term mindset. Zidane et al. (2018) showed that the contractors did not think about the deadline but on the following tasks. It reinforces the perspective from Kotter (2008) that teams with a sense of urgency lead empowered individuals in achieving clear, tangible short-term victories that quiet critics and win over skeptics.

3.4.1.11. Productive Drive vs. Destructive Frenzy

According to Kotter (2008), a *false sense of urgency* is described as a pervasive and insidious condition with much energetic activity. Still, it is driven by anxiety, anger, and frustration rather than a focused determination to win. This urgency leads to frenzied behaviors that might appear productive on the surface but are unproductive or destructive. Unlike *true urgency*, a powerful and positive force focused on moving quickly to seize opportunities or avoid threats, false urgency results in frantic and aimless activities that exhaust and stress people without moving an organization closer to its goals. The author highlights the crucial distinction between true and false urgency. *Confusing them can result in unsuccessful endeavors and overlooked chances*. *True urgency leads to productive outcomes and progress, while false urgency drains an organization's resources and energy on tasks that do not contribute to its ability to succeed in a changing environment*.

3.4.2. Theme 2: Time Management

Time is a crucial dimension in urgent project management. Time management encapsulates *recognition and decree*, *space-time analysis*, *event prediction*, and *temporariness*. Table 3.5 presents these characteristics alongside relevant sources. For example, Gonçalves et al. (2023) highlight the role available response time plays in implementing strategies prioritizing critical services or leveraging available resources, enabling flexible and agile processes for rapidly evolving high-risk emergencies. Furthermore, in extremely urgent projects, the risk of delay should be reduced at any cost (da Penha et al., 2024).

Table 3.5 - Summary of the urgent project schedule management.

#	Characteristics	Short Description	Sources
1	Recognition and Decree	Explicitly recognize the urgency.	(Cochran et al., 1978; da Penha et al., 2024; Nachbagauer, 2022; Zidane et al., 2018)
2	Space-Time Analysis	Space-time analysis for urgent project time prediction.	(Assaad et al., 2020; Gab-Allah et al., 2015, p.; Gonçalves et al., 2023; Ongpeng et al., 2019; Wu et al., 2020; Yan et al., 2009)
3	Event Prediction	Predicting the predecessor event of the urgent project.	(Behrmann et al., 2005; Rózsa et al., 2005; Wang et al., 2019)
4	Temporariness	Different time perspectives related to urgent projects and urgency in general.	(Conte et al., 1995; da Penha and ten Caten, 2023b; De Waard and Kalkman, 2022; Gonçalves et al., 2023; Kotter, 2008; Ligthart et al., 2016)

3.4.3. Theme 3: Stakeholders' Urgency Management

Managers give attention to stakeholders' claims regarding power, legitimacy, and urgency (Aaltonen et al., 2008; Al Nahyan et al., 2019). The urgency is the demand for immediate action, whether due to time constraints or the stakeholders' high stake in the result (Project Management Institute - PMI, 2017, p. 513). Mitchell et al. (1997) state that urgency consists of time sensitivity and criticality. For instance, stakeholders with greater power, legitimacy, and urgency attributes have overseen disaster recovery projects

demonstrating superior performance (Mojtahedi and Oo, 2017). Also, other authors highlight the urgency of the multiple internal and external stakeholder influences as an essential driving force (Lin et al., 2019). The literature describes stakeholders' urgency through the topics presented in Table 3.6.

Sullivan and Beach (2009) evaluated cases of catastrophic failures suggesting that effective management of stakeholder relationships is crucial for timely and successful project delivery, emphasizing the need to understand and address stakeholders' urgent needs and expectations. Mitcheltree (2023) highlights how project partners, customers, and suppliers may have varying degrees of urgency regarding the innovation process. The paper suggests that creating a shared sense of urgency (Kotter, 2008) among all stakeholders is essential for overcoming complacency and ensuring the swift realization of innovation.

Table 3.6 - Summary of the urgent project stakeholders' urgency.

#	Characteristic	Short Description	Sources
1	Attribute Urgency	Urgency is one of the stakeholder attributes that predict project performance.	(Aaltonen et al., 2008; Al Nahyan et al., 2019; Lin et al., 2019; Mitchell et al., 1997; Xia et al., 2017)
2	Mobilization	Stakeholders' urgency allows stakeholders to coordinate the immediate response and accelerates project mobilization tasks.	(Azeem et al., 2022; Crawford et al., 2013; da Penha et al., 2024; Gonçalves et al., 2023; Lin et al., 2019; Mojtahedi and Oo, 2017)
3	Interests and Claims	The necessity of using immediate action in response to stakeholders' interests and claims.	(Azeem et al., 2022; Bahadorestani et al., 2019; Wearne, 2006; Yang et al., 2014)
4	Collaborative Arrangement	Project professionals are expected to handle urgent projects with those who have shared a history of collaboration and/or look forward to collaborating in the future.	(da Penha et al., 2024; Gonçalves et al., 2023; Ligthart et al., 2016; Silva, 2014; Wearne and White-Hunt, 2014; Zidane et al., 2018)
5	Performance	Stakeholders with higher power, legitimacy, and urgency attributes have overseen projects that show improved performance.	(De Waard and Kalkman, 2022; Mojtahedi and Oo, 2017; Vahanvati, 2018)
6	Delivery	The decision of project delivery models.	(Bingham et al., 2018)
7	Shared Sense of Urgency	It is the understanding and alignment among project stakeholders on the action to achieve project goals, overcome complacency and drive innovation.	(da Penha et al., 2024; Gonçalves et al., 2023; Kotter, 2008; Mitcheltree, 2023)

3.4.4. Theme 4: Risks Management

The urgency of a project can lead to negative consequences and impacts due to its rapid execution (Zidane et al., 2018), and the time available to respond in emergencies is restricted (Gonçalves et al., 2023). Some studies highlight the project's risks and uncertainty when dealing with urgency. Cochran et al. (1978), for example, describe the severe role of uncertainty stemming from a legitimate urgency in commercial projects to capitalize on new technology. Zidane et al. (2018) demonstrate a case study that explores the connection between embracing uncertainty and managing project speed.

Table 3.13 (Appendix 3E) summarizes risk in urgent projects, categorizing risks into 16 (sixteen) categories ranging from *cost risks* to *time urgency risks*. For example, *cost risks* involve contractual cost claims, inaccurate cost estimates, fluctuating material prices, and late payments. *Time urgency risks* highlight the consequences of inadequate schedule pressure and the cascading effects of time pressure on work quality and team morale. Table 3.14 (Appendix 3E) outlines eight impact categories of urgent projects, ranging from *cost* and *environmental* to *health* and *time impacts*, each with a specific consequence.

It is vital to have in mind that excessively rigid time constraints imposition in expected projects to the detriment of project risk factors can sometimes have catastrophic impacts, as occurred in the Space Shuttle Columbia disaster that disintegrated upon re-entry into the Earth's atmosphere, killing all seven astronauts (Sullivan and Beach, 2009). Furthermore, the success of typical mitigating strategies is hindered by the restricted time available for emergency response (Gonçalves et al., 2023).

Finally, when dealing with new classes of problems, as in the case of the COVID-19 pandemic, *dynamic simulation models* can help with risk analysis. As presented by Gonçalves et al. (2023), especially in the face of urgency, speed of emergency, flexibility, and agility, there is also a need to quickly develop *System Dynamics* (DS) models integrating different data flows. From a risk analysis point of view, the development of dynamic simulation models can generate advance projections of the problem under analysis and allows teams and organizations to be reorganized (Gonçalves et al., 2023).

3.4.5. Theme 5: Costs Management

Theme 5 explores the balance between the *extra costs and value* derived from rapid delivery, the *cost-speed dilemma* faced when resources are constrained and project timelines are accelerated, and the *cost-risks dilemma*.

3.4.5.1. Cost – Value Relationship

Probably, highly urgent projects will cost more because the value of delivering the project is overwhelmingly greater than the extra cost of working as quickly as possible (Wearne and White-Hunt, 2014, p. 15). After all, as presented by Azeem et al. (2022), customers' main priority is to complete the urgent project as soon as possible. Økland et al. (2018) mention that reducing time more significantly resulted in less time in ensuring the quality of cost estimates before project financing. Although there are different perceptions of urgency, working faster than usual will incur an increased cost (Wearne and White-Hunt, 2014).

3.4.5.2. Cost-Speed Dilemma

In general, the urgency depends on the budget available for the urgent project to achieve the speed necessary to deliver faster results. If the budget is limited, the speed will be limited to the minimum cost (Wearne and White-Hunt, 2014, p. 10), or if the objective is to complete for the minimum total cost (Wearne and White-Hunt, 2014, p. 12); to achieve the maximum speed, an "unlimited" budget; or some speed in between are required. For instance, Zidane et al. (2018) studied the project speed to deliver in a much shorter duration than a similar telecommunication infrastructure project. Managers must lower performance expectations or face increased risks and potential catastrophic failure when resources are diminished, as seen before NASA's Columbia disaster (De Waard and Kalkman, 2022; Sullivan and Beach, 2009). In the context of the "iron triangle" (Barnes, 1970), reducing costs and cutting expenses can lead to a decrease in quality or compromise the safety of the work, as presented by Zidane et al. (2018).

3.4.5.2. Cost-Risks Dilemma

Costs-risks is a trade-off frequently encountered in project management and operational planning, as exemplified by Sullivan and Beach (2009) to keep the Space Shuttle Program under strict time constraints. In the context of the Columbia Disaster, costs ensure operational reliability, which implies a discussion on how organizations allocate financial resources to mitigate risks and ensure high reliability. However, the elimination of what were perceived as non-essential elements can reduce immediate costs but may introduce long-term risks that were not adequately accounted for. This perception suggests a trade-off where immediate cost savings were prioritized over

potential long-term risks, under the assumption that these risks were manageable within the given time frames.

3.4.6. Theme 6: Suppliers Management

Theme 6 addresses the challenges of *selecting and cooperating with suppliers* under the constraints of tight deadlines and the necessity for rapid delivery, highlighting collaboration in high-pressure scenarios.

3.4.6.1. Suppliers Selection

Because of the short delivery window, some suppliers decline to accept the project. The acceptance can be related to having delivered a similar project scope in a normal project, and to the whole contract value with a more considerable net profit margin in a short period of time (Zidane et al., 2018). For example, Ishak et al. (2015) showed that in urgent (and mega) projects, a supplier selection procedure based on Price Rate Table (PRT) has more disadvantages than advantages in terms of project performance.

3.4.6.2. Suppliers Cooperation

Sometimes, it is a complex endeavor to find external suppliers. Zidane et al. (2018) present the relevance of virtual cooperation between organizations involved in urgent projects working with global suppliers. The authors show that the urgent project can impose challenges in terms of the time difference, combined with cultural differences and amplified by the rigorous schedule (from two years in a typical case to three months in the urgent project). They state that subcontractors are motivated by the desire to earn the contractor's trust because their partnership extends beyond just a short-term contract to encompass long-term collaboration. Furthermore, the suppliers seek consistent long-term customers who can provide the required materials, tools, and machinery (Zidane et al., 2018).

3.4.7. Theme 7: Scope Management

Theme 7 highlights *scope fragmentation*, *prioritization*, and *uncertainty* to meet project objectives within constrained timelines.

3.4.7.1. Scope Fragmentation

Sometimes, it is impossible to deliver the entire urgent scope of the project within the shortest time frame (Zidane et al., 2018). For this reason, new ways of defining the project's scope can be necessary. For example, Nachbagauer (2022) clarified the possibility of organizational fragmentation. It reinforces the need to gather requirements in emergency contexts properly; when system definitions are too rigid, there is the possibility that relevant aspects and actors are inopportunely lost, negatively affecting the outcome of the project (De Waard and Kalkman, 2022).

3.4.7.2. Scope Prioritization

If it is impossible to deliver the entire scope, fragmentation alone would not be enough to solve the problem. In the case analyzed by Zidane et al. (2018), the solution of transforming the scope of the urgent complex project into different networked subprojects was presented: *a core network project* (delivered on time) and *access network subprojects* (delivered based on prioritization), dividing, as such, the project complexity into a network of simpler subprojects. It leads this feature into the *scope-speed dilemma*, in which the speed gain was solved by defining a rigid and urgent main project that fits the central scope and prioritizing sub-scopes, more flexible and after the central deadline.

3.4.7.3. Scope Uncertainty

Another characteristic presented in the literature was the lack of knowledge about the scope, one of the sources of project uncertainty (Zidane et al., 2018), and that sometimes the demand uncertainty is high (da Penha et al., 2024; Gonçalves et al., 2023). Trivedi and Singh (2017) developed a multi-objective decision model for post-disaster choices, showing that a decision model can speed up the decision when there are divergent objectives (De Waard and Kalkman, 2022).

3.4.8. Theme 8: Quality Management

Working as fast as possible increases quality-related risk probability. The schedule compressing technique known as fast tracking can increase the quality risks because, to shorten the project's schedule, activities are executed in parallel, not in sequences in normal conditions (PMI, 2017b, p. 215; Zidane et al., 2018). Azeem et al. (2022) highlight the risk of compromising quality, and Zidane et al. (2018) present a case study where the cost reduction implies the safety loss, then the quality of the work. Notice that although quality is a relevant constraint in typical projects, it was the least relevant topic (compared to others) within urgent project management. Therefore, there remains a conflict between project quality and quick decision-making (De Waard and Kalkman, 2022; Kim and Choi, 2013).

3.4.9. Theme 9: Integration Management

Theme 9 underscores the necessity for *agile project direction* and *pilot projects* to ensure cohesive operations and decision-making in fast-paced and risk-laden environments.

3.4.9.1. Project Direction and Management

Urgent project integration is challenging. As presented by De Waard and Kalkman (2022), directing operations in a risky context is complex, and consequently, aims and approaches will tend to depend on the more adaptative teams; also the relevance in resource availability (time and money) and safety in a risky extreme environment.

3.4.9.2. Pilot Projects

The study of Campbell et al. (2021) during the COVID-19 pandemic highlights the importance of adapting existing projects and partnerships for fast pilot projects. De Waard and Kalkman (2022) also recommend that managers take an agile approach by testing new pilot projects, and these projects will allow better choices and adaptation of future projects. Smaller pilots (scope reduction approach) are relevant to test and gather fast feedback (Collyer et al., 2010). This method of scoping reduction aims to minimize the first stage to receive feedback quickly and align the work with reality faster. However, caution is advised so that the pilots of new projects do not lead to delays (Vahanvati and Mulligan, 2017).

3.4.10. Theme 10: Knowledge Management

Theme 10 highlights the dual challenges and opportunities in knowledge creation and transfer, where collaboration and communication are key to the complexities of urgency, uncertainty, and task ambiguity.

3.4.10.1. Knowledge Creation

In the context of knowledge creation, collaboration is one of the answers to urgency (Aarrestad et al., 2015; van den Ende, 2003). Aarrestad et al. (2015) found that increasing collaboration is a reaction to a sense of urgency in high-stakes projects, which Gonçalves et al. (2023) reinforced. It entails broadening the range of interactions and the depth of emotions in generating knowledge (Aarrestad et al., 2015). As the levels of urgency,

uncertainty, and task ambiguity rise, the importance of thinking creatively and acting innovatively also increases (De Waard and Kalkman, 2022). When creating knowledge in urgent projects, Gonçalves et al. (2023) presented the "collaborative sessions" approach with very specific objectives rather than co-producing all aspects of knowledge.

3.4.10.2. Knowledge Transfer

In knowledge transfer, project urgency affects *communication*, *trust*, and *reciprocity* between project teams (Ren et al., 2019). However, studies go in different directions about knowledge transfer. Sun et al. (2019) emphasize that the project's urgency will have a favorable impact on knowledge transfer among network members. On the other hand, Zhou et al. (2020) highlight that the sense of urgency regarding time has a detrimental impact on the willingness to share knowledge researching cross-project knowledge transfer (horizontal and vertical) within project-based organizations. In the same direction, the pressing nature of projects adversely affects inter-project communication and transfer intention (Ren et al., 2018), strengthening the contradiction. Mitcheltree (2023) highlights how understanding technological capabilities, market needs, and innovative processes contributes to a sense of urgency and innovation.

3.4.11. Theme 11: Communications Management

As some of the urgent projects need to gain speed, time constraints and pressure will directly affect the increase in communication between network members, motivating teams to seek knowledge from other teams to solve the problems as soon as possible (Sun et al., 2019), and to generate more urgency (Kotter, 2008). However, despite the need for increased communication, it can be argued that some teams do not have time to communicate due to time pressure (Ren et al., 2018). Table 3.7 shows some solutions presented in the literature to mitigate this problem.

Table 3.7 - Summary of the urgent project's communication.

#	Characteristic	Short Description	Sources
1	Decentralized Communication	Used in management and transfer of knowledge within and between projects and allows acting with fasting decision-making.	(Al Nahyan et al., 2019; Soetanto and Proverbs, 2002; Wearne and White-Hunt, 2014; Zidane et al., 2018)
2	Trust and Commitment	The communication presented before reinforces the relevance of trust in oral commitments.	(Walker and Lloyd-Walker, 2016; Wearne, 2006; Zidane et al., 2018)
3	Transparent, Open, and Continuous Communication	Clear, open, and continuous communication among project participants and stakeholders is needed to align goals, manage expectations, and address challenges.	(Mitcheltree, 2023)
4	Communication Need	High-urgency teams needed to communicate with relevant people to generate more urgency relentlessly.	(Kotter, 2008)

3.4.12. Theme 12: Financial Management

The literature presents financial measures of Net present value (NPV), Return on investment (ROI), and Benefit-cost ratio (BCR).

3.4.12.1. Net Present Value

Zidane et al. (2018) bring two ways of seeing the variability of the Net Present Value after a certain time: (i) the reduction of the network monetary value because of technology advances, inflation, and deregulation; and (ii) the rise of the monetary value following a competition.

3.4.12.2. Return on Investments and Cost to Benefit Ratio

The urgency of a commercial project primarily resides in Return on Investment (ROI), where ROI is related to two factors - savings and investment - and equals savings on investment (Rong Chang et al., 2014; Zidane et al., 2018). Zidane et al. (2018) present a case study where the telecommunication project expected four times the return on the investment. The sooner the service was introduced to the market, the sooner it would generate income, imposing the urgent project duration compressing. However, according to the authors, the ROI can be seen as simply cost-effectiveness in an urgent project.

3.4.13. Theme 13: Health and Safety Management

The literature presents two health and safety management characteristics: *Intensity-Safety Relationship*, and *Time Constraints on Safety*.

In the context of the Intensity-Safety Relationship, there are safety issues in extreme-intensity work situations, as shown by Zidane et al. (2018), such as working nonstop for 18 hours a day for three months. Mohammadi and Tavakolan (2019) modeled the effects of production pressure on safety performance, demonstrating that pressures caused by contractual deadlines or clients negatively affect safety performance. The authors describe that, under high levels of pressure: managers can ignore safety practices, increasing working speed to catch up the schedule and meet the expectations of clients and companies; it is more likely that the workers would make mistakes; and production pressure negatively impacts safety through the increase of rework and fatigue (Mohammadi and Tavakolan, 2019). The project pressure is, therefore, related to safety management (Liu et al., 2022).

Regarding Time Constraints on Safety, as presented by Sullivan and Beach (2009), time constraints, compounded by the need to reduce costs, can adversely affect safety. In high-stakes environments such as space exploration, the pressure to meet deadlines and budget constraints can compromise safety measures, as essential processes are rushed or bypassed. The Columbia disaster presents a lesson when safety is non-negotiable.

The article by Gonçalves et al. (2023) aligns with both the characteristics of managing intensity-security relationships and the implications of time constraints on security, as it focuses on the rapid restructuring of the health system and adaptations of public health policies in response to the COVID-19 pandemic emergency. The article discusses how urgent reorganization was needed to manage hospital and ICU capacities, medical and nursing staff, and essential supplies such as oxygen during the peak demand of the pandemic.

3.4.14. Theme 14: Innovation Management

A *dominant design* is vital in commercial new product development or an entirely new service (van den Ende, 2003). The idea of urgent projects is evident when innovators must create products quickly to establish the dominant design (van den Ende, 2003). Thus, to bring a new (Tishler et al., 1996) product or service to the market, the project is considered to be of a high degree of urgency. McDonough and Pearson (1993) studied the perceived urgency when new products must be offered extremely fast to not lose market share. The authors present the companies' dilemma of fast delivery of less innovative projects versus the delay of the new product in the hope of increasing innovation, in a more strategic level of analysis. Mitcheltree (2023) explores how innovation in an inter-organizational setting requires a concerted effort to overcome complacency. The study emphasizes the sense of urgency, collaboration, and risk management to achieve innovations.

3.5. PARTIAL CONCLUSIONS

The combination of Systematic Literature Review and Snowball approach reveals an understanding of how urgency impacts project execution across various dimensions. This

paper identified eight characteristics consolidated into three core concepts of *expectation*, *priority*, and *speed*, which are essential in conceptualizing urgent projects. These concepts produce a more solid conceptual foundation, minimizing the gap of lack of consensus in the urgent project definition presented by Zidane et al. (2018), and reinforcing some concepts related to urgency presented by da Penha and ten Caten (2023b).

Additionally, the research highlighted sixty-nine core characteristics and fourteen thematic areas of Urgent Project Management, encompassing *human resources and teams*, *time*, *stakeholders' urgency*, *risks*, *costs*, *suppliers*, *scope*, *quality*, *integration*, *knowledge*, *communications*, *financial metrics*, *health and safety*, and *innovation*. The findings indicate that urgent projects demand a distinct approach to management, emphasizing the cruciality of rapid decision-making, stakeholder engagement, and adaptive strategies to manage complexities and uncertainties. We underscore a dynamic and flexible project management framework that accommodates accelerated timelines, prioritizes safety, and leverages the skills and commitment of highly competent teams. Moreover, integrating innovative practices and communication channels is highlighted as vital for sustaining the pace and ensuring the delivery of urgent projects.

It is noticeable that, depending on the urgency, urgent project management has similarities with conventional projects, such as commitment-innovation relationships, team selection, and operational flexibility behaviors. However, despite the similarities, managing extremely urgent projects seems to require a different mindset that transcends traditional, agile management approaches, and project management methodologies.

Because of the time pressure and constraints, such as speed management, intensity to deliver superfast results, a short-term mindset, and the recognition and decree of urgency, the achievement of some urgent projects seems to lie in the mindset changing, from traditional, agile, or hybrid, to an urgent short-term mindset where the sense of urgency, speed, adaptation, flexibility, autonomy, innovation, decentralized and pragmatic leadership, experience and high level of skills, intensity, instinct, timing, collaboration, trust in oral commitments and stakeholder partnerships, scope fragmentation, intensified stakeholder demands, heightened risks, and the necessity for rapid, yet thoughtful decision-making, for example, seems to be more prominent addressing the project urgency. Therefore, *an urgent mindset should be adaptable to the unique challenges presented by urgency*. Moreover, the analysis of the risk categories narrows the perspective of urgent projects to people because of the relevance of partnerships, teams, and time. *Projects with high levels of urgency seem to have a high-risk high-level return strategy*.

Notice that speed, a combination of time and outcome, appears as an essential dimension, encapsulating the other characteristics of urgent project management. In the theoretical domain, the traditional theory of time management in project management fails to analyze urgent projects, even with schedule compressing by reducing the duration of the project as much as possible by "crashing" or "fast-tracking" it (PMI, 2017b, p. 215; Zidane et al., 2018). Although there is some research about time management, there is not enough research about the meaning of time in urgent project management. Traditional research on time management is focused on execution and control, maybe because of the general perspective of time as a uniform, universal, and infinite measurement. Accordingly, there is much more to understand about time in the context of Project Management and project time management. This study helps establish the urgent project management theoretical domain.

This research is suitable because it gathers different levels of understanding in project management knowledge areas with diverse management challenges, characteristics, and real-world urgent project tradeoffs. Furthermore, it points to a potential mismatch between Project Management Theory and the practicalities of managing a highly urgent project about achieving local maximums in many dimensions, such as speed, work, tasks, and so on. Therefore, it was not possible to prove that the Project Management Theory works in highly urgent projects, nor that there is a unique dynamic or best practice for managing these projects. On the contrary, based on project management concepts, it was possible to show that there are dilemmas and contradictions in the theory to be researched

in the future, and that the literature does not address these levels. Hence, they need to be explored in case studies, for instance.

Finally, we expect to achieve this research's aim by summarizing the body of knowledge on urgent project management to be tested and generalized to solve real-world problems. The insights derived from this article contribute to a deeper understanding of urgent project management.

3.4.1. Limitations

This research's limitations are related to: (i) The possibility of exploring more scientific databases for data extraction and analysis; and (ii) The necessity to validate the findings on urgent real-world projects.

3.4.1. Future Challenges

New research on urgent projects is required to better understand some of the characteristics related to this paper, e.g., the individual sense of urgency; the trade-off between specificity and flexibility; the relationship among uncertainty, speed, and risks; the paradox of accuracy and speed simultaneously; necessary skill to deliver an extremely urgent project in the context of improvisation and fragmentation; and so on.

Table 3.8 presents some future challenges of urgent project management according to the concepts (*expectation* – C1, *priority* – C2, and *speed* – C3) and themes (*human resources and teams* – T1, *time* – T2, *stakeholders' urgency* – T3, *risks* – T4, *costs* – T5, *suppliers* – T6, *scope* – T7, *quality* – T8, *integration* – T9, *knowledge* – T10, *communications* – T11, *financial* – T12, *health and safety* – T13, and *innovation* – T14).

Table 3.8 - Urgent project management future challenges.

Concepts or Themes, and Characteristics		**Future Challenges**	#
C1	Unexpected or Unforeseen Urgency	Conduct studies on preparation and response to unforeseen events; examine the linkage between practices and success (Geraldi et al., 2010).	1
	Expected or Foreseen Urgency	Research commercial urgent expected projects.	2
C2	Time Urgency	Study correlations between individual and project urgency. Analyze stakeholder prioritization in extreme urgency projects.	3
	Dynamic Urgency	Investigate the evolution of urgency, i.e., projects that became urgent after their beginning, having urgent intermediate or final deadlines.	4
C3	Work Intensity	No identified gap.	--
	Timing Speed	Analyze how timing speed is managed in urgent projects.	5
	Speed Management	Explore the effects of speed management on project urgency and vice versa. Understand speed layers management.	6
	Speed-Reflection Balance	Differentiate between time-based and need-based urgencies, and study optimal pacing strategies, for instance. E.g., when to slow down and have patience.	7
T1	Team Selection	No identified gap.	--
	Commitment-Innovation Relationship	Examine how a sense of urgency affects commitment and innovation in teams. Explore psychological and individual aspects for engagement in urgent projects.	8
	Group Dynamics	No identified gap.	--
	Expecting the Unexpected Mindset	Understand teams, managers, or organizations with the mindset of expecting the unexpected. Advance the topic from military and commercial perspectives.	9
	Operational Flexibility Behaviors	Resolve contradictions in the literature regarding flexible and adaptive behaviors in urgent projects. Explore the trade-off between specificity and flexibility under time pressure.	10

	Concepts or Themes, and Characteristics	Future Challenges	#
	Accuracy-Speed Management	Understand the link between project uncertainty (accepting or minimizing errors), speed, and their relation to increasing urgent project risks (e.g., increasing costs or compromising quality). Explore the paradox of achieving accuracy and speed simultaneously.	11
	Highly Skilled Teams Management	Understand and assess the decision-making autonomy of managers in urgent projects. Identify skills that enhance improvisation and fragmentation.	12
	Intensity-Consistency Relationship	Analyze the positive and negative impacts of intensity in an urgent project over the consistency of a typical project. Understand projects overcoming ripple effects of schedule changes. Assess the effects of increase intensity with the fast entrance of new stakeholders.	13
	Leadership Skills and Performance Relationship	Identify the administrative, human relations, leadership, technical, multicultural coordination, and managerial skills for managing urgent projects.	14
	Short-Term Urgent Mindset	Explore the short-term urgent mindset in urgent and emergency projects.	15
	Productive Drive vs. Destructive Frenzy	No identified gap.	--
T2	Recognition and Decree	Investigate the origins of why urgent projects emerge.	16
	Space-Time Analysis	Develop and test new forecasting methods for urgent project scenarios. For example, time and space-time forecasting could give fast scenarios for fast decision-making and logistical analysis. Testing project schedule forecasting that could consider conventional projects to build scenarios for urgent projects.	17
	Event Prediction	Test and evaluate machine learning models for predicting disaster timings.	18
	Temporariness	Understand different time perspectives in the context of urgent projects.	19
T3	Attribute Urgency	Investigate urgency attributes of stakeholders in real-time urgent situations.	20
	Mobilization	Analyze the scenarios in which urgent projects arise and analyze how stakeholder urgency allows stakeholders to coordinate immediate responses, the risks involved; and its relation to response strategies.	21
	Interests and Claims	Deepen understanding of stakeholders' interests and claims in urgent projects.	22
	Collaborative Arrangement	Explore factors influencing short-term and long-term success in collaborative urgent projects.	23
	Performance	Define what exactly performance in extremely urgent projects depends on the context and the emergence, and differentiate between short-term and long-term performance.	24
	Delivery	Research on stakeholder delivery and possible decisions on project delivery models.	25
	Shared Sense of Urgency	No identified gap.	--
T4	Risk Categories	Advance understanding of time urgency and partnership risks.	26
	Impact Categories	No identified gap.	--
T5	Cost-Value Relationship	Explore definitions of value in the context of urgent projects and their costs.	27
	Cost-Speed Dilemma	Develop simulation models to explore time, cost, and uncertainty trade-offs in urgent projects.	28
	Cost-Risk Dilemma	No identified gap.	--
T6	Suppliers Selection	Deepen the selection of suppliers in urgent projects, especially regarding the delivery of scope, performance, value, and profit margin.	29

Concepts or Themes, and Characteristics		Future Challenges	#
	Suppliers Cooperation	Deepen the analysis of external, local, regional, and global suppliers regarding face-to-face and virtual cooperation. Study cooperation dynamics. E.g., understand the perspective of long-term cooperation, therefore, after the urgent projects.	30
T7	Scope Fragmentation	No identified gap.	--
	Scope Prioritization	No identified gap.	--
	Scope Uncertainty	No identified gap.	--
T8	Compromising Quality	No identified gap.	--
T9	Project Direction and Management	Integrate and assess tools and technologies for managing urgent projects.	31
	Pilot Projects	No identified gap.	--
T10	Knowledge Creation	No identified gap.	--
	Knowledge Transfer	No identified gap.	--
T11	Decentralized Communication	Investigate the impact of decentralized communication on decision-making speed and stakeholder engagement.	32
	Trust and Commitment	Identify and analyze cases where oral commitments in urgent projects failed, exploring reasons and solutions.	33
	Clear, Open, and Continuous Communication	No identified gap.	--
	Communication Need	No identified gap.	--
T12	Net Present Value	No identified gap.	--
	Return on Investments and Cost to Benefit Ratio	No identified gap.	--
T13	Intensity-Safety Relationship	No identified gap.	--
T14	Dominant Design	No identified gap.	--

3.6. APPENDIX 3A: Additional References Identified Through Snowball Method

This appendix (Table 3.9) presents the articles added after SLR from the first-order Snowball approach. The table shows the sources obtained in the Systematic Literature Review and the respectively added references (articles, books, book chapter, technical note, and call for paper).

Table 3.9 - Additional articles gathered by the Snowball approach.

Original Source from SLR	Reference Added	Type	#
(Nachbagauer, 2022)	(Bechky and Okhuysen, 2011)	Article	1
	(Meyer and Simsa, 2018)	Article	2
	(Nachbagauer and Schirl-Boeck, 2019)	Article	3
	(Söderholm, 2008)	Article	4
	(Weick and Sutcliffe, 2008)	Article	5
	(Weick and Sutcliffe, 2015)	Book	6
	(Lundin and Söderholm, 1995)	Article	7
	(Du Gay, 2016)	Book Chapter	8
	(Granqvist and Gustafsson, 2016)	Article	9

Original Source from SLR	Reference Added	Type	#
	(Wajcman and Dodd, 2017)	Book	10
(Fredberg and Pregmark, 2022)	(Kotter, 2008)	Book	11
(Wang et al., 2021)	(Morgeson and DeRue, 2006)	Article	12
(Ligthart et al., 2016)	(Conte et al., 1995)	Article	13
(Bahadorestani et al., 2019)	(Mitchell et al., 1997)	Article	14
(Al Nahyan et al., 2019)	(Soetanto and Proverbs, 2002)	Article	15
(Zidane et al., 2018)	(Zidane et al., 2016)	Article	16
	(Wearne and White-Hunt, 2014)	Book	17
	(Loosemore, 1998)	Article	18
	(Walker and Lloyd-Walker, 2016)	Article	19
	(Barnes, 1970)	Technical Note	20
	(Geraldi et al., 2010)	Journal Article	21
(Liu et al., 2022)	(Assaad et al., 2020)	Article	22
	(Mohammadi and Tavakolan, 2019)	Article	23
(Mojtahedi and Oo, 2017)	(Yun et al., 2016)	Article	24
	(Swarup et al., 2011)	Article	25
(De Waard and Kalkman, 2022)	(Hällgren et al., 2018)	Article	26
	(Hällgren et al., 2022)	Call for Paper	27
	(Collyer et al., 2010)	Article	28
	(Sullivan and Beach, 2009)	Article	29
	(de Waard and Kramer, 2008)	Article	30
	(de Waard et al., 2014)	Article	31
	(Melkonian and Picq, 2011)	Article	32
	(Melkonian and Picq, 2010)	Article	33
	(Musca et al., 2014)	Article	34
	(Dimitroff et al., 2005)	Article	35
	(Trivedi and Singh, 2017)	Article	37
	(Crawford et al., 2013)	Article	38
	(Walker et al., 2017)	Article	39
	(Tauber, 2015)	Article	40
	(von Meding et al., 2016)	Article	41
	(Vahanvati and Mulligan, 2017)	Article	42
	(Kim and Choi, 2013)	Article	43
	(Hayles, 2010)	Article	44
	(Levie et al., 2017)	Article	45
	(Zhong and Pheng Low, 2009)	Article	46
(van den Ende, 2003)	(Lambe and Spekman, 1997)	Article	47
(da Penha et al., 2024)	(da Penha and ten Caten, 2023a)	Article	48
	(da Penha and ten Caten, 2023b)	Article	49
	(Luo et al., 2020)	Article	50
	(Chen et al., 2021)	Article	51
	(Laneve et al., 2016)	Article	52
	(Sun et al., 2017)	Article	53
	(Maleka and Matli, 2022)	Article	54
	(Wang et al., 2021)	Article	55

3.7. APPENDIX 3B: Core Concepts and Characteristics of Urgent Projects

Table 3.10 organizes the three concepts (*expectation*, *priority*, and *speed*) and their characteristics related to urgent projects.

Table 3.10 - Urgent project core concepts.

#	Concepts	Urgent Project Characteristics	Sources
1	Expectation	Unexpected or Unforeseen Urgency	(Geraldi et al., 2010; Hällgren and Wilson, 2008; Söderholm, 2008; Wearne, 2006; Wearne and White-Hunt, 2014, p. 17; Weick and Sutcliffe, 2008)
		Expected or Foreseen Urgency	(Geraldi et al., 2011; Økland et al., 2018; Shenhar and Dvir, 2007; Wearne and White-Hunt, 2014; Williams, 2005; Zidane et al., 2018)
2	Priority	Time Urgency	(Assaad et al., 2020; Liu et al., 2022; Mohammadi and Tavakolan, 2019; Ren et al., 2019; Zhou et al., 2020)
		Dynamic Urgency	(De Waard and Kalkman, 2022; Leung et al., 2016; Musca et al., 2014)
3	Speed	Work Intensity	(da Penha et al., 2024; Leung et al., 2016; Zidane et al., 2018)
		Timing Speed	(McDonough and Pearson, 1993; Nachbagauer, 2022)
		Speed Management	(Azeem et al., 2022; De Waard and Kalkman, 2022; Fredberg and Pregmark, 2022; Lu et al., 2022; McDonough and Pearson, 1993; Mohammadi and Tavakolan, 2019; Nachbagauer, 2022; Wang et al., 2016; Wang et al., 2019; Wearne and White-Hunt, 2014; Zidane et al., 2018)
		Speed-Reflection Balance	(Du Gay, 2016; Granqvist and Gustafsson, 2016; Kotter, 2008; Lundin and Söderholm, 1995; Nachbagauer, 2022; Söderholm, 2008; Wajcman and Dodd, 2017)

3.8. APPENDIX 3C: Themes and Characteristics of Urgent Project Management

This appendix summarizes the characteristics classified into themes related to managing urgent projects.

Table 3.11 - Themes and characteristics of urgent project management.

#	Theme	Urgent Project Management Characteristics	# Characteristics
1	Human Resources and Teams	Team Selection; Commitment-Innovation Relationship; Group Dynamics; Expecting the Unexpected Mindset; Operational Flexible Behaviors; Accuracy-Speed Management; Highly Skilled Teams Management; Intensity-Consistency Relationship; Leadership Skills and Performance Relationship; Short-Term Urgent Mindset; and Productive Drive vs. Destructive Frenzy.	11
2	Time	Recognition and Decree; Space-Time Analysis; Event Prediction; and Temporariness.	4
3	Stakeholders' Urgency	Attribute Urgency; Mobilization; Interests and Claims; Collaborative Arrangement; Performance; Delivery; and Shared Sense of Urgency.	7
4	Risks	Risk Categories: Cost; Event Occurrence; Partnership; Physical Resources; Quality; Project; Regulation; Reputation; Safety; Stakeholders; Team Resources; Technological; Time Urgency; Operational; Imagined; and Unknown.	16
		Impact Categories: Cost; Environmental; Financial; Impact on Life; Health; Impact on Strategic Goals; Reputation; Time.	8

#	Theme	Urgent Project Management Characteristics	# Characteristics
5	Costs	Cost-Value Relationship; Cost-Speed Dilemma; and Cost-Risk Dilemma.	3
6	Suppliers	Supplier Selection; and Suppliers Cooperation.	2
7	Scope	Scope Fragmentation; Scope Prioritization; and Scope Uncertainty.	3
8	Quality	Compromising Quality.	1
9	Integration	Project Direction and Management; and Pilot Projects.	2
10	Knowledge	Knowledge Creation; and Knowledge Transfer.	2
11	Communications	Decentralized Communication; Trust and Commitment; Clear, Open, and Continuous Communication; and Communication Need.	4
12	Financial	Net Present Value; Return on Investments; and Cost to Benefit Ratio.	3
13	Health and Safety	Intensity-Safety Relationship; and Time Constraints on Safety.	2
14	Innovation	Dominant Design.	1
		Total	69

3.9. APPENDIX 3D: Characteristics of Human Resources and Teams Management

Table 3.12 describes the characteristics, each with a brief description and sources related to human resources and team management in urgent projects.

Table 3.12 - Summary of the urgent project teams management characteristics.

#	Characteristics	Short Description	Sources
1	Team Selection	The challenge of selecting professionals for an urgent project.	(Campbell et al., 2021; De Waard and Kalkman, 2022; Tauber, 2015; von Meding et al., 2016)
2	Commitment-innovation Relationship	People fully involved in urgent projects can be more committed and innovative.	(De Waard and Kalkman, 2022; Loosemore, 1998; Melkonian and Picq, 2010; Wearne and White-Hunt, 2014; Zidane et al., 2018)
3	Group Dynamics	The existence of the inhibiting group dynamics.	(De Waard and Kalkman, 2022; Dimitroff et al., 2005; Hällgren, 2010)
4	Expecting the Unexpected Mindset	Teams with capabilities to handle extreme changes in the project's context in military or rapidly changing environments.	(Bechky and Okhuysen, 2011; Collyer et al., 2010; De Waard and Kalkman, 2022; Melkonian and Picq, 2010)
5	Operational Flexible Behaviors	New behavior patterns based on flexibility and adaptation for the urgent project.	(Ligthart et al., 2016; Ren et al., 2019; Zidane et al., 2018)
6	Accuracy-speed Management	Urgency seems to present a challenge of balancing achieving speed and minimizing errors.	(Assaad et al., 2020; Azeem et al., 2022; Fredberg and Pregmark, 2022; Gonçalves et al., 2023; Zidane et al., 2018)
7	Highly skilled Teams Management	Highly skilled and experienced teams can simplify a project's complexity.	(Nachbagauer, 2022; Urrea and Yoo, 2023; Zidane et al., 2018)
8	Leadership Skills and Performance Relationship	It is the central axis that manages the speed and shortens the project's duration.	(McDonough and Pearson, 1993; Urrea and Yoo, 2023; Wearne, 2006; Zidane et al., 2018)

#	Characteristics	Short Description	Sources
9	Intensity-consistency Relationship	Highly skilled professionals' intensity over consistency.	(Assaad et al., 2020; Azeem et al., 2022; Mohammadi and Tavakolan, 2019; Zidane et al., 2018)
10	Short-term Urgent Mindset	Practitioners need to have a short-term mindset with a focus on the problem.	(Zidane et al., 2018)

3.10. APPENDIX 3E: Risk Management

Table 3.13 provides risk categories, with a brief description of the risks associated with each category and the related sources.

Table 3.13 – Risk categories in urgent project management.

#	Risk Categories	Risks Short Description	Sources
1	Cost Risks	Risks of contractual cost claims, including inaccurate cost estimates, fluctuating material prices, and late payments.	(Azeem et al., 2022)
2	Event Occurrence Risks	Risks of event occurrence (seismic and neotectonic) in the context of earthquakes.	(Behrmann et al., 2005; and Rózsa et al., 2005)
3	Partnership Risks	Risks of mobilization of contractors, coordination and communication between parties, and poor performance of contractors.	(Azeem et al., 2022)
		Risk of a large partnership contract.	(Zidane et al., 2018)
		Risk of mobilizing resources without signing a contract.	(Zidane et al., 2018)
4	Physical Resources Risks	Risks related to the overload of physical resources and availability of materials. For instance, not enough ICU beds available, and quickly expanding hospital facilities.	(Azeem et al., 2022; Gonçalves et al., 2023)
5	Quality Risk	Risk of compromising quality.	(Azeem et al., 2022; Zidane et al., 2018)
6	Project Risks	Risks of project errors, inadequate documentation gaps, and scope changes.	(Azeem et al., 2022)
		Significant levels of interdependence among projects.	(Collyer et al., 2010)
7	Regulation Risks	Risk of obtaining no objection certificates (NOCs)/authorizations.	(Azeem et al., 2022)
8	Reputation Risks	Risks related to the prime contractor's reputation as a supplier.	(Zidane et al., 2018)
		Risk of damage to reputation.	(Sullivan and Beach, 2009)
9	Health and Safety Risks	Safety-related cost-cutting risks.	(Zidane et al., 2018)
		Quickly changing high-pressure circumstances.	(Gonçalves et al., 2023)
		Risk of staff burnout.	(Gonçalves et al., 2023)
		Risk of death.	(Gonçalves et al., 2023; Sullivan and Beach, 2009)
10	Stakeholders Risks	Stakeholder-related risks through integrated analyses of risk attributes and stakeholder influences (e.g., urgency).	(Xia et al., 2017)
		Engagement of stakeholders with diverse objectives and viewpoints.	(Gonçalves et al., 2023)
		Risks to not meeting stakeholders' expectations for safety and performance.	(Sullivan and Beach, 2009)
11	Team Resources	Risk of changing work rates and availability of qualified personnel.	(Azeem et al., 2022)

#	Risk Categories	Risks Short Description	Sources
	Risks	Risk of deficient staffing levels due to the specialized care needed.	(Gonçalves et al., 2023)
		Risk of group thinking, when group members focus too much on consensus, possibly neglecting imperative matters.	(Sullivan and Beach, 2009)
12	Technological Risks	Risk of technological changes during the crisis, for example, during the COVID-19 pandemic, because of the superfast digital transformation.	(Azeem et al., 2022)
		Risk when the failure to properly manage technology could threaten the value of company stock or drain resources from more profitable ventures.	(Sullivan and Beach, 2009)
		Risk of compromised innovation quality.	(Mitcheltree, 2023)
		Risk of missed opportunities for innovation as a result of complacency.	(Mitcheltree, 2023)
13	Time Urgency Risks	Risk of inadequate schedule pressure, failure to act when the project needs to be accelerated, or needs to "take appropriate action, such as hiring new staff, using overtime, or adding shifts."	(Assaad et al., 2020)
		Risk of ripple effects from time pressure, including long working hours; fatigue and morale decline; reduced productivity; errors increase; and even death, among others.	(Assaad et al., 2020; Sullivan and Beach, 2009)
		Risk of inaccurate time estimates.	(Azeem et al., 2022)
		Risks associated with urgent rework projects.	(Yim et al., 2015)
		Risks of excessively rigid time constraints imposition.	(Collyer et al., 2010; Sullivan and Beach, 2009)
		The risk of project delays.	(Azeem et al., 2022; da Penha et al., 2024; Mitcheltree, 2023)
14	Operational Risks	Risk of situations that include uncertain or hazardous operating environments.	(Sullivan and Beach, 2009)
		Risk such as false assumptions about reality.	(Sullivan and Beach, 2009)
		Risks of the disaster incubation period, when minor anomalies evolve into significant problems.	(Sullivan and Beach, 2009)
15	Imagined Risks	Risk that has not materialized but has been identified as a potential future hazard.	(Sullivan and Beach, 2009)
16	Unknown Risks	Risks that emerge in unique and unaccounted-for situations. E.g., risks in a changing environment.	(Collyer et al., 2010; Sullivan and Beach, 2009)

Table 3.14 outlines impact categories related to project urgency, each detailing the consequences and the respective sources.

Table 3.14 - Impact categories of project urgency.

#	Impact Categories	Impact or Consequence Short Description	Sources
1	Cost Impacts	Communication cost. The degree of urgency impacts the level of communication costs in collaboration projects.	(van den Ende, 2003)
2	Environmental Impacts	Environmental penalties. Greenhouse gas emissions "due to transporting heavy equipment, material supplies, and workers over greater distances."	(Ongpeng et al., 2019)

#	Impact Categories	Impact or Consequence Short Description	Sources
3	Financial Impacts	Financial benefits. Projects with high financial benefits were ranked as urgent.	(Zidane et al., 2018)
4	Impact on Life	Death. Projects with high time constraints may ignore risk factors, for example, in the death of the Columbia space shuttle astronauts.	(Gonçalves et al., 2023; Sullivan and Beach, 2009)
5	Health Impacts	Personal health. The impacts of stress, exhaustion, and safety.	(Zidane et al., 2018)
6	Impact on Strategic Goals	Strategic objectives. Projects with high-level strategic objectives were ranked as urgent.	(Zidane et al., 2018)
7	Reputation Impacts	Customer satisfaction. Customers from other projects were dissatisfied with the main contractor due to their bold decision to repurpose equipment from several other projects.	(Zidane et al., 2018)
8	Time Impacts	Number of redesigns. The degree of urgency impacts the number of redesigns in collaboration projects.	(van den Ende, 2003)

3.11. APPENDIX 3F: Data Matrix of Sources, Concepts, and Themes

Table 3.15 provides the data matrix of sources, concepts, and themes. The concepts and themes are indicated by C1 to C3, and T1 to T14. Each source is marked with 'x' against specific concepts or themes it addresses. Themes T1, T2, T3, T4, and T10 have relatively more references.

Table 3.15 – Data matrix of sources, concepts, and themes.

#	Sources	C 1	C 2	C 3	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14
1	(Aaltonen et al., 2008)						x											
2	(Aarrestad et al., 2015)													x				
3	(Al Nahyan et al., 2019)						x								x			
4	(Assaad et al., 2020)		x		x	x		x						x				
5	(Azeem et al., 2022)			x	x		x	x	x			x						
6	(Bahadorestani et al., 2019)						x											
7	(Barnes, 1970)								x									
8	(Bechky and Okhuysen, 2011)				x			x					x	x				
9	(Behrmann et al., 2005)					x		x										
10	(Bingham et al., 2018)						x											
11	(Campbell et al., 2021)				x								x					
12	(Chen et al., 2021)					x		x			x	x	x	x				
13	(Cochran et al., 1978)					x												
14	(Collyer et al., 2010)			x		x		x					x					
15	(Conte et al., 1995)				x	x												
16	(Crawford et al., 2013)						x											
17	(da Penha and ten Caten, 2023a)		x	x		x			x		x							
18	(da Penha and ten Caten, 2023b)		x	x		x	x	x	x		x		x					
19	(da Penha et al., 2024)	x		x		x	x	x			x		x	x	x		x	x
20	(De Waard and Kalkman, 2022)		x	x	x	x	x		x		x	x	x	x				
21	(de Waard and Kramer, 2008)				x								x					
22	(de Waard et al., 2014)	x			x	x							x	x				
23	(Dimitroff et al., 2005)				x			x						x				
24	(Du Gay, 2016)			x		x							x					
25	(Eisenhardt and Brown, 1998)	x																
26	(Fredberg and Pregmark, 2022)			x	x													
27	(Gab-Allah et al., 2015)					x												

#	Sources	C 1	C 2	C 3	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14
28	(Geraldi et al., 2010)	x			x			x							x			
29	(Gonçalves et al., 2023)				x	x	x	x			x			x			x	
30	(Granqvist and Gustafsson, 2016)			x		x												
31	(Hällgren and Wilson, 2008)	x																
32	(Hällgren et al., 2018)							x			x							
33	(Hällgren et al., 2022)					x		x						x				
34	(Hällgren, 2010)				x													
35	(Hayles, 2010)													x				
36	(Ishak et al. (2015)									x								
37	(Kim and Choi, 2013)							x				x	x	x				
38	(Kotter, 2008)				x	x	x								x			
39	(Lambe and Spekman, 1997)							x					x	x				x
40	(Laneve et al., 2016)							x										
41	(Leung et al., 2016)		x															
42	(Levie et al., 2017)						x	x					x					
43	(Ligthart et al., 2016)				x	x	x											
44	(Lin et al., 2019)						x											
45	(Liu et al., 2022)		x														x	
46	(Loosemore, 1998)				x			x							x			
47	(Lu et al., 2022)			x														
48	(Lundin and Söderholm, 1995)			x		x							x	x				
49	(Luo et al., 2020)				x	x	x	x		x			x					
50	(Maleka and Matli, 2022)																	x
51	(McDonough and Pearson, 1993)			x	x													x
52	(Melkonian and Picq, 2010)				x									x				
53	(Melkonian and Picq, 2011)				x									x				
54	(Meyer and Simsa, 2018)	x											x	x				
55	(Mitchell et al., 1997)						x											
56	(Mitcheltree, 2023)				x		x	x						x	x			x
57	(Mohammadi and Tavakolan, 2019)		x	x	x			x									x	
58	(Mojtahedi and Oo, 2017)						x											
59	(Morgeson and DeRue, 2006)				x	x		x										
60	(Musca et al., 2014)		x		x										x			
61	(Nachbagauer and Schirl-Boeck, 2019)	x						x					x	x				
62	(Nachbagauer, 2022)			x	x	x					x							
63	(Økland et al., 2018)	x							x									
64	(Ongpeng et al., 2019)					x		x										
65	(PMI, 2017)											x						
66	(Ren et al., 2018)													x	x			
67	(Ren et al., 2019)		x		x									x				
68	(Rong Chang et al., 2014)															x		
69	(Rózsa et al., 2005)					x		x										
70	(Shenhar and Dvir, 2007)	x																
71	(Silva, 2014)						x											
72	(Söderholm, 2008)	x						x							x			
73	(Soetanto and Proverbs, 2002)						x						x		x			
74	(Sullivan and Beach, 2009)				x			x	x					x				
75	(Sun et al., 2017)										x		x					x
76	(Sun et al., 2019)													x	x			
77	(Swarup et al., 2011)						x						x	x				
78	(Tauber, 2015)				x		x							x				
79	(Tishler et al., 1996)																	x
80	(Trivedi and Singh, 2017)							x					x					

#	Sources	C 1	C 2	C 3	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8	T 9	T 10	T 11	T 12	T 13	T 14
81	(Urrea and Yoo, 2023)				x									x				
82	(Vahanvati and Mulligan, 2017)						x				x		x	x				
83	(Vahanvati, 2018)						x											
84	(van den Ende, 2003)							x						x				x
85	(von Meding et al., 2016)				x								x	x				
86	(Wajcman and Dodd, 2017)			x		x												
87	(Walker and Lloyd-Walker, 2016)						x						x	x				
88	(Walker et al., 2017)						x											
89	(Wang et al., 2016)			x														
90	(Wang et al., 2019)			x		x												
91	(Wang et al., 2021)				x			x					x		x			
92	(Wearne and White-Hunt, 2014)	x		x	x		x		x						x			
93	(Wearne, 2006)				x		x											
94	(Weick and Sutcliffe, 2008)	x			x			x					x	x				
95	(Weick and Sutcliffe, 2015)	x			x			x					x	x				
96	(Williams, 2005)	x																
97	(Wu et al., 2020)					x												
98	(Xia et al., 2017)						x	x										
99	(Yan et al., 2009)					x												
100	(Yang et al., 2014)						x											
101	(Yun et al., 2016)												x	x	x			
102	(Zhong and Pheng Low, 2009)														x			
103	(Zhou et al., 2020)		x											x				
104	(Zidane et al., 2016)					x		x	x									
105	(Zidane et al., 2018)	x		x	x	x	x	x	x	x	x	x			x	x	x	
	Total	**14**	**10**	**19**	**36**	**30**	**31**	**35**	**10**	**3**	**11**	**6**	**28**	**34**	**16**	**2**	**5**	**8**

4. ARTICLE 3: ANALYZING URGENCY IN ACADEMIC LITERATURE: A COMPUTATIONAL TEXT-MINING APPROACH

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Abstract:
Managing urgency in time-sensitive projects is an underexplored area in project management literature. This article addresses the gap by utilizing Word Frequency Analysis (WFA) and Latent Dirichlet Allocation (LDA) to analyze the concept of urgency within academic writings on project management. It analyzes 105 academic papers and extracts 1349 sentences containing "urgent" or "urgency." Key terms such as "unexpected," "time," and "stakeholder" emerged from a Word Frequency Analysis of 4440 preprocessed words. At the same time, LDA revealed twelve distinct themes related to managing urgent projects. This study's combination of WFA and unsupervised machine learning in Natural Language Processing (NLP) helps to advance the field of project management by offering a novel, data-driven understanding of urgent project management.

Keywords:
Topic Modeling, Latent Dirichlet Allocation, Word Frequency Analysis, Project Management, Urgent Projects, Urgency, Text Mining

Article 3

Analyzing Urgency in Academic Literature: A Computational Text-Mining Approach

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Abstract: Managing urgency in time-sensitive projects is an underexplored area in project management literature. This article addresses the gap by utilizing Word Frequency Analysis (WFA) and Latent Dirichlet Allocation (LDA) to analyze the concept of urgency within academic writings on project management. It analyzes 105 academic papers and extracts 1349 sentences containing "urgent" or "urgency." Key terms such as "unexpected," "time," and "stakeholder" emerged from a Word Frequency Analysis of 4440 preprocessed words. At the same time, LDA revealed twelve distinct themes related to managing urgent projects. This study's combination of WFA and unsupervised machine learning in Natural Language Processing (NLP) helps to advance the field of project management by offering a novel, data-driven understanding of urgent project management.

Keywords: Topic Modeling, Latent Dirichlet Allocation, Word Frequency Analysis, Project Management, Urgent Projects, Urgency, Text Mining

4.1. INTRODUCTION

The field of project management has undergone increasingly significant changes, becoming more complex (Nachbagauer, 2022; Zidane et al., 2018) and often more urgent in environments that change increasingly faster (da Penha et al., 2024). In this context, dealing, managing, and responding to urgent situations becomes a necessary skill for project managers and professionals.

Understanding the urgency in project management begins by recognizing the nature of this concept (da Penha and ten Caten, 2023b, 2023a; Kotter, 2008). Urgency can be intrinsic or external to the project, resulting from different sources, such as imminent deadlines, market demands (Zidane et al., 2018), unforeseen crises, or time constraints driven by innovation (da Penha et al., 2024; Lechler and Grace, 2007). These factors can pose unique challenges, requiring different strategies and responses. Furthermore, the perception of urgency can vary from individual to individual (Kotter, 2008) and between stakeholders, adding a layer of complexity to its management (da Penha and ten Caten, 2023b).

Understanding and managing urgency is even more important in some types of projects. For example, in megaprojects, where the scale and risks are high, the impact of poor time management and urgency can be profound, affecting project costs and the image of the maintainer (Denicol et al., 2020). Likewise, in agile project environments, where adaptability and rapid response are critical, navigating urgent steps, aspects, and deadlines can be crucial to maintaining project viability and delivering in the shortest possible time (da Penha et al., 2024).

Despite the recognized importance of urgency in project management (da Penha and ten Caten, 2023b, 2023a; Wearne, 2006; Wearne and White-Hunt, 2014; Zidane et al., 2018), there is a gap in comprehensive, computational analyses on how the concept is framed and addressed in academic literature. Existing research predominantly focuses on

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qualitative assessments or case-specific studies, such as da Penha et al. (2024), Wearne and White-Hunt (2014), and Zidane et al. (2018), leaving a gap in the data-driven exploration of urgency across a broad spectrum of project management contexts. This gap highlights the need for an in-depth computational approach to understand the varying dimensions, implications, themes, and responses associated with urgency in urgent project management literature.

To fill this gap, we present the following Research Question: *How is urgency articulated within the academic domain of urgent project management, and what insights can computational text-mining reveal about the thematic and conceptual patterns in the literature?* To answer this question, we aim to provide insights into how urgency is addressed in urgent project management. The study seeks to reveal patterns and themes associated with urgency. This research used a computational approach to process 105 academic papers related to urgent projects to achieve this. In this way, we used Word Frequency Analysis (WFA), Latent Dirichlet Allocation (LDA) based on Blei et al. (2003), and Natural Language Processing (NLP) to analyze sentences labeled as "urgent."

This paper contributes to a deeper understanding of urgency within project management literature. Computational analysis offers a data-driven view of urgency that provides a perspective on the implications of urgency as discussed in academic texts. By identifying prevalent themes and patterns, this study provides diverse ways academic literature addresses urgency. This perspective enhances theoretical and practical approaches to urgent project management.

The following section explores the theoretical background that frames our understanding of urgency in project management. It outlines the fundamental theories and prior research that are the basis for our approach to analyzing urgent project management. Following this, the research method details the selection of papers, data extraction, preprocessing, and analysis using Word Frequency Analysis and Latent Dirichlet Allocation. Then, we present the results, discussing the themes identified through the text-mining approach and their implications for theory and practice in project management. Finally, the discussion integrates these findings with the theoretical framework. Then, a conclusion summarizes the insights gained and suggests directions for future research.

4.2. THEORETICAL BACKGROUND

The theoretical foundation of this paper is presented based on the Project Management Theory in the context of urgent projects and analyzed using Latent Dirichlet Allocation (LDA).

4.2.1. Project Management Theory in the Context of Urgent Projects

The literature on project management was fuzzy on defining urgent projects and urgency levels. Despite da Penha and ten Caten's (2023b) efforts in conceptualizing urgency and defining urgent projects, there are no customary practices, so we can say what typical and urgent cases are (Zidane et al., 2018). At the same time, the way the word "urgent" is used in practice can imply different degrees of urgency open to different understandings; nevertheless, it is common sense that urgent means working faster than usual (Wearne and White-Hunt, 2014).

Da Penha and ten Caten (2023a) discuss the definition and concepts of urgent projects. Furthermore, other authors describe and analyze their characteristics such as speed management (Zidane et al., 2018), timing speed (McDonough and Pearson, 1993; Nachbagauer, 2022), unexpected (Söderholm, 2008; Wearne, 2006; Wearne and White-Hunt, 2014, p. 17; Weick and Sutcliffe, 2008) and expected urgency (Eisenhardt and Brown, 1998; Wearne and White-Hunt, 2014; Zidane et al., 2018), dynamic urgency (De Waard and Kalkman, 2022; Leung et al., 2016; Musca et al., 2014), time urgency (Kotter, 2008; Ren et al., 2018; Zhou et al., 2020), time cost (Wearne and White-Hunt, 2014) and

uncertainty (Cochran et al., 1978; Zidane et al., 2018). In other words, dimensions in the urgent project management domain.

4.2.2. Latent Dirichlet Allocation (LDA)

Latent Dirichlet Allocation - LDA (Blei et al., 2003) is a probabilistic machine learning method that allows us to find themes in extensive collections of texts. It assumes that these texts/documents are random mixtures of topics and that a probability distribution characterizes each topic. In other words, the method assumes that each document can be represented as a set of topics, and a distribution of words distinguishes each topic. LDA allows us to classify documents into topics even without predefined topics, making it a tool for unsupervised machine learning in natural language processing (NLP). LDA can handle the multitude of themes within text data, offering insights into prevailing ideas.

4.2.3. ChatGPT-4, natural language processing (NLP) and generation (NLG)

ChatGPT-4 (OpenAI, 2024), released by OpenAI, is a Generative Pre-trained Transformer - GPT model (Ren et al., 2021; Vaswani et al., 2017) and falls into the Large Language Model (LLM) category. The digit "4" means it is in the fourth variant of the model. By using Deep Learning (DL) methods (Goodfellow et al., 2016), ChatGPT-4 can understand and generate texts. The DL model uses a model trained on large amounts of text, allowing the outputs to reproduce/simulate logical and contextually appropriate text in each interaction. Therefore, ChatGPT-4 is an Artificial Intelligence (AI) in the Natural Language Processing – NLP and Generation – NLG category, as described by Vinyals and Le (2015). According to Brown et al. (2020), ChatGPT can be used for various purposes, such as creating diverse content, translating texts, discussions and conversations, creating tutorials, and programming, among other applications. Scientifically, applications range from evaluating the accuracy of differential medical diagnosis generated by ChatGPT (Hirosawa et al., 2023), picking stocks (Pelster and Val, 2024), and academic publishing in general (Curtis and ChatGPT§, 2023).

4.3. RESEARCH METHOD

This article adopts a computational text-mining approach to analyze urgency within academic literature on project management. It extracts and analyzes textual content from a corpus of academic files. The corpus was sourced from the Scopus database from 1973 to 2022 and consists of articles on urgent project management. The code was implemented in a Jupyter Notebook environment for reproducibility and data integrity.

4.3.1. Step 1: Data Extraction, Preprocessing, Structuring, and Output

The Python programming language was employed to perform automated data extraction from PDF files. The aim was to filter sentences containing "urgent" or "urgency." The study utilized the PyPDF2 library for reading PDFs and the 'pandas' library for data manipulation and storage. Essential libraries include 'os,' 'PyPDF2', 're,' 'regex,' 'pandas,' and 'google.colab' were utilized.

4.3.1.1. Data Extraction

In the initial stage, we focused on aggregating and preparing the dataset. This process began with identifying and collecting PDF documents stored within a directory. Using the ' os ' module, we listed all files in the specified directory. The directory path, denoted as '/content,' served as the repository for these documents. Subsequently, a filtering mechanism was implemented to isolate PDF files from the file listing.

4.3.1.2. Data Preprocessing

The subsequent phase involved extracting the textual content from each document for analysis. For this purpose, we employed the 'PyPDF2' library (Mathieu Fenniak et al., 2022) for reading and extracting text. Initially, we established a Python dictionary to store the text content extracted from each PDF file. Utilizing the `PdfReader` class provided by 'PyPDF2', we instantiated a reader object for each PDF file, enabling the traversal and text extraction from each page within the document. The extraction process iterated over all PDF document pages, aggregating the textual content into a single string variable. Upon completion of the extraction for each document, the consolidated text content was stored in the previously initialized dictionary, keyed by the document's filename, ensuring a structured and accessible dataset for further analysis.

4.3.1.3. Data Structuring

In this phase, we focused on extracting and transcribing sentences containing the terms "urgent" or "urgency." We employed regular expressions ('regex'), a tool for pattern matching and text manipulation facilitated by the `re` module. A regex pattern was used to delineate sentences within the text, enabling the targeted extraction of sentences encapsulating our terms of interest.

Then, we transformed the compiled dictionary into a pandas DataFrame, a data structure for data manipulation. This transformation facilitated sorting documents by publication year extracted from the PDF filenames. The DataFrame was then sorted based on the year of publication.

4.3.1.4. Data Output

Next, we employed the `files` module from `google.colab` (Google, 2024) to download the processed DataFrame directly to a local machine for subsequent analysis. The resultant dataset was saved as an Excel file.

4.3.1.5. Data Verification and Analysis

After extracting and structuring the data, the research team manually verified and analyzed the generated dataset. Each data set row was visually read and cross-referenced with the content of the original PDF files. This step was vital to ensure the analysis's integrity and the collected data's reliability. Any discrepancies or inconsistencies were corrected, establishing a reliable data set for future research steps. Sources and authors within the sentences were excluded to ensure readability. We have deleted 26 rows.

4.3.2. Step 2: Word Frequency Analysis (Keywords Analysis)

This method allows us to conduct a first-level analysis of the "Urgent Sentence" column by word frequency to understand the common themes or topics related to urgency in project management. Objectives: (i) To examine the prevalence and significance of specific words in sentences tagged as "urgent;" and (ii) To understand the thematic underpinnings in the discourse surrounding urgency.

4.3.2.1. Data Preprocessing

Text data was preprocessed using the Natural Language Toolkit (NLTK), a library for working with human language data (Bird et al., 2009). This process involved removing punctuation, converting all text to lowercase, tokenizing the sentences to break them down into individual words (or 'tokens'), and removing stopwords, commonly used words that are excluded from analyses due to their lack of substantive content (common words such as "and," "the," "is," and so on, that do not add meaning to a sentence), along with non-alphabetic characters. A predefined list of stopwords from the Natural Language Toolkit (NLTK) library is used, and a custom list of domain-specific stopwords is added to remove irrelevant words. Words were reduced to their base or dictionary

form, known as 'lemmas.' For example, “running,” “runs,” and “ran” were all reduced to “run.” It helps to combine information about similar words to reduce dimensionality. Following this, we employed the ‘Gensim’ library to construct a dictionary and corpus from our tokenized data.

4.3.2.2. Data Analysis

The corpus object translated our documents into a vectorized form based on word frequencies. We conducted a Word Frequency Analysis to identify the most prevalent terms within sentences flagged for their expression of urgency. The frequency distribution of the words was computed using the `Counter` class from Python's `collections` module, enabling the identification and quantification of the most common terms within the dataset. We then sort the words by frequency to identify the most common words.

The findings were visualized through a horizontal bar chart, plotting the 30 most frequent words, utilizing the ‘Matplotlib’ library. A word cloud is also generated to visualize the prominence of terms in urgent sentences. It helps us quickly see which words are frequently mentioned concerning “urgency” in the dataset.

We interpret the results of the Word Frequency Analysis to identify common themes or topics. It involves a human qualitative analysis of the most common words and their possible meanings in the context of urgent project management. The most frequent words indicate themes or issues often associated with urgency in the dataset.

Word Frequency Analysis only provides an overview of the most common words. It does not consider the context in which these words are used. In addition to this limitation, providing a more in-depth understanding of the themes related to urgent project management is necessary, as presented in the next step.

4.3.3. Step 3: Topic Modeling (Thematic Analysis)

The Latent Dirichlet Allocation (LDA) was used to analyze text data to identify the latent topics within the set of documents on urgent projects. The methodology is grounded in the work of Blei et al. (2003), which assumes that documents are represented as random mixtures of latent topics, where a probabilistic distribution of words characterizes every topic.

The generative process for each document includes selecting a topic distribution, then choosing a topic based on this distribution for each word in the document, and finally selecting a word from a topic-specific distribution. In this sense, the LDA for topic modeling (Blei et al., 2003) evaluates coherence scores to determine the optimal number of topics. The Coherence Model from Gensim provided these scores, which assess the degree of semantic similarity between high-scoring words within each topic. The goal is to obtain a better understanding of the topics that are frequently considered in the urgent project management domain.

An evaluation was conducted by varying the topics from 2 to 20, with the coherence score for each configuration being computed and recorded. This analysis was graphically represented by plotting coherence scores against the number of topics generated using Matplotlib. The objective was to identify a model configuration that maximized the coherence score, indicating a balance between topic specificity and comprehensiveness. Blei et al. (2003) used perplexity to measure the inaccuracy of the model’s assignment to the topic model and determined the number of topics of the LDA topic. As presented by the authors, for a test set of M documents, the perplexity is:

$$perplexity(D_{test}) = exp\left\{-\frac{\sum_{d=1}^{M}\log p(W_d)}{\sum_{d=1}^{M} N_d}\right\}$$

Where D_{test} is the test set in the corpus, N_d represents the number of words in document d, W_d represents the words in document d, and $p(W_d)$ represents the probability of word W_d generated in the document. The code prompts the user to enter

the chosen number of topics and then trains the LDA model accordingly. This process is underpinned by several assumptions (Blei et al., 2003), including the fixed dimensionality of the Dirichlet distribution and the treatment of document lengths as independent variables.

4.3.4. Step 4: Topic's Interpretation

A qualitative analysis is conducted to interpret the identified topics. We used ChatGPT-4 (OpenAI, 2024) to substantiate the interpretations. The iterative analysis method aims to refine and validate interpretations of specific topics by generating multiple, independent responses to a set of data, followed by comparative analysis to assess consistency, identify contradictions, and synthesize the understanding.

After the table of the Core themes, we used the following prompt to generate the interpretation of the topics:

"ChatGPT, I would like you to answer the above question three times, each as if it were your first time answering. Please ensure each response is unique and detailed. After receiving the responses, compare them to assess consistency. Contradictions or significant variations may indicate hallucinations, while similar or consistent responses suggest accuracy. This method relies on the language model's capability to provide varied responses, enabling an evaluation of the information's reliability. At the end, could you provide me with the final table?"

We independently generated three sets of interpretations (responses) to the given themes for each topic. It involved analyzing the data three times, each as if for the first time, to ensure that each set of interpretations is unique and unbiased by previous analyses.

Then, we compared independently generated sets of interpretations to identify consistencies, contradictions, or variations. We assessed consistency between responses to determine the reliability of interpretations. Similar responses suggest accuracy and reliability, while contradictions or variations may indicate potential biases or inaccuracies (hallucinations).

We synthesize the results of the comparative analysis into a final set of refined interpretations. It involved integrating consistent themes, insights, and nuances identified across the independent sets of responses.

4.4. RESULTS

The results section has been structured to align with the steps outlined in the research method section, offering insight into findings from data extraction to topic modeling and interpretation steps to analyzing urgency in the academic literature on project management.

4.4.1. Results of Data Extraction, Preprocessing, Structuring, and Output

We used Python to scan 105 academic papers within the urgent project management domain for sentences with "urgent" or "urgency," cataloging these along with the paper's title and year. Then, we saved the sorted data as an Excel file. The dataset contains 1353 entries and three columns: (i) Year: The years of publication for the works listed range from 1973 to 2022, indicating a research span covering nearly five decades. (ii) Title. (iii) Urgent Sentence: There are 1349 unique urgent sentences. Duplicate sentences were eliminated.

Table 4.16 provides the top 30 sources with urgent sentences. It catalogs academic studies that contain the words "urgent" or "urgency" within their content. The data shows a wide range from 321 sentences at the highest to 11 sentences at the lowest. There is an outlier in the year 2014 from the book "Managing the Urgent and Unexpected Twelve Project" (Wearne and White-Hunt, 2014), which has substantially more urgent sentences (321) compared to the other titles.

Several articles (e.g., Wearne and White-Hunt, 2014; Zidane et al., 2018) focus on managing urgent and unexpected projects. Works such as the one by Fredberg and Pregmark (2022) explore how organizations handle the urgency of transformation. Articles (e.g., Mitchell et al., 1997; Bahadorestani et al., 2019) explore the role of stakeholders in project success. Research by McDonough and Pearson (1993) investigates the relationship between perceived urgency and project performance. Lechler and Grace (2007) analyze management practices for highly innovative and urgent projects. Furthermore, the studies encompass sectors, including telecommunications (Zidane et al., 2018), construction (Bahadorestani et al., 2019; Mojtahedi and Oo, 2017; Wang et al., 2021), and disaster recovery projects (Mojtahedi and Oo, 2017; Yang et al., 2014), indicating the universal relevance of topics related to urgent projects.

Table 4.16 - Top 20 sources with the most sentences related to urgency, with references (authors and year of publication) and the number of sentences identified in each document.

#	Source	# sentences
1	(Wearne and White-Hunt, 2014)	321
2	(Fredberg and Pregmark, 2022)	75
3	(Mitchell et al., 1997)	65
4	(McDonough and Pearson, 1993)	62
5	(Lechler and Grace, 2007)	54
6	(Zidane et al., 2018)	49
7	(Conte et al., 1995)	49
8	(Morgeson and DeRue, 2006)	48
9	(van den Ende, 2003)	42
10	(Granqvist and Gustafsson, 2016)	37
11	(Nachbagauer, 2022)	36
12	(Bahadorestani et al., 2019)	35
13	(Wearne, 2006)	32
14	(Yang et al., 2014)	28
15	(Mojtahedi and Oo, 2017)	25
16	(Wang et al., 2021)	21
17	(Hensmans, 2015)	19
18	(Bingham et al., 2018)	18
19	(Sun et al., 2019)	17
20	(Cochran et al., 1978)	17
21	(Behrmann et al., 2005)	16
22	(Aram and Javian, 1973)	15
23	(Tang et al., 2015)	15
24	(Azeem et al., 2022)	14
25	(Silva, 2014)	13
26	(Xia and Chan, 2012)	12
27	(Tishler et al., 1996)	12
28	(Al Nahyan et al., 2019)	12
29	(Yim et al., 2015)	11
30	(De Waard and Kalkman, 2022)	11

4.4.2. Results of Word Frequency Analysis (Keywords Analysis)

We analyzed the word frequency of the 4440 final database (after text preprocessing techniques, including tokenization, stopword removal, and lemmatization) from the

"Urgent Sentence" column to understand the common words related to urgency in project management. The most frequent term was "unexpected," occurring 269 times, followed by "time" (230 occurrences), "stakeholder" (223 occurrences), "team" (151 occurrences), and "event" (136 occurrences). The list of the top 42 most frequent words (Table 4.18) presents a set of terms offering insights into urgent project management. Figure 4.5 presents the horizontal bar chart of the top 30 most frequent words in analyzing urgent sentences.

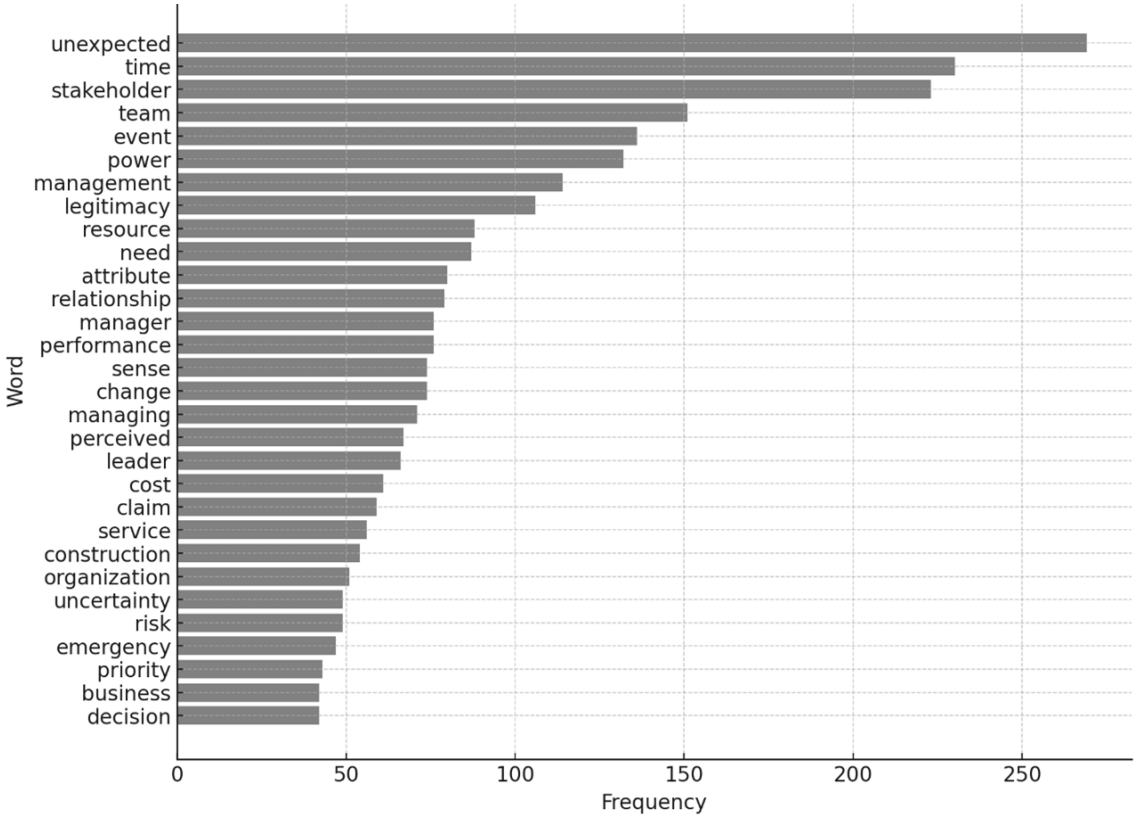

Figure 4.5 - The top 30 most frequent words found in analyzing urgent sentences.

Figure 4.6 - Word Cloud of urgent sentences without the words "urgent," "urgency," "urgently," "project," and "projects."

These terms serve as linguistic markers for understanding urgent project management. It becomes evident that urgency is not a one-dimensional concept but interacts with variables ranging from time, resources, and even perceptions. Table 4.18 provides an interpretation of the words related to urgent projects.

Word Cloud (Figure 4.6). The word cloud shows the most common words in the "Urgent Sentence" column. In this visual representation, the size of each word indicates its frequency in the dataset. The larger the word size, the more likely it is to be mentioned in source data about urgent projects. We excluded the words "urgent," "urgency," "urgently," "project," and "projects" from the word cloud for better interpretation.

It is worth noting that the terms are interconnected. For instance, "management" involves allocating "resources" while considering the "time" constraints and "stakeholder" concerns. From the word cloud, it is possible to notice central themes ("unexpected," "team," "stakeholder," "management," "time," "change," "leader," "sense," and "relationship" for instance), management focus ("resource," "decision," "performance," "cost," "risk," "strategy," and "planning" for example), project elements (e.g., "schedule," "task," "priority," and "result"), and Emergent Situations ("emergency," "unexpected," "crisis," and "risk").

4.4.3. Results of Topic Modeling (Thematic Analysis)

Latent Dirichlet Allocation (LDA) for Topic Modeling used the "Urgent Sentence" column to identify prevalent themes associated with urgency in project management. Through this machine learning algorithm for discovering topics that run across a set of sentences of documents approach, we discern the dominant subjects frequently related to urgent matters in project management literature.

The following table organizes the interpretations provided for each topic, presenting a clear view of the relationship between the central terms and the interpreted concepts.

Table 4.17 - Topics related to urgency in projects.

Topic	Core Terms	Topics Interpretation
0	urgency, management, time, urgent, project, disaster, responsible, relationships, public	Urgency in Disaster Management.
1	urgency, project, urgent, managers, team, unexpected, time, perceived, work	Team Dynamics and Urgency.
2	urgency, stakeholder, degree, network, urgent, model, service, work, positive	Stakeholder Network and Urgency.
3	urgency, unexpected, project, work, need, urgent, stakeholders, university, innovation	Innovation and Urgency.
4	urgency, project, power, need, sense, development, manager	Power Dynamics in Urgent Projects.
5	urgent, unexpected, projects, project, work, urgency, cases, time, managing	Unexpected Projects.
6	urgency, time, project, power, urgent, stakeholders	Stakeholder Influence on Urgency.
7	urgency, project, stakeholder, urgent, sense, different, projects, work	Stakeholder Urgency.
8	urgent, time, urgency, project, unexpected, related, managing, case	Unexpected Time Urgency.
9	project, urgent, urgency, unexpected, teams, team, work, projects, resources, cases	Team and Resource Management in Urgent Projects.
10	urgency, urgent, event, projects, project, research, sense, time	Event-Driven Urgency.
11	urgent, managing, project, urgency, team, differences, projects	Managing Team Differences in Urgent Projects.

Table 4.17 outlines an overview of the twelve topics. The core terms for each topic indicate thematic focuses such as stakeholder involvement, time management, and unexpected events. Each topic outlines a distinct area of interest through its core terms.

4.4.4. Results of Topic's Interpretation

At this step, we sought consistency and depth of insights in the final interpretation of the table of topics to generate a final table that synthesizes the key points related to project urgency. Table 4.19 (Appendix 4B) encapsulates the understanding of urgency in project management.

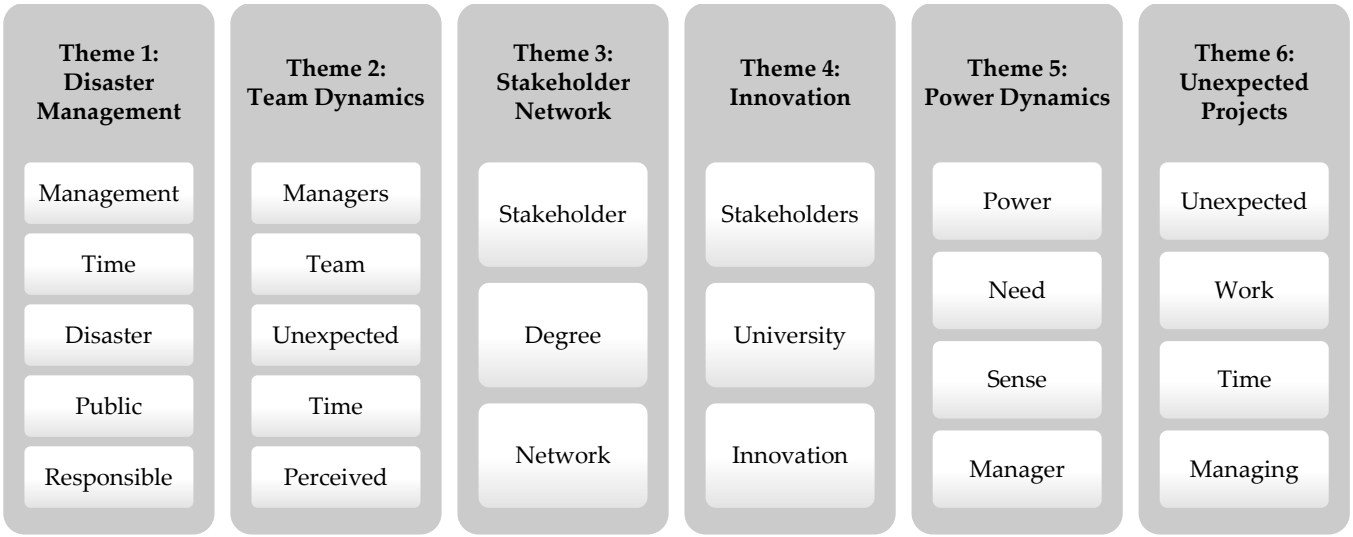

Figure 4.7 – Framework illustrating the topics related to urgency (themes 1 to 6).

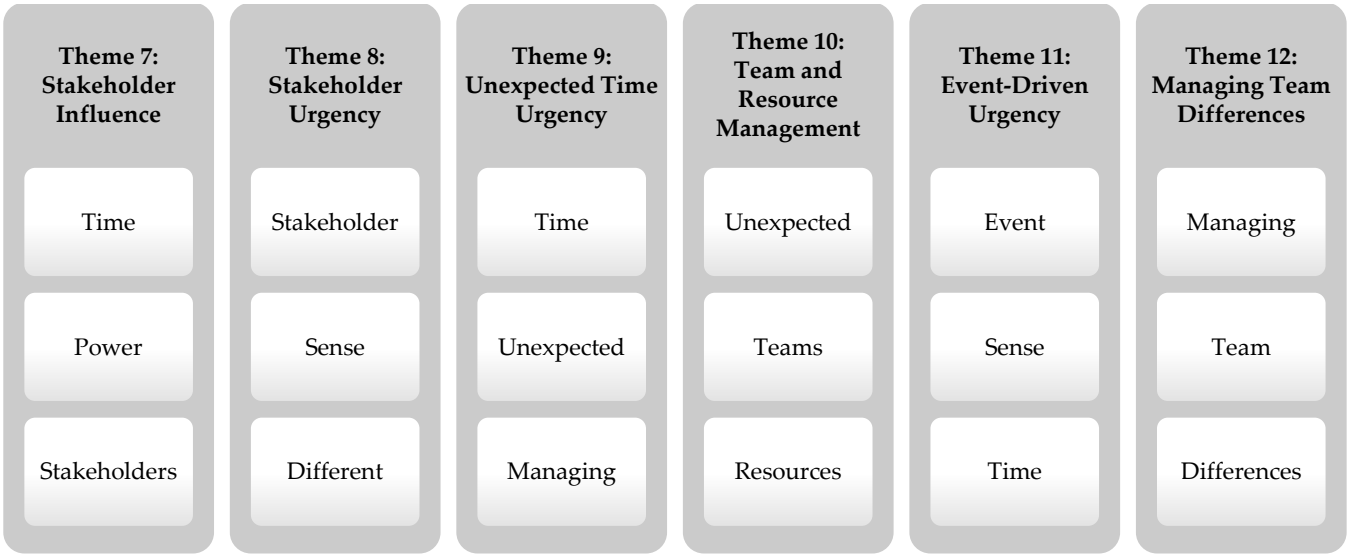

Figure 4.8 – Framework illustrating the topics related to urgency (themes 7 to 12).

Across the three answers, while each offers a unique perspective on interpretations of each topic, the central themes remain consistent: (i) The importance of understanding and managing project urgency; (ii) The impact of stakeholder relationships and networks; (iii) The need for agile and adaptive project management strategies; and (iv) The role of

leadership in managing urgency. These consistent themes across responses suggest accuracy and reliability in interpreting project urgency topics.

4.5. THEORETICAL DISCUSSION

This section discusses the findings from the computational analysis through exploration in the context of established theories as possible theoretical insights into the management of urgent projects. The following discussions highlight the relationship between urgency and time sensitivity in project management, the importance of stakeholder management, and the relevance of bounded rationality in decision-making in urgent situations.

4.5.1. Time Sensitivity and Urgency in Project Management

The concept of urgency in project management (da Penha and ten Caten, 2023b), deeply intertwined with time sensitivity (da Penha and ten Caten, 2023a), dictates whether a project is successful or unsuccessful (Lechler and Grace, 2007). Urgent projects demand immediate attention due to their critical nature and high uncertainty (Nachbagauer, 2022), often arising in complex and risky scenarios (Mojtahedi and Oo, 2017; Nachbagauer, 2022; Sun and Xu, 2011) or innovation projects (Lechler and Grace, 2007). They necessitate rapid decision-making, coordination, and a management approach focused on swift execution (Zidane et al., 2018). Despite their time-bound nature to achieve specific outcomes, urgent projects involve improvisation and fragmentation, emphasizing the significance of stakeholder management and oral commitments for timely delivery (Zidane et al., 2018). These projects highlight the complexity of urgency management within time-constrained environments (da Penha and ten Caten, 2023b).

The concept of time sensitivity, encapsulated by the frequent usage of words such as "unexpected," "time," "need," and "emergency," parallels with existing theories of Time-Based Competition (Stalk and Hout, 1990), an influential concept in the field of business strategy and operations management. It suggests that time, as a resource, is often scarce and highly valued in urgent projects (da Penha et al., 2024; Gonçalves et al., 2023), demanding swift decision-making and execution. The core premise of Time-Based Competition (TBC) is that time is a critical and often overlooked source of competitive advantage. According to Stalk and Hout (1990), companies that can reduce the time it takes to develop, produce, and deliver products and services can achieve superior performance and market leadership, a concept aligned with the management of urgent projects, such as presented by Zidane et al. (2018).

4.5.2. Stakeholder Theory and Project Urgency

Stakeholder theory (Freeman, 1984) also aligns with our results (Bahadorestani et al., 2019; Mitchell et al., 1997; Mojtahedi and Oo, 2017; Yang et al., 2014), especially on word frequency such as "stakeholders," "legitimacy" and "power." These terms reflect the diverse and sometimes contradictory interests that a project manager must reconcile. According to these authors, the practical applications of the theory focus on relationships with stakeholders, communication, learning, and integrative involvement.

Criticality. In the context of Stakeholder Theory, urgency refers to one of the key attributes used to assess the importance and influence of stakeholders concerning an organization (Harrison et al., 2019). This concept is introduced in the work of Mitchell et al. (1997), os stakeholders são classificados com base em três atributos: poder, legitimidade e urgência. Urgency, in this context, refers to the degree to which stakeholder claims demand immediate attention from managers, and the degree to which these issues are critical to the stakeholder.

Time Sensitivity. In the broader framework of Stakeholder Theory, urgency plays an essential role in shaping organizational strategies and actions. Organizations typically

need to balance the diverse demands of stakeholders. The urgency attribute helps distinguish between stakeholders requiring more immediate attention and those less time-sensitive. This ability to prioritize the needs of stakeholders is essential for managing different interests. This way, organizations can respond to the most imminent concerns, develop relationships, execute actions, and improve organizational performance (Harrison et al., 2019).

Sense of urgency. Including urgency as an attribute in stakeholder theory improves the understanding of interactions between stakeholders and the manager, providing a framework for identifying which stakeholders are most influential and, therefore, require immediate attention in a given context. The dimensions of criticality and time sensitivity create a sense of urgency that influences how managers prioritize stakeholders. Stakeholders with more urgent and critical claims are more likely to receive immediate attention and be prioritized by managers.

4.5.3. Bounded Rationality in Decision Making

Analysis of the topics suggests conceptual and thematic alignments concerning Simon's behavioral model of rational choice (Simon, 1955). Simon's work introduced concepts such as bounded rationality, proposing that individuals make rational decisions within the limitations of available information, cognitive capacity, and time. While it does not explicitly focus on "urgency" as a standalone topic, the concept is inherently tied to decision-making processes under the constraints of bounded rationality. Urgency management in projects can be aligned with Simon's concept of limited rationality, where decisions must be made under time pressure (Conte et al., 1995) and with limited information, common characteristics in urgent situations. Furthermore, responding to unexpected and urgent events (Wearne, 2006; Wearne and White-Hunt, 2014) can be related to Simon's theory about decision-making under conditions of uncertainty and the need to adapt and adjust strategies based on new information.

4.6. PARTIAL CONCLUSIONS

This research explored urgency within the project management domain through a computational text-mining approach. Utilizing a dataset with 105 academic documents and employing Word Frequency Analysis and Latent Dirichlet Allocation (LDA), the study analyzed the concept of urgency, revealing prevalent themes and patterns across nearly five decades of literature.

The Word Frequency Analysis underscored terms such as "unexpected," "time," "stakeholder," "team," and "event." It shows that time constraints, stakeholder expectations, and unforeseen events influence urgency in project management.

The thematic analysis through LDA revealed twelve distinct themes related to managing urgent projects, such as "Urgency in Disaster Management," "Team Dynamics and Urgency," "Innovation and Urgency," and "Managing Unexpected Projects." These themes indicate that urgency involves various aspects of project management, from disaster response and stakeholder involvement to innovation and unexpected challenges.

The theoretical discussion provided in this paper connects it with established theories such as Time-Based Competition and Stakeholder Theory. It elaborates on the role of time sensitivity and stakeholder management in urgent projects, touching upon bounded rationality in decision-making under urgent conditions.

Finally, this research contributes to the knowledge of urgent project management by offering a novel, data-driven perspective on urgency. Uncovering the thematic richness of urgency provides a foundation for future research in project management.

4.6.1. Limitations

Word Frequency Analysis provides an overview of the predominant terms associated with urgency in project management. However, it cannot capture the contextual meanings behind each term. This limitation suggests the need for a qualitative exploration to analyze thematic layers. The use of LDA is based on the premise that documents are represented as a blend of topics. As we started with selecting "urgent" sentences, this assumption may not reflect the complexity of all the data in the documents.

4.6.2. Future Research Directions

To address the limitations inherent in quantitative analysis of “urgent” sentences, future research could incorporate qualitative analyses to provide a more interpretive examination of themes identified through word frequency and topic modeling. Qualitative approaches, such as case study interviews or qualitative thematic analyses of literature, can provide valuable information about the contextual meaning of terms and themes related to the project's urgency.

Moreover, the accelerated pace of digital transformation presents challenges and opportunities for managing the urgency of projects. Future research can explore how technologies, instant communication tools, and agile methodologies improve responsiveness in managing urgent projects.

Urgency management practices can vary radically across industries due to unique challenges, regulatory environments, and project types. Future research could conduct comparative analyses of emergency or urgency management in healthcare, construction, IT, and emergency services to uncover sector-specific strategies and insights.

To capture the evolving nature of project management practices in response to urgency, longitudinal studies could provide valuable information about how organizations adapt their strategies over time. It could involve monitoring the implementation and results of urgent projects over time to understand the long-term effects of different management approaches.

Recognizing the importance of stakeholder management in urgent project scenarios, future research could aim to integrate diverse stakeholder perspectives, including clients, end users, project team members, and external partners. It could involve qualitative studies that explore stakeholders' expectations, experiences, and contributions to managing urgency in projects.

4.7. APPENDIX 4A: Lexical Analysis of Urgent Projects

Table 4.18 provides the words related to urgent projects.

Table 4.18 - Top 42 words related to urgent projects and their interpretation.

#	Word	Frequency	Interpretation
1	unexpected	269	Unpredictability in urgency or emergency projects.
2	time	230	The role that time management plays.
3	stakeholder	223	The significance of stakeholder needs and concerns.
4	team	151	A focus on teamwork and coordination in time-sensitive projects.
5	event	136	Specific incidents/events that are sensitive to time.
6	power	132	The authority and influence.
7	management	114	Management practices are central to handling urgency in projects.
8	legitimacy	106	Legitimacy of stakeholders.
9	resource	88	Resources, including human resources, materials, and financial assets.
10	need	87	The importance of understanding the urgent need of a project.

#	Word	Frequency	Interpretation
11	attribute	80	Specific qualities or characteristics that a project or its stakeholders must possess or adhere to.
12	relationship	79	Building and maintaining relationships among team members, stakeholders, and external entities facilitates problem-solving and fosters collaboration.
13	manager	76	The role of the manager in directing and facilitating urgent project tasks.
14	performance	76	How effectively teams or projects perform under urgency and pressure.
15	sense	74	The capability to understand and make meaning of urgent situations.
16	change	74	Adapting to new challenges or alterations in project scope swiftly.
17	managing	71	The process of overseeing and controlling project elements in a high-urgency environment.
18	perceived	67	The perception of urgency.
19	leader	66	Leadership is vital for setting the direction and making quick decisions
20	cost	61	Cost considerations become more prominent as rapid actions can result in additional expenses.
21	claim	59	The stakeholder claims to maintain the integrity of the project.
22	service	56	Industry-specific contexts.
23	construction	54	Industry-specific contexts.
24	organization	51	The organizational level approach to projects.
25	uncertainty	49	Dealing with unknowns that can impact project outcomes.
26	risk	49	Recognizing and mitigating risks.
27	emergency	47	--
28	priority	43	The term “priority” indicates the need to identify and focus on the most critical tasks or aspects that require immediate attention.
29	business	42	The broader business environment affects decision-making in urgent situations.
30	decision	42	Making choices quickly and under pressure.
31	important	41	What should be prioritized.
32	situation	41	The setting in which urgency occurs.
33	communication	41	Effective communication to ensure that stakeholders are aligned and informed.
34	impact	41	The effects that decisions can have.
35	result	41	The ultimate aim is achieving favorable outcomes.
36	term	40	--
37	contractor	38	The involvement of third-party entities.
38	proximity	38	Closeness in time or space to urgent issues.
38	success	37	Urgent management aims to achieve the project objectives.
40	action	36	The need for swift, decisive action is implicit in any urgent scenario.
41	disaster	34	Catastrophic events or outcomes that must be avoided or managed.
42	public	34	Those projects that bear broader societal relevance or are under the purview of public accountability are often subjected to increased urgency due to public sentiment.

4.8. APPENDIX 4B: Interpretation of Topics Related to Urgency

The following table provides topic interpretations related to urgent projects. provides topic interpretations related to urgent projects.

Table 4.19 - Interpretation of topics related to urgency in projects.

Topic	First Response	Second Response	Third Response	Final Answer	Researchers Interpretation
0	Enhanced focus on the urgency within project management, especially regarding disaster response, emphasizing the strategic relationship management and public engagement to mitigate urgency impacts.	Now emphasizes the complex interplay between project urgency and disaster management, highlighting the importance of responsible management and public relations in navigating the challenges posed by urgent projects.	Adjusted to emphasize urgency's impact on project management, particularly in disaster response scenarios, underscoring the importance of effective communication and public relations strategies.	Highlights the nuanced management of urgency, particularly in disaster scenarios, focusing on strategic relationship management and effective public communication.	Management of urgency in projects in the face of disasters. The central terms suggest a concern with responsible management practices, maintaining relationships and public communication.
1	Detailed exploration of the dynamics between project urgency, management practices, and team responsiveness, highlighting the critical role of managerial foresight and team agility in addressing unexpected challenges.	Refines the focus on the interrelationship between urgency, project execution, and team dynamics, emphasizing the importance of managerial insight and team readiness in tackling sudden project shifts.	Refocused to explore the dynamics of urgency in project management, highlighting the triadic relationship between urgency, project execution strategies, and team dynamics, especially in managing unexpected challenges.	Explores the dynamic interplay between urgency, managerial foresight, and team dynamics in addressing sudden project challenges.	Urgency in project teams, including the roles of managers and the effects of unexpected challenges. The core terms suggest exploring how project teams perceive and manage urgency.
2	A closer look at stakeholder networks reveals the intricate balance between urgency, service quality, and work model innovation, suggesting a positive correlation between well-managed urgency and service improvement.	Offers a deeper exploration into the role of stakeholder engagement and network models in managing project urgency, showcasing the benefits of a positive stakeholder network on project outcomes.	Enhanced to delve into the significance of stakeholder networks in modulating project urgency, illustrating how a robust stakeholder network can positively influence project service models and outcomes.	Delves into the impact of stakeholder networks on managing urgency, suggesting a positive influence on project services and outcomes.	The impact of stakeholder networks on emergency management, highlighting the positive aspects of stakeholder involvement in improving service models and work processes.
3	Illuminates the critical need for innovation and flexible project management in educational institutions to swiftly adapt to urgent, unforeseen challenges, emphasizing the role of stakeholders in fostering an environment conducive to rapid innovation.	Updates to reflect the urgency in academic and innovation-driven projects, stressing the necessity for quick adaptation and stakeholder involvement in facing unexpected obstacles.	Updated to discuss the critical role of innovation and urgent response in academic projects, emphasizing the need for quick adaptability to unexpected challenges, with a strong focus on stakeholder engagement.	Discusses the urgency of fostering innovation and adaptability in projects, especially in academic contexts, to overcome unexpected hurdles.	The urgency of innovation and adaptation in projects in university environments, suggests a focus on how urgency drives the need for innovative solutions and stakeholder engagement.

Topic	First Response	Second Response	Third Response	Final Answer	Researchers Interpretation
4	Explores the strategic implications of urgency on project development, particularly the need for strong leadership and a clear sense of direction to harness urgency positively.	Broadens the perspective on how urgency impacts project planning and execution, underscoring the critical need for leadership and a clear understanding of project goals to effectively manage urgency.	Expanded to analyze the influence of urgency on project development and management, stressing the importance of leadership in navigating urgent situations to maintain project momentum.	Analyzes the strategic implications of urgency on project planning and leadership, emphasizing the need for a clear direction and urgency management.	The influence of power and the need for a sense of urgency in project development point to the role of managers in project urgencies.
5	Focuses on the pragmatic aspects of managing urgent and unexpected project developments, advocating for a structured yet flexible approach to case management and time optimization.	Shifts focus towards strategic management of unexpected and urgent situations in projects, advocating for case-based learning and efficient time management practices.	Refined to highlight the management of urgent and unexpected events in projects, with a focus on employing case studies and effective time management to address these challenges.	Focuses on strategic approaches to managing urgent and unexpected situations, emphasizing case study learning and time management.	Management of unexpected and urgent situations in projects, highlighting the importance of optimizing time and responding to urgent challenges.
6	Discusses the temporal and power dynamics inherent in projects affected by urgency, suggesting strategies for balancing stakeholder influence with effective time management.	Reexamines the influence of urgency on project timing and stakeholder dynamics, offering insights into balancing urgency with stakeholder expectations and project deadlines.	Revised to explore the interplay between time sensitivity, stakeholder power, and urgency in projects, suggesting strategies for effectively balancing these elements to achieve project goals.	Examines the balance between urgency, stakeholder power, and project timing, offering insights into effective urgency management strategies.	The relationship between urgency, time sensitivity and power of project stakeholders, suggesting an analysis of how these factors impact project results.
7	Examines the varied perceptions of urgency across different stakeholder groups, underlining the importance of aligning project objectives with stakeholder expectations to navigate urgency effectively.	Explores the diverse perceptions of urgency among project stakeholders and its impact on project execution, highlighting the need for strategic alignment and communication.	Updated to examine the varied perceptions of urgency among stakeholders and their impact on project processes, advocating for strategic communication to align stakeholder interests with project aims.	Investigates diverse stakeholder perceptions of urgency and their impact on project execution, highlighting the importance of strategic stakeholder engagement.	How urgency is perceived and acted upon differently by stakeholders and within projects, indicating an interest in diverse project environments and stakeholder perspectives.
8	Analyzes the critical role of time management in responding to urgent and unexpected project changes, emphasizing the need for agile project frameworks that can	Concentrates on the importance of effective time management and flexibility in project management, especially in response to unforeseen and urgent situations.	Focused on the crucial role of time management in dealing with urgent and unexpected project alterations, advocating for agile methodologies to enhance project responsiveness.	Emphasizes the importance of agile project management in responding to unexpected and urgent changes, advocating for flexible time management practices.	Time management in response to urgent and unexpected project developments, highlighting the importance of agility and adaptability in project management practices.

Topic	First Response	Second Response	Third Response	Final Answer	Researchers Interpretation
	accommodate rapid shifts in priorities.				
9	Highlights the challenges and strategies for team management and resource allocation in urgent project scenarios, stressing the importance of resilience and adaptability in team dynamics.	Discusses the effect of urgency on team collaboration and resource management, emphasizing adaptive strategies for maintaining project momentum in the face of unexpected challenges.	Adjusted to address the challenges of managing teams and resources under urgent conditions, emphasizing the need for flexible strategies to handle unexpected project developments.	Highlights the impact of urgency on project teams and resource management, stressing adaptability and resilience in urgent scenarios.	Operational challenges and strategies for managing teams and resources under urgent conditions, especially in response to unforeseen project developments.
10	Delves into the impact of specific events on project urgency, advocating for a research-driven approach to understanding and mitigating urgency in project development contexts.	Investigates how specific events trigger a sense of urgency in projects, suggesting a more research-oriented approach to understanding and leveraging urgency in project management.	Modified to reflect the role of specific events in triggering project urgency, promoting a research-driven approach to better understand and mitigate the impacts of urgency on project execution.	Explores the influence of specific events on project urgency, advocating for a research-based approach to understand and address urgency.	The role of specific events in triggering urgency in projects, highlighting the importance of research in managing project urgency.
11	Investigates the subtle differences in urgency perception and response among project teams, calling for tailored management strategies that recognize and address these nuances effectively.	Looks into the nuances of urgency perception within project teams, advocating for management approaches that are sensitive to these differences and can adapt accordingly.	Tailored to investigate the subtle variances in urgency perception and management across project teams, calling for adaptive leadership strategies that recognize and address these differences.	Investigates nuances in urgency perception and management within project teams, calling for adaptive and nuanced leadership strategies.	Urgency management in different projects, focusing on team dynamics and recognizing differences in the perception and management of urgency.

5. ARTICLE 4: AN ANALYSIS OF URGENCY IN PROJECT MANAGEMENT: THE UNIFIED PROJECT URGENCY AND ECONOMIC SPEED ANALYSIS MODEL

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Abstract:

This paper aims to address the gap in the literature concerning the role of urgency in project management. Specifically, it seeks to develop a Unified Theoretical Model which combines the variables urgency, speed, duration, and cost. To achieve this aim, an analysis of articles was conducted from the Scopus database to understand the relationships and trade-offs among the variables. The research method involves both Literature Synthesis and Theoretical Model Formulation, culminating in the Unified Project Urgency and Economic Speed Analysis Model. This model serves as a mathematical and theoretical framework designed for making managerial decisions on time-sensitive projects. This article introduces the concept of High Intensity and Time Sensitivity Projects. It highlights the interactions between urgency, duration, speed, and costs, thereby providing a structure to guide managerial actions. The study contributes to enriching the theoretical foundations in the field of urgent project management. Finally, it opens avenues for future research by extending theoretical insights that are relevant for both researchers and industry professionals.

Keywords:

Urgent Projects; Urgency; Project Management; Time Management; Speed

Article 4

An Analysis of Urgency in Project Management: The Unified Project Urgency and Economic Speed Analysis Model

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ABSTRACT: This paper aims to address the gap in the literature concerning the role of urgency in project management. Specifically, it seeks to develop a Unified Theoretical Model which combines the variables urgency, speed, duration, and cost. To achieve this aim, an analysis of articles was conducted from the Scopus database to understand the relationships and trade-offs among the variables. The research method involves both Literature Synthesis and Theoretical Model Formulation, culminating in the Unified Project Urgency and Economic Speed Analysis Model. This model serves as a mathematical and theoretical framework designed for making managerial decisions on time-sensitive projects. This article introduces the concept of High Intensity and Time Sensitivity Projects. It highlights the interactions between urgency, duration, speed, and costs, thereby providing a structure to guide managerial actions. The study contributes to enriching the theoretical foundations in the field of urgent project management. Finally, it opens avenues for future research by extending theoretical insights that are relevant for both researchers and industry professionals.

Keywords: Urgent Projects; Urgency; Project Management; Time Management; Speed

RESUMO: Este artigo aborda a lacuna na literatura a respeito do papel da urgência na gestão de projetos. Especificamente, busca desenvolver um Modelo Teórico Unificado que integra as variáveis urgência, velocidade, duração e custo. Para atingir esse objetivo, foi realizada uma análise de artigos a partir do banco de dados Scopus, para entender as relações e *trade-offs* entre as variáveis mencionadas. O método de pesquisa inclui tanto a síntese da literatura quanto a Formulação do Modelo Teórico, culminando no Modelo Unificado de Análise de Urgência e Velocidade Econômica em Projetos. Este modelo serve como uma estrutura matemática e teórica projetada para a tomada de decisões gerenciais em projetos urgentes. Este artigo introduz o conceito de Projetos de Alta Intensidade e Sensibilidade ao Tempo. Ele enfatiza as interações entre urgência, duração, velocidade e custos, fornecendo assim uma estrutura para orientar decisões gerenciais. O estudo enriquece as bases teóricas no campo da gestão de projetos urgentes. Por fim, abre caminhos para futuras pesquisas, estendendo percepções teóricas que têm aplicabilidade tanto para pesquisadores quanto para profissionais da indústria.

Palavras-chave: Projetos Urgentes; Urgência; Gerenciamento de Projetos; Gerenciamento de Tempo; Velocidade

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5.1. INTRODUCTION

The academic literature about urgent project management has primarily focused on specific dimensions of urgency, such as timing (Nachbagauer, 2022), the management of a tight time window of an unexpected market opportunity (Zidane et al., 2018), unexpected events or circumstances, communication, costs, stakeholders' interest (Wearne, 2006), influence on risks (van den Ende, 2003), organizational response (De Waard and Kalkman, 2022), project cost and project classification (Wearne and White-

Hunt, 2014), unsafe zones that pose a threat to residents' lives (El-Anwar and Aziz, 2014), and its challenges in project environments (Yim et al., 2015). Moreover, studies have explored urgency within specialized contexts such as military projects (Tishler et al., 1996), earthquake reconstruction projects (Sun and Xu, 2011), firefighting, healthcare (Nachbagauer, 2022), construction, engineering, and civil infrastructure (Wearne, 2006). Papers about urgent projects also touch on topics such as the decision-making process regarding time and speed (Nachbagauer, 2022), and management strategies for extremely urgent projects (Zidane et al., 2018).

Previous literature suggest that the projects' degree of urgency can be based on (e.g.): (i) the expected cost, thus the economical speed of the project (Wearne and White-Hunt, 2014, p. 10); or (ii) the expected time (duration), thus the development and delivery speed of the project (speed), therefore, ignoring the criteria of optimizing resources. However, this dual understanding is insufficient to analyze an urgent project; it needs a relation between variables that could correlate the degree of urgency with other variables presented in the project management domain to assess urgency and vice versa. Moreover, the literature presents gaps that necessitate additional investigation. Nachbagauer (2022) and Xia and Chan (2012) posit that elements such as flexibility and decision-making processes can modify the impact of urgency on project duration. Regarding the relationship between urgency and cost, though Wearne (2006) discusses immediate acceptance of cost uncertainty in urgent projects. Existing studies do not address these interplays and the ramifications of urgency across diverse dimensions, such as speed, costs, duration, and project outcomes. Therefore, there is a lack of an integrated model that captures the dynamic interactions between the influence of the varying degree of urgency across multiple dimensions. Furthermore, only Tang et al. (2015) gave a mathematical perspective related to the urgency of the project to the manager.

Guided by the above insights, this study's Research Question is: *How do variations in the degree of urgency influence the project duration, speed, and costs within the domain of project management?* To answer this question, this paper aims to develop a more holistic understanding of urgency that integrates the dynamics of urgency, speed, duration, and cost in project management. The research seeks to develop a theoretical framework by synthesizing existing literature on urgent project management. This literature synthesis serves as the theoretical underpinning for the study, aggregating knowledge concerning key variables such as urgency, speed, duration, and cost. Finally, the research aims to develop a Unified Model, incorporating theoretical evidence and developing graphical representations to clarify the interactions among the primary variables.

This paper makes contributions to the field of project management. Firstly, it synthesizes the fragmented literature on project urgency, providing a consolidated viewpoint. Through a combination of thematic and analytical approaches, the study develops a novel theoretical-analytical framework, the Unified Project Urgency and Economic Speed Analysis Model, which combines the degree of urgency, project duration, speed, and costs. This research also provides valuable insights into how small changes can have a cascading effect on different aspects of an urgent project. Finally, the findings shed light on the many-sided nature of urgency in project management contexts and contribute to the development of a Unified Project Urgency and Economic Speed Analysis Model, offering insights for enhancing project planning, execution, as well as operational and strategic decision-making processes.

5.2. BACKGROUND THEORY

The research is structured to advance in steps. A theoretical-analytical framework was developed, integrating concepts both from the field of urgency and from project management studies. This framework serves as a structured lens for examining how urgency interacts with various dimensions of a project. Four dimensions are central to the framework: (i) Level of Project Urgency (U), defined as a quantitative measure indicating the urgency of a project; (ii) Speed of Execution (V), denoting the rate at which project

milestones are achieved; (iii) Project Cost (C), representing the economic resources allocated for the prompt completion of a project; and (iv) Time Span (D), indicating the overall duration from the inception to the closure of a project. These dimensions guide the development of mathematical models for studying the dynamics of project urgency. It is posited that all projects have an inherent level of urgency, which this framework aims to analyze.

5.2.1. What Is an Urgent Project?

An urgent project is characterized by a need for rapid completion, or prompt attention. Wearne and White-Hunt (2014) emphasize the subjective nature of urgency and that it often demands faster work processes, sometimes leading to increased costs. In line with this view, Wearne (2006) states that speed of execution takes precedence over cost considerations. However, Nachbagauer (2022) suggests that the sense of urgency can be influenced by time scarcity and boundaries, a point that Wearne (2006) also hints at when stating that the perception of urgency may evolve over time. McDonough and Pearson (1993) add that external factors, such as competition or market share, often drive the need for rapid project completion.

Time constraints are a recurring theme. Zidane et al. (2018) focuses on the tight time window and the need for accelerated delivery, which is reinforced by Xia and Chan (2012) who describe urgent projects as having an "unrealistic" schedule for completion. El-Anwar and Aziz (2014) bring a domain-specific perspective, linking the concept of urgency to the immediate needs in slum upgrading projects. Meanwhile, Popa et al. (2011) describe an urgent project as one that is response-driven, particularly in emergency situations. Sun and Xu (2011) illustrate the concept of urgency through the large-scale Wenchuan earthquake reconstruction project, while Aram and Javian (1973) generalize the urgency dimension in terms of immediate attention or action.

Several authors discuss the implications of urgency on project timelines. Yim et al. (2015) state that the urgency of a project increases when it exceeds its originally allocated timeframe, especially in the context of rework projects. Hensmans (2015) defines an urgent project as one involving strategic changes requiring immediate action. Ren et al. (2018) echo the concept of time pressure as a defining attribute. De Waard and Kalkman (2022) refer to urgent projects as those requiring a rapid response, often in crisis situations. Van den Ende (2003) also discusses the time-sensitive nature of projects in the context of market competition.

In the existing literature on project urgency, several research gaps become evident. Although Tang et al. (2015) introduce a mathematical perspective, there is limited investigation into the utility and constraints of mathematical models for representing the urgency dimension across diverse project types. The existing scholarly literature largely focuses on qualitative debates and case studies, pointing to a lack of in-depth quantitative studies or hybrid research methods that could offer a more well-rounded view of project urgency. Furthermore, there is a notable absence of quantitative metrics to evaluate the degree of urgency across different projects (Wearne, 2006; Xia and Chan, 2012).

5.2.2. The Temporal Aspect: Project Duration

Duration and the level of urgency. Several studies focus on the necessity of immediate action, thereby suggesting a need for compressed timelines (Wearne, 2006; Xia and Chan, 2012; Nachbagauer, 2022). Nachbagauer (2022) articulates that selecting the appropriate speed is crucial for tackling issues in time-sensitive projects, while Zidane (2018) identifies the use of specific techniques such as crashing and fast-tracking to expedite the project schedule. Ren et al. (2018) corroborate the idea that time constraints and pressure are integral attributes of urgent projects.

The relationship between project duration and urgency becomes evident in financially driven projects, where the projects' lifecycles can be dramatically reduced.

Zidane et al. (2018) provide an example of a project condensed from two years to just three months, achieved through tactical decision-making and prioritization over other tasks. Wearne and White-Hunt (2014) further emphasize that urgency correlates with time constraints, and Yim et al. (2015) note that exceeding the original timeframe escalates the project's urgency.

There is a consensus that the urgency of a project can impact its overall duration. A significant number of authors, including Zidane et al. (2018), Wearne (2006), and De Waard and Kalkman (2022), contend that higher levels of urgency can significantly shorten the duration of a project. This is attributed to accelerated delivery, immediate action, and less control over time in urgent situations. Moreover, a few authors such as Sun and Xu (2011), van den Ende (2003), and Mojtahedi and Oo (2017) also mention that the urgency of a project can have an impact on its duration but clarify that this relationship could be mediated or influenced by other factors, such as the complexity of the project, stakeholder attributes, and existing infrastructure.

The predominant view is that the duration of a project does not have a direct effect on its urgency. Authors such as Zidane et al. (2018) and Wearne (2006) explicitly state that urgency is typically driven by external factors such as unexpected circumstances, business opportunities, or threats to assets, rather than the duration of the project itself. Wearne and White-Hunt (2014) and Mojtahedi and Oo (2017) further support this view, mentioning that the duration of a project does not directly impact its urgency. It is also worth noting that a substantial number of papers did not directly address the relationship between the duration of a project and its urgency.

5.2.3. The Aspect of Project Speed

The speed of an urgent project varies depending on numerous factors. Project speed encompasses the rate at which a project's scope is delivered within a specified timeframe, closely linked with urgency, and often requiring swift actions and creative solutions (Sun and Xu, 2011; Xia and Chan, 2012). In the case of Wearne (2006), speed takes precedence over cost, emphasizing rapid action and decision-making. Nachbagauer (2022) discusses the importance of selecting the right speed to meet critical objectives, implying that while speed is essential, it must also be controlled and deliberate. Aram and Javian (1973) discuss urgency as a dimension along with priority and profitability, suggesting that speed might be balanced against these other considerations. According to Bingham et al. (2018), urgency can influence the choice of project delivery methods, highlighting the role of speed in logistical decisions. Pan et al. (2010) imply that speed can be a function of service quality measurements, while Sun et al. (2019) note that time constraints directly affect communication frequency among project members, impacting the project's pace.

De Waard and Kalkman (2022) assert that heightened levels of urgency prompt a shift from structured to improvised organizational responses, underscoring the necessity for escalated project speed under conditions of elevated urgency, uncertainty, and task ambiguity. Yim et al. (2015) acknowledge that urgent projects, such as redesign projects, entail compressed schedules and heightened time pressure. Wearne and White-Hunt (2014) observe that the term "urgent" inherently implies the demand for accelerated work, which consequently propels project speed, often yielding augmented costs. Their proposed categorization of tasks based on planned duration and cost aligns with distinct tiers of project speed. Mojtahedi and Oo (2017) characterize urgency as a determinant that shapes project priorities and decision-making processes, thereby directly influencing the pace of project execution. Furthermore, Wearne (2006) suggests that urgent projects often require swift decision-making and action to address exigent circumstances.

5.2.4. The Financial Aspects: Project Costs

The cost implications of an urgent project are notably different from those of projects that operate under standard time constraints. Specifically, Wearne and White-Hunt (2014)

point out that urgent projects often necessitate the allocation of resources in an uneconomical manner to expedite the project's delivery, thereby incurring increased costs. Similarly, Wearne (2006) mentions that in urgent projects, the speed of execution takes precedence over cost considerations, signaling the potential for elevated expenditure. Zidane (2018) also acknowledges that urgent projects may involve increased costs due to the need for accelerated delivery. Xia and Chan (2012) specify that when a construction project operates under an urgent schedule, it demands sufficient material supply, adequate staffing, and sophisticated coordination, all of which can add complexity and thereby potentially increase costs.

Project costs serve as a factor that intersects with urgency, speed, and duration, presenting challenges and trade-offs that shape resource allocation, financial viability, and overall project feasibility (Wearne and White-Hunt, 2014, p. 12; Mojtahedi and Oo, 2017). According to Van den Ende (2003), urgency exerts a profound influence on project costs, with heightened exigency potentially leading to increased communication expenses and influencing decisions regarding governance modes in collaborative endeavors. The classification of tasks based on projected duration and anticipated expenses, as proposed by Wearne and White-Hunt (2014), accentuates the financial ramifications associated with varying degrees of urgency. Further insight into the interplay between urgency and costs is provided by Wearne and White-Hunt's (2014) differentiation between minimum initial cost, economic duration, and minimum time.

It is worth noting, as articulated by Wearne (2006), that exigent projects that materialize unexpectedly may necessitate an immediate assumption of cost-related risks. El-Anwar and Aziz (2014) offer a framework aimed at providing more precise and practical predictions regarding slum upgrading project expenses and timelines. This framework empowers effective oversight aimed at controlling and reducing total project expenditures and durations. Within the work of Zidane et al. (2018), the project's costs were substantial, estimated at USD100 million for the first phase and USD1.2 billion for the total budget. The project's urgency was linked to financial motives, seeking to enhance stock value and overall profitability. Budget considerations played a central role in decision-making and project success.

The relationship between the urgency and the cost of executing a project seems to be positively correlated. Nachbagauer (2022), McDonough and Pearson (1993), and Zidane et al. (2018) state that urgent projects may involve increased costs due to the need for accelerated delivery or financial motives. Similarly, Wearne (2006) and El-Anwar and Aziz (2014) note that urgent projects require immediate acceptance of cost risks and aim to utilize all available resources, thereby contributing to higher costs. Pan et al. (2010) and Tang et al. (2015) suggest that project delivery methods and the project manager's sensitivity to completion time are motivated by both cost and urgency, implying a correlation between these factors. Finally, Wearne and White-Hunt (2014) argue that the extra cost incurred in urgent projects is justified by the greater value of delivering the work quickly.

5.3. RESEARCH METHOD

The methodology of this article is separated into two steps. Step one starts by reviewing existing literature to explore how urgency interacts with speed, cost, and duration in projects. The discussion of this literature was presented in the background theory section (5.2). Step two develops a unified model to describe how level of project urgency, speed of execution, total cost, and time span interact in urgent projects, using math and visuals to explain the relationships. It culminates in the formulation of the Unified Project Urgency and Economic Speed Analysis Model, which is a theoretical framework that combines these variables.

Post-synthesis, we defined the variables of interest of the Model (U, D, V, and C), and set constraints ensuring all variables are non-negative. To capture the interrelationships among variables, abstract mathematical functions are formulated. Two theoretical

frameworks emerged to serve as the foundation of a structured analytical lens for investigating urgent projects.

First, we present the General Urgent Projects Analysis Model. The model explores the concept of project speed, introducing it as the rate of achieving project objectives within a given time frame. It outlines the significance of speed and duration, particularly in projects characterized by high urgency. Next, we present the Economic Speed Model. This model extends the General Urgent Projects Analysis Model by adding the financial variable as presented by Wearne and White-Hunt (2014, p. 11), focusing on the cost implications of varying speeds.

These two models culminated in the formulation of the Unified Theoretical Project Urgency and Economic Speed Analysis Model. The Unified Model combines the preceding models into a single framework. It offers a quadrant-based visualization, emphasizing the non-negative nature of the variables involved.

5.4. RESULTS

In the domain of project management, the relationship among urgency, duration, speed, and cost shapes the model of urgent projects. While shorter durations are expected for more urgent projects, it's the fusion of speed and duration that characterizes urgency. Incorporating cost into the analysis creates an economic speed model. The combination of these variables emerges in the unified theoretical analytical model called Unified Project Urgency and Economic Speed Analysis Model, offering a framework where urgency, speed, cost, and duration are analyzed simultaneously.

5.4.1. Variables, Interrelationships, and Constraints

Definition of Variables. The analytical model identifies four primary variables: (i) Urgency (U) signifies the time-sensitivity of the project's completion, i.e., a measure of how quickly the project needs to be completed; (ii) Duration (D) specifies the time needed to finish the project; (iii) Speed (V) indicates the project's rate of progress; and (iv) Costs (C) represent the financial expenditure required for the project's completion.

Relationships Among Variables. The interrelationships between these variables can be categorized as presented in Table 5.20.

Table 5.20 - Variables, relationships among variables, and sources.

Variables	Relationships Among Variables	Sources
Urgency and Duration	A direct relationship exists between urgency and duration, i.e., heightened urgency typically requires a reduced duration.	(Wearne, 2006; Xia and Chan, 2012; Nachbagauer, 2022; Ren et al., 2018; Zidane et al., 2018)
Urgency and Speed	An increase in urgency usually results in an increase in speed.	(Wearne, 2006; Nachbagauer, 2022; De Waard and Kalkman, 2022; Zidane et al., 2018)
Urgency and Costs	The relationship between urgency and costs reveals that higher urgency may cause elevated costs.	(Wearne and White-Hunt, 2014; Wearne, 2006; Zidane et al., 2018)
Duration and Costs	A longer duration generally correlates with increased costs.	(Wearne, 2006; Tang et al., 2015; Van den Ende, 2003; Zidane et al., 2018)
Speed and Costs	Greater speed can either increase costs due to the need for more resources or decrease costs if the project is completed efficiently.	(Wearne and White-Hunt, 2014; Wearne, 2006; Zidane et al., 2018)

Mathematical Formulation. The relationships among these variables can be mathematically formulated as: (i) Duration as a function of Urgency: $D = f1(U)$; (ii) Speed as a function of Urgency: $V = f2(U)$; (iii) Costs as a function of Urgency: $C = f3(U)$; (iv) Costs as a function of Duration: $C = f4(D)$; and (v) Costs as a function of Speed: $C =$

$f5(V)$. Here, $f1$, $f2$, $f3$, $f4$, and $f5$ are functions to be determined either empirically or theoretically. For mathematical simplicity, we do not use indexes 1, 2, …, in the following text.

Model Constraints. The constraints of the model are as follows: (i) Urgency cannot be negative: $U \geq 0$; (ii) Duration cannot be negative: $D \geq 0$; (iii) Speed cannot be negative: $S \geq 0$; and (iv) Costs cannot be negative: $C \geq 0$. For the visual construction of the model, it was considered that the variables are normalized.

5.4.2. General Urgent Projects Analysis Model

Project duration (D) and speed (V) are critical variables in the management of urgent projects, especially in managing projects with extremely high urgency, as illustrated in Quadrant I, point A from Figure 5.9. Duration is often a function of the project's Urgency (among other management variables). However, duration alone does not capture the complexity of such projects. Therefore, the concept of project speed (V) is introduced, defined as the rate of achieving objectives within a given time frame. In scenarios of extreme urgency, both minimizing duration and maximizing speed seems to be crucial, as depicted in Point A', Quadrant II, Figure 5.9. The graphical depictions serve only as neutral functional representations and do not necessarily indicate linear or straightforward relationships between variables.

5.4.3. Economic Speed Model

To develop a theoretical-analytical framework, the variables cost, duration and speed were incorporated into a unified model called the Economic Speed Model, as presented by Wearne and White-Hunt (2014, p. 11). This model complements the General Urgent Projects Analysis Model by focusing on the financial aspects of urgent projects. This model serves to clarify several key considerations (Wearne and White-Hunt, 2014, p. 11): (i) the financial implications of operating at maximum speed; (ii) the incremental cost incurred by accelerating operations beyond standard rates; and (iii) the decision-making criteria for selecting a speed that minimizes costs and thus mitigates urgency. Figure 5.9 illustrates the integration of cost, duration, and speed.

5.4.4. Unified Project Urgency and Economic Speed Analysis Model

The two theoretical models combined culminate in the development of the Unified Project Urgency and Economic Speed Analysis Model, as displayed in Figure 5.9. This model combines a unified framework presented across four quadrants. The point of origin is common to all quadrants and is designated by a "+" sign, reflecting that the attributes of time, speed, cost, and urgency have non-negative values. Different points within this model are defined to signify varying levels of project urgency, such as point A for Extreme Urgency, point B for High Urgency, and point C for the level of urgency appropriate to the project's Minimum Cost (Wearne and White-Hunt, 2014, p. 11).

Conceptual Importance of the High-Intensity Sector. From the analysis of the model, the "High-Intensity Sector" (Figure 5.9) has been selected to denote the area within it. This sub-component of the Unified Model serves as the area of focus for managerial decision-making, capturing the heightened levels of urgency and the complex trade-offs involved in executing urgent projects. The word "Intensity" captures the magnified focus on optimizing speed, often requiring swift and impactful decision-making. Therefore, the "High-Intensity Sector" describes the zone of maximum complexity and decision-making challenge in urgent project management.

The High-Intensity Time-Sensitive Projects. Notice that we assume that every project possesses some level of urgency influenced by external conditions or internal organizational priorities. Then, the term "urgent project" may not sufficiently differentiate projects with the outlined characteristics from other projects. A more appropriate term

could be "High-Intensity Time-Sensitive Projects" or simply "High-Intensity Projects." This terminology captures the essence of projects that are not only urgent but also present additional challenges and criticalities such as complexity, and high stakes.

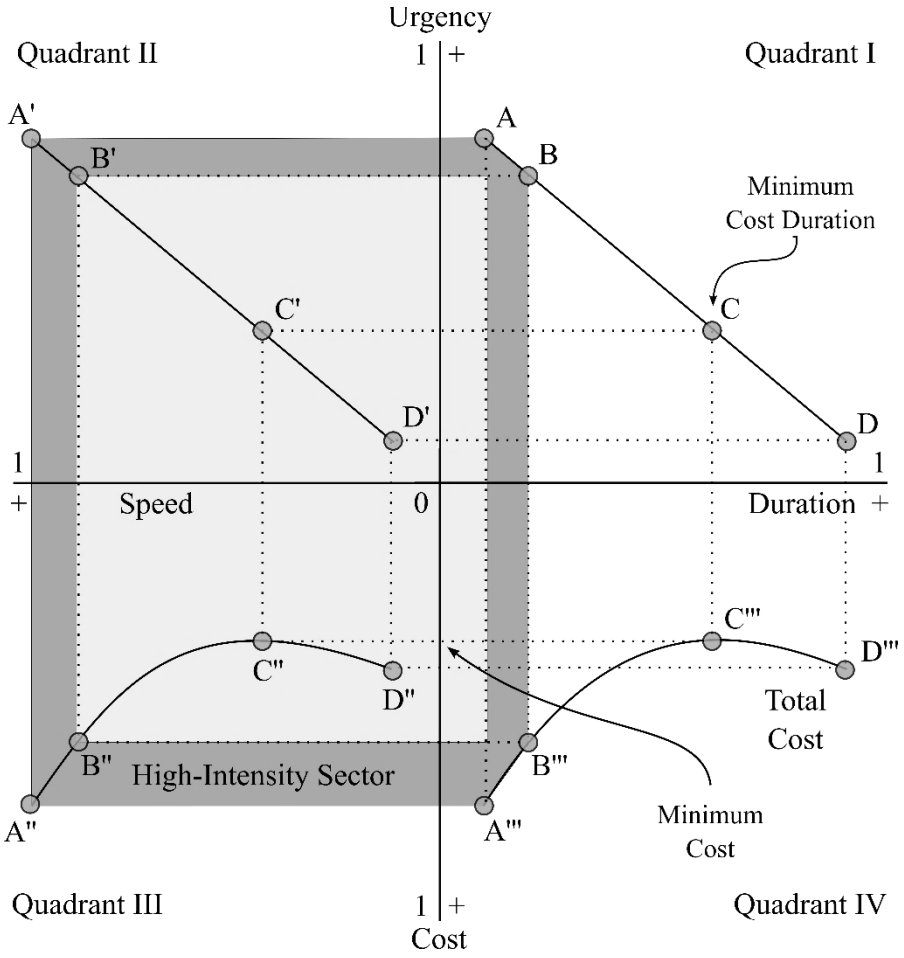

Figure 5.9 - Unified Project Urgency and Economic Speed Analysis Model: Relationships among the degree of urgency, duration, speed, and total cost.

The High-Intensity Time-Sensitive Projects definition. A High-Intensity Time-Sensitive Project refers to a project that requires immediate attention and action due to its crucial nature, likely with high complexity and high risks. These projects are characterized by tight deadlines and a high level of urgency. They often involve addressing pressing problems, such as disasters, conflicts, or emergencies, where time is of the essence. The term "high-intensity" emphasizes the intensity, speed, and pressure associated with these projects, while "time-sensitive" highlights the importance of timely execution and delivery. These projects require efficient coordination, quick decision-making, and the ability to adapt quickly to changing circumstances. Managing High-Intensity Time-Sensitive Projects requires a unique set of skills, including strong leadership, communication, and the ability to prioritize tasks and resources.

Projects characterized by high intensity and time sensitivity. Zidane et al. (2018) discusses a case study of a telecommunications infrastructure project in Algeria that had a high level of urgency and was successfully delivered within a tight time window. The project presented by Popa et al. (2011) aims to prepare response actions in case of a major earthquake, indicating a high level of urgency. Examples of projects with an extremely high level of urgency could include emergency response projects, time-sensitive research projects, or projects with strict regulatory deadlines (Ren et al., 2018). De Waard and Kalkman (2022) discuss extreme context studies in project management, which involve situations with high levels of urgency.

Wearne and White-Hunt (2014) discuss various projects characterized by high intensity and time sensitivity. These include constructing a temporary deck for a damaged bridge over a crocodile-infested river, pending permanent repairs; setting up a temporary electricity transmission line to restore power in Auckland's central business area through a railway tunnel and open-wire transmission; elevating a portion of the river Aire banks in Yorkshire, United Kingdom, while also conducting emergency repairs and constructing flood control measures; restoring railway tracks, overhead power, and signaling systems on a section of the East Coast Main Line in Great Heck, Yorkshire, United Kingdom; constructing a temporary railway station for a new television business; raising the banks of the Thames for flood control; stabilizing a viaduct with supports; and repairing a remote highway bridge.

Managerial Decision-Making. The factor of urgency holds significant weight in managing urgent projects and may manifest as a calculated managerial choice. Within the High-Intensity Sector, managers can opt for maximum (or near maximum) speed and the minimum (or near minimum) duration. This deliberate approach drives project outcomes, resulting (theoretically) in the maximum (or near maximum) total cost of the project (Figure 5.9). Mathematically, the relationship can be expressed as $C = f(U, D, V)$, encapsulating the interdependency of urgency, time (duration), and speed.

5.5. DISCUSSIONS

This discussion explores the implications of the findings, contextualizing them within the existing literature.

5.5.1. Theoretical Models and Practical Manifestations of Project Urgency

Both the General Urgent Projects Analysis Model and the descriptions of projects with varying levels of urgency emphasize the critical role of project duration and speed (McDonough and Pearson, 1993; Wearne and White-Hunt, 2014, p. 11). The Economic Speed Model and the accounts of high-urgency and exceptional-urgency projects both highlight the financial implications of operating at maximum speed and the incremental costs incurred (Wearne and White-Hunt, 2014, p. 11; Zidane et al., 2018). Both perspectives agree that timing is a critical factor, especially in projects with high to extreme levels of urgency (Nachbagauer, 2022; De Waard and Kalkman, 2022). Both the theoretical and practical viewpoints are outcome-oriented, focusing on the successful completion of projects within specified constraints (Wearne and White-Hunt, 2014, p. 11; Penha et al., 2022).

While the Economic Speed Model discusses the financial implications of urgency, projects with exceptional urgency, such as those in healthcare, are often motivated by immediate needs rather than financial considerations (Wearne and White-Hunt, 2014, p. 11; McDonough and Pearson, 1993). The theoretical models, particularly the Economic Speed Model, imply a degree of control over time through financial planning and speed optimization (Wearne and White-Hunt, 2014, p. 11). In contrast, De Waard and Kalkman (2022) suggest that in high levels of urgency, the control over time decreases and requires an improvisational response. The theoretical frameworks do not explicitly address the scale and impact of projects, which are considered significant factors in the practical examples, particularly in projects with exceptional urgency such as earthquake reconstruction (Sun and Xu, 2011).

5.5.2. High-Intensity Sector and Academic Literature

High-Intensity Sector and Extreme Contexts. The High-Intensity Sector serves as a complementary framework to the typology of project management dynamics for extreme contexts developed by De Waard and Kalkman (2022). While De Waard and Kalkman focus on the manageability of time in extreme contexts—emergency, risky, and

disruptive—the High-Intensity Sector model incorporates duration, speed, and degree of urgency. This unified model allows for the analysis of projects in extreme contexts, particularly those that deviate from traditional PMBOK logic and require improvisational responses (De Waard and Kalkman, 2022).

Both the High-Intensity Sector model and the academic literature emphasize the critical role of urgency in project management (McDonough and Pearson, 1993; Wearne, 2006; De Waard and Kalkman, 2022; Sun and Xu, 2011; Zidane et al., 2018). Effective coordination among various stakeholders or departments is highlighted as crucial for the success of urgent projects (McDonough and Pearson, 1993; Wearne, 2006). The ability to adapt quickly to changing circumstances is considered vital in the High-Intensity Sector as presented in academic literature (Wearne, 2006; Lechler and Grace, 2007). Both the High-Intensity Sector model and Zidane et al. (2018) discuss the financial aspects of urgent projects, although the former focuses on the theoretical maximum cost while the latter discusses financial motivation. The High-Intensity Sector model underscores the importance of time, whether it's speed, duration, or the manageability of time (De Waard and Kalkman, 2022; Zidane et al., 2018).

The model introduces the term "High-Intensity Time-Sensitive Projects" to differentiate from merely "urgent projects," a term commonly used (without definition) in academic literature (McDonough and Pearson, 1993; Wearne, 2006; De Waard and Kalkman, 2022; Sun and Xu, 2011; Zidane et al., 2018). The High-Intensity Sector model posits that urgency can be a calculated managerial choice, focusing on maximum speed and minimum duration. This is not explicitly discussed in the academic literature reviewed (McDonough and Pearson, 1993; Wearne, 2006). The High-Intensity Sector model offers a generalized framework which helps to discuss projects with varying scales and impacts, such as the Wenchuan earthquake reconstruction (Sun and Xu, 2011) and the 9/11 pile removal (Wearne and White-Hunt, 2014).

5.6. PARTIAL CONCLUSIONS

This article substantiates the notion that urgency in project management encompasses a multidimensional structure, combining speed, cost, duration, and degree of urgency. Common usage of the term “urgent project” lacks specificity in separating projects with these attributes from others. A refined nomenclature, characterizing “High-Intensity and Time-Sensitive Projects” or “High-Intensity Projects”, seems to be more appropriate for specific projects. This terminology encapsulates projects characterized not only by extreme urgency, but also by elements that include complexity, high risks, and the need for specialized team members, for example.

Moreover, the article makes contributions to the understanding of the interrelationships between urgency and the essential dimensions of the project. By gathering data from literature and theorizing about varying degrees of urgency, this study helps enrich the existing literature. Furthermore, this article presents a new theoretical framework: the Unified Model for Analysis of Urgency and Economic Speed of Projects. This framework provides project managers and academics with a representation that allows them to analyze urgent project situations, offering a multidimensional assessment based on urgency, project duration, speed, and costs.

A primary limitation centers on the assumption that project managers can accurately quantify urgency, cost, speed, and duration. In real-life scenarios, these variables often succumb to unpredictable external influences, which the model currently does not account for. Such omissions signal areas where the model's utility could be less than optimal. To mitigate these limitations, future versions of the model could integrate statistical, or machine learning methods designed to handle variable uncertainty. Specifically, Bayesian networks or stochastic models offer promising avenues for quantifying the inherent uncertainties linked to each of the model's variables.

Furthermore, the model is not dynamic and does not account for changes in project variables over time, thereby limiting its applicability in projects that are highly volatile or

have changing constraints. Introduction of time-dependent variables could render the model dynamic, making it more applicable to projects with shifting urgencies or constraints. Another suggestion for future work is to use system dynamics.

6. ARTICLE 5: NAVIGATING THE URGENCY: AN OPEN INNOVATION PROJECT OF PROTECTIVE EQUIPMENT DEVELOPMENT FROM A QUADRUPLE HELIX PERSPECTIVE

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Abstract:

This study empirically explores the Quadruple Helix model's potential in facilitating an urgent Open Innovation project. By examining the life cycle of the project developed during the COVID-19 pandemic crisis in Brazil, it reveals complex interactions among Government, Academia, Industry, and Civil Society stakeholders, while also shedding light on the various risks arising from their dynamic collaboration. Employing an approach that combines case study analysis, risk assessment, and theoretical framework development, we unravel the project's evolution, highlighting pivotal elements such as trust, collaboration, communication, agile mindset, stakeholder partnerships, scale, and logistics. Additionally, the study underscores concerns related to finance, time, reputation, and health, which warrant consideration. Risk analysis uncovers internal and external risks and categorizes thirty-two risks, with one deemed unacceptable, thus revealing valuable insights into stakeholders' partnerships, institutional image, public equipment, manufacturing, project management, human resources, intellectual property, regulation, and sanitation risks. Building on these findings, we develop a new framework illustrating the management of the urgent Open Innovation project through the fast-paced

Quadruple Helix formation. By exploring stakeholder collaboration and risk management, this research provides insights into the adaptability and speed required to successfully execute an emergency project, as well as presenting practical strategies for risk management and mitigation, significantly contributing to the domains of the Quadruple Helix and project management research.

Keywords:
Urgent Projects; Quadruple Helix; Risks; Stakeholders; Open Innovation; Pandemic; Agile Mindset; Emergency Project; Agile Project; Project Management

Article 5

Navigating the Urgency: An Open Innovation Project of Protective Equipment Development from a Quadruple Helix Perspective

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Abstract: This study empirically explores the Quadruple Helix model's potential in facilitating an urgent Open Innovation project. By examining the life cycle of the project, developed during the COVID-19 pandemic crisis in Brazil, it reveals complex interactions among Government, Academia, Industry, and Civil Society stakeholders, while also shedding light on the various risks arising from their dynamic collaboration. Employing an approach that combines case study analysis, risk assessment, and theoretical framework development, we unravel the project's evolution, highlighting pivotal elements such as trust, collaboration, communication, agile mindset, stakeholder partnerships, scale, and logistics. Additionally, the study underscores concerns related to finance, time, reputation, and health, which warrant consideration. Risk analysis uncovers internal and external risks and categorizes thirty-two risks, with one deemed unacceptable, thus revealing valuable insights into stakeholders' partnerships, institutional image, public equipment, manufacturing, project management, human resources, intellectual property, regulation, and sanitation risks. Building on these findings, we develop a new framework illustrating the management of the urgent Open Innovation project through the fast-paced Quadruple Helix formation. By exploring stakeholder collaboration and risk management, this research provides insights into the adaptability and speed required to successfully execute an emergency project, as well as presenting practical strategies for risk management and mitigation, significantly contributing to the domains of the Quadruple Helix and project management research.

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6.1. INTRODUCTION

The concept of Open Innovation (OI) captures the efforts of organizational relationships to actively pursue external knowledge while also utilizing their internal knowledge externally (Filiou, 2020). To enable this process, establishing interorganizational relationships becomes crucial, as demonstrated by the Quadruple Helix (QH) theoretical model (Galvão et al., 2017; Pirlone et al., 2020; Popa et al., 2021). This model encapsulates the participation of Firms, Universities, Governments, and User Communities, who collectively engender a dynamic process (Costa et al., 2021). The overlap of both OI and the QH model can represent a collaborative approach to generating value for Society and organizations (Parveen et al., 2015). In this context, it is observed

that such collaborative efforts in resource and knowledge sharing can lead to enduring advantages across economic, environmental, and social sectors, with a focus on sustainability (Yun and Liu, 2019).

Although early research (Baierle et al., 2021; Casaramona et al., 2015; Miller et al., 2016; Parveen et al., 2015; Yun and Liu, 2019) has investigated different aspects of Open Innovation with the Quadruple Helix model, normative empirical insights for specific contexts are still limited. Extant contributions in the literature include investigations on smart cities (Wirtz and Müller, 2023), payment system innovation (Niankara, 2023), start-up ecosystems (Ziakis et al., 2022), knowledge transfer (Miller et al., 2016), business model and applications (Carayannis et al., 2017; Emaldi et al., 2017), as well as innovation and technology environments (Baierle et al., 2021; Koprivšek and Lorber, 2017; Lorber, 2017). In this sense, the QH model appears as a manifestation of Open Innovation cooperating in the same sector (Papa et al., 2021).

Some authors (Yun and Liu, 2019) explore the role of Open Innovation in attaining sustainability amid the ongoing Fourth Industrial Revolution. The authors clearly emphasize the necessity for case studies to enrich the Open Innovation micro-dynamics model with quadric-helices as the way to achieve sustainability. More centrally, despite the extensive body of knowledge on healthcare and medical innovation as a response to the COVID-19 pandemic and the research conducted on risk management, there have been only a few studies so far that combine a QH model with risks, including explicitly analyzing natural and man-made disasters (Pirlone et al., 2020) and healthcare (Popa et al., 2021). Moreover, adopting the Quadruple Helix framework in the context of urgent projects from the stakeholders' perspective remains unexplored in the literature, offering promising opportunities for investigation.

Urgent projects (da Penha and ten Caten, 2023b, 2023a; Wearne and White-Hunt, 2014) encompass various scenarios, such as: (i) natural disasters, e.g., floods (Wearne and White-Hunt, 2014, p. 115), earthquakes (Liu et al., 2015), forest fires (Laneve et al., 2016), rock-fall protection (Liu et al., 2015), and ice disasters (Wang et al., 2019); (ii) infectious diseases, such as a pandemics in the context of construction (Chen et al., 2021; Luo et al., 2020) or healthcare (Maleka and Matli, 2022); and (iii) infrastructure failure, e.g., power supply restoration (Wearne and White-Hunt, 2014, p. 145), post-disaster reconstruction (Wu et al., 2021), or war situations (Sun et al., 2017). Urgent projects are unique and critical initiatives that demand rapid action and collaboration among stakeholders. Within this context, emergency projects can be identified as a particular type of urgent projects, with the former occurring in an emergency, or in otherwise risky or disruptive contexts (De Waard and Kalkman, 2022). Some authors (Maleka and Matli, 2022) reinforce this perspective on emergency situations.

Though the literature (da Penha and ten Caten, 2023b; Maleka and Matli, 2022; Popa et al., 2011; Wang et al., 2021) addresses the subject of emergency projects, it fails to provide a clear definition. An emergency can be described as a sudden severe/dangerous event or situation that requires immediate action (Oxford University Press, 2021a). Moreover, an emergency situation refers to an extraordinary nonmilitary event that, by scale and intensity, poses a significant threat to the lives and health of the population, to the environment, to essential materials, and to cultural values (Popa et al., 2011). Resolving such situations requires urgent measures and actions, allocating additional resources, and coordinating the management of forces and resources (Popa et al., 2011). In extraordinary non-military events, the theory suggests that there is an urgent project subcategory, High Intensity and Time Sensitive Projects (da Penha and ten Caten, 2023a), that can occur in extreme contexts (De Waard and Kalkman, 2022).

The emergence of the COVID-19 pandemic presented a fertile environment to explore the interactions among the QH's stakeholders while also shedding light on the risks of High-Intensity and Time-Sensitive Projects (da Penha and ten Caten, 2023a) that originated from their dynamic collaboration. This was particularly relevant because of the need for super-rapid innovation projects in the face of unknown effects on the disease's overall population mortality (Banerjee et al., 2020). This led to the following Research

Question: *How can urgent Open Innovation projects be executed in the context of the Quadruple Helix model considering stakeholder dynamics and the risk involved?*

This question is explored in the context of a case study involving the urgent development of Personal Protective Equipment (PPE) in Brazil during the COVID-19 pandemic. As the Quadruple Helix model includes stakeholders from Government, Academia, Industry, and Civil Society, it is used to understand the collaborative dynamics and associated risks of executing an urgent Open Innovation project. This study aims to gain a deeper understanding of the micro-dynamics for knowledge sustainability (Yun and Liu, 2019) of the urgent Open Innovation project from the perspective of the helix leaders. This research highlights the importance of an agile mindset, stakeholder partnerships, scale, and logistics in managing an urgent project. It also emphasizes the various risks and impacts of this QH interaction during the pandemic, such as financial, temporal, reputational, and health issues. By categorizing thirty-two risks, one of which is considered unacceptable, internal and external risks to the project in this context are revealed, in addition to risk categories regarding partnerships, institutional image, manufacturing of public equipment, project management, human resources, intellectual property, regulation, and sanitation. With this Research Question, we aim to develop a new framework for managing urgent Open Innovation projects in the accelerated context of the formation of the Quadruple Helix, with a focus on stakeholder collaboration and risk management and mitigation. To achieve this, this research combines qualitative case study analyses, risk assessment, and the development of a theoretical framework to explore an urgent Open Innovation project in times of crisis.

Analyzing the Brazilian response to the COVID-19 crisis holds significant academic and practical importance, especially in understanding institutional collaboration during disruptive events. Brazil, as the world's fifth-largest country, covering an area of approximately 8,515,767 square kilometers (Martins and James, 2020), and the sixth most populous nation, faced unique challenges in managing a vast health and humanitarian system during the pandemic. This included a range of urgent projects, from developing personal protective equipment (PPE) such as face shields (Chaturvedi et al., 2020; Gomes et al., 2020) to constructing field hospitals (Batista et al., 2020, p. 19; Ciccotti et al., 2021; Sanchez et al., 2021). The urgency and scale of these projects in Brazil are noteworthy. The country successfully produced and distributed 278,137 units of face shields across 8 states, covering 470 cities and benefiting 498 institutions and hospitals. This achievement is significant considering the typically prolonged timelines required for conventional Open Innovation (OI) projects of similar scale and complexity. Brazil's ability to rapidly conceive, develop, and execute such a massive project nationwide offers valuable insights into managing urgent, large-scale projects in times of national emergency (Wearne, 2008; Zidane et al., 2018). Furthermore, the Brazilian case provides an essential contribution to the literature on disrupted contexts (De Waard and Kalkman, 2022), which lacks sufficient discussion. This includes the transition from centralized to decentralized, ad hoc project management in such scenarios (Nachbagauer, 2022). By examining how Brazil crossed these complexities, valuable lessons can be learned about managing large-scale, urgent projects under severe time constraints, an area that remains underexplored in current academic research.

By delving into stakeholders' collaboration and risk management in the context of a High-Intensity and Time-Sensitive Project, this paper gives valuable insights into the adaptability and speed required for the successful execution of such projects. The study analyzed stakeholder dynamics, understanding helices' connections and the interactions' characteristics. It also identified a relation of critical risks and discovered which risk is deemed unacceptable. Moreover, the research highlights the difference between risks in non-urgent projects (such as partnership and institutional risks) and High-Intensity and Time-Sensitive Projects (such as logistical risks), as well as the emergence of newly identified risks (e.g., regulation and sanitation). Overall, this study contributes to advancing the managerial aspect of the Quadruple Helix and project management

research fields, particularly concerning urgent projects, stakeholders, and risk management.

6.2. THEORETICAL BACKGROUND

In this section, we provide a review of the theoretical foundation pertinent to this research. It is grounded in the Quadruple Helix (QH) theoretical model (Del Giudice et al., 2017), an established framework for understanding and examining the micro-dynamics of stakeholder collaboration within innovation ecosystems (Yun and Liu, 2019). The QH model expands upon the traditional Triple Helix model by incorporating Civil Society as a fourth helix (Carayannis and Campbell, 2010; Leydesdorff and Smith, 2022). First, we explore Open Innovation (Chesbrough, 2003; Chesbrough et al., 2006; Huizingh, 2011) with the Quadruple Helix model. Additionally, we present an overview of emergency projects to establish the necessary context to explore the urgent Open Innovation project during the pandemic crisis. Finally, we present the risks associated with urgent projects in the context of the QH model. By utilizing the Quadruple Helix model as a theoretical lens, we seek to untangle the complexities of urgent Open Innovation projects, offering a perspective that facilitates a profound understanding of the interactions, roles, and contributions of each helix.

6.2.1. Open Innovation and the Quadruple Helix Model

Open Innovation (OI) is a collaborative approach (Papa et al., 2021) to innovation that involves the purposeful exchange of knowledge across organizational boundaries, utilizing both financial and non-financial mechanisms in accordance with the organization's business model (Chesbrough and Bogers, 2014). The OI process overlaps the Quadruple Helix (QH) and encompasses the interconnectedness of the University, Industry, Government, and Society, forming an innovation knowledge infrastructure (Leydesdorff and Ivanova, 2016). Both frameworks emphasize the importance of collaboration and engagement among multiple stakeholders. Open Innovation promotes the idea of sharing and co-creating knowledge across organizational boundaries, while the Quadruple Helix model recognizes the interplay and interdependencies between the four sectors in driving innovation and societal development. The Open Innovation framework sits alongside the Quadruple Helix theory, identifying connections between the various stakeholders (Yun and Liu, 2019).

The concept of Open Innovation, as explored in existing papers (Chesbrough and Bogers, 2014; Kessler, 2013, p. 515; Parveen et al., 2015), involves the utilization of external networks by organizations to facilitate the development of innovation and knowledge (Dess and Shaw, 2001). This approach serves as a complementary option to traditional in-house research and development (R&D) practices (Coombs et al., 2003). Analyzing the timeline of the overlap between OI and QH frameworks, data from the Scopus database until July 2023 (Figure 6.10) illustrate that, since 2006, the focus of research on innovation and technology environments has shifted from technology transfer to the exploration of diverse methods and forms of innovation (Baierle et al., 2021). This shift seems to increase positive impacts while reducing the risks and uncertainties (Alonso and Bressan, 2016) associated with Open Innovation and technology.

Recent research indicates a growing interest in economic factors (Costa et al., 2023; Niankara, 2023; Ziakis et al., 2022) and technology environments (Baierle et al., 2021; Costa et al., 2023; Tewdwr-jones and Wilson, 2022; Wirtz and Müller, 2023). After 2019, the literature discusses various studies such as user communities driving firms' innovation (Costa et al., 2023), financial inclusion and payment system innovation (Niankara, 2023), smart cities as collaborative ecosystems (Wirtz and Müller, 2023), start-up ecosystems (Ziakis et al., 2022), co-designing urban innovation (Tewdwr-jones and Wilson, 2022), multiple helices models (Leydesdorff and Smith, 2022), and micro- and macro-dynamics

of Open Innovation with a Quadruple Helix Model as the way to achieve sustainability (Yun and Liu, 2019).

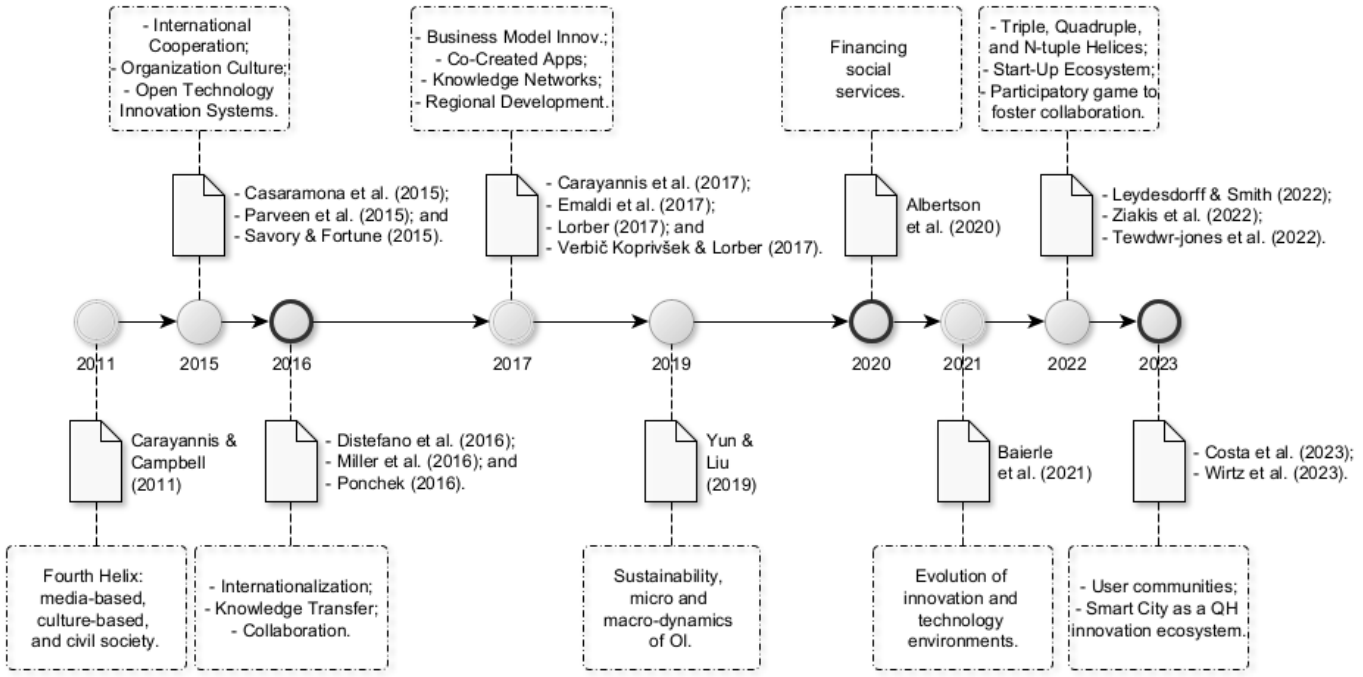

Figure 6.10 - Timeline of Open Innovation in the context of the QH model.

However, the analysis of the existing literature on Open Innovation with the Quadruple Helix model reveals an incomplete examination of all the QH dimensions. As presented by Yun and Liu (2019), there is a need to enrich the "Open Innovation micro-dynamics model with quadric-helices", as corroborated by recent studies mentioned here; this indicates a lack of exploration of the interplay and collaboration among the four dimensions. Therefore, a deeper examination of the Quadruple Helix model is necessary to fully understand its implications for Open Innovation. Furthermore, despite the recent importance of innovation as a result of the COVID-19 pandemic, there is no explicit mention of urgent Open Innovation projects in the QH model.

6.2.2. Urgent Project Risks within the Context of the QH Model

Risk is the probability of an adverse event occurring in a given time frame or the probability of a variation of an expected result (Guertler and Spinler, 2015). Within the context of the Quadruple Helix model, urgent project risks involve multiple stakeholders, each contributing their own set of risks. Government actors may face risks related to cost factors (Wynn, 2018) as well as reputation concerns (Siegel et al., 2003), for example, which are particularly pertinent to the dimension of anticipation within the responsible innovation framework (Stilgoe et al., 2013). Academic institutions may encounter risks pertaining to the reputation of their faculty members (Fulop and Couchman, 2006; Harman and Sherwell, 2002) and scientific production (Azagra-Caro et al., 2019). Industry stakeholders, on the other hand, may be exposed to risks associated with production and innovation (Elia et al., 2020; Siyanbola et al., 2012), potential loss of technological competitive advantage (Ankrah et al., 2013; Lee and Win, 2004), and supply chain vulnerabilities (Klimczak et al., 2017). Finally, Civil Society actors may face, for instance, risks related to public perception (Ankrah and AL-Tabbaa, 2015).

The literature analysis shows studies that fit the current research on Quadruple Helix and risks, despite risk management increasingly relying on collaboration (Yun and Liu, 2019) and the relevance of anticipation related to responsible innovation (Stilgoe et al.,

2013). Concerning the risk types, the risks identified in the literature are related to (i) socio-ethical risks (Popa et al., 2021) in areas such as privacy and data property, disruption of existing societal structures, inequality, and injustice; and (ii) natural risks (Pirlone et al., 2020). The specific application cases were related to (i) healthcare and responsible innovation (Popa et al., 2021) in the context of digital twins (combining emerging technologies such as Artificial Intelligence, Internet of Things, big data, and robotics) and (ii) natural and man-made disasters in the context of the resilience of a city (the ability of an urban system to adapt to an external event and quickly return to normality, Pirlone et al. (2020)). Therefore, only one (Popa et al., 2021) is related to healthcare in traditional projects or operations, and none of them to urgent projects.

When reviewing the relevant literature, risks in the context of QH can be classified into two categories: internal or external. Internal risks include misaligned technology strategy, inadequate internal capabilities, and process inefficiency (Wynn, 2018), inefficient Technology Transfer Offices (TTO) processes, insufficient faculty involvement, cultural barriers and misaligned incentives (Siegel et al., 2003), financial loss, relational issues, institutional impact (Fulop and Couchman, 2006), ethical conflicts and academic integrity, conflicts of interest, compromising research autonomy, internal governance challenges (Harman and Sherwell, 2002), conflicting R&D spending priorities, reduced University-Industry collaboration, inadequate in-house R&D, and internal organizational conflicts (Azagra-Caro et al., 2019). External risks include market dynamics impacting product development, insufficient external collaboration (Wynn, 2018), adverse environmental and institutional factors, inadequate Industry engagement, market dynamics and legal environment (Siegel et al., 2003), policy changes and Government regulations, market dynamics and competition (Fulop and Couchman, 2006), sponsor pressure and influence, public perception and trust issues, legal and contractual challenges, reputational damage and altered research agendas (Harman and Sherwell, 2002), economic cycles impacting trust and collaboration, policy and funding changes, changes in external economic conditions, and fluctuating public and Government support (Azagra-Caro et al., 2019).

Finally, the risk assessment and analysis of potential risks associated with the development of an urgent OI project under the QH framework shed light on the complexities and challenges that arise from the interaction among the four helices (Government, Academia, Industry, and Civil Society) in an urgent scenario. By incorporating viewpoints from stakeholders within each helix, the risk analysis offers multiple perspectives on the involved risks, from operational to strategic, and from internal to external risks (Siegel et al., 2003; Wynn, 2018). This approach captures a broad spectrum of potential risks and aids in understanding how different stakeholders perceive these risks. By integrating risk assessment into the QH model, the research expands this theoretical framework and adds a layer of potential challenges and uncertainties related to the Quadruple Helix model. This combination is relevant for developing risk mitigation strategies, especially in the context of superfast interactions among the helices in future extremely urgent projects.

6.3. MATERIALS AND METHODS

This research employs three distinct approaches: (i) Case Study Analysis, (ii) Risk Assessment and Analysis, and (iii) Theoretical Framework Development. The Case Study Analysis involves an empirical case study approach to gain insights into the stakeholders' dynamics, key characteristics, and life cycle of the urgent agile project (presented in Sections 6.3.1 and 6.4.1). The chosen case study serves as the descriptive step of the investigation and is used to understand the contemporary event and then to analyze it from the risk perspective. Regarding the Risk Assessment and Analysis, the urgent project is analyzed from a risk management perspective. This part of the research focuses on identifying and analyzing potential risks, considering the viewpoints of stakeholders from each helix (outlined in Sections 6.3.2 and 6.4.2). Finally, the Theoretical Framework

Development was built advancing on the theoretical framework presented by Pirlone et al. (2020). It combines risk assessment techniques with the principles of the Quadruple Helix (QH) framework (presented in Sections 6.3.3 and 6.4.3).

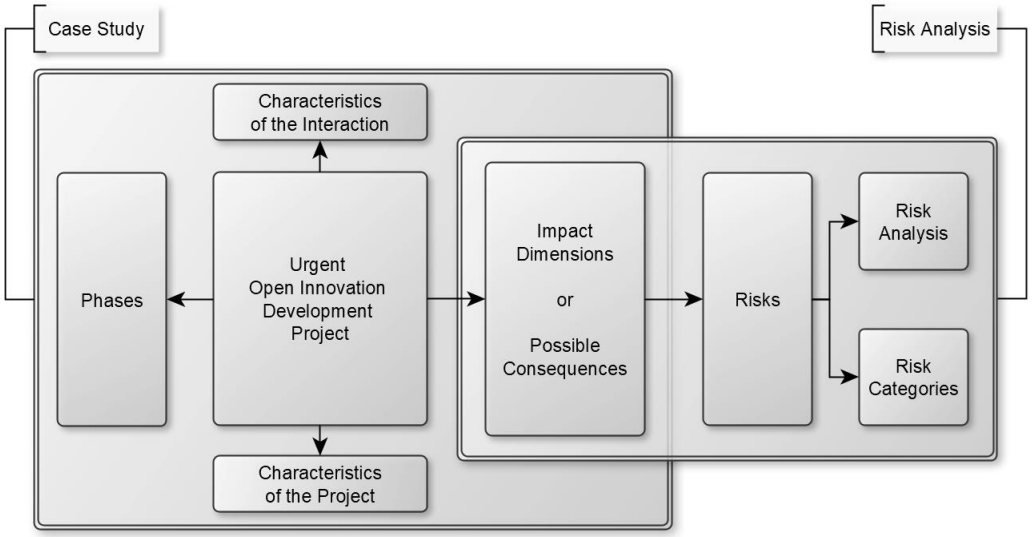

Figure 6.11 - Conceptual framework combining case study and risk analysis.

Figure 6.11 presents the conceptual framework for the research and visually summarizes the integration of Case Study and Risk Analysis. The starting point is a case study of an urgent innovation project, moving through the assessment of the project's characteristics and phases, identifying the impact dimensions or consequences, and then proceeding to the risk analysis and categorization. The flowchart outlines this structured approach formed by two sections labeled "Case Study", on the left, and "Risk Analysis", on the right, indicating the sequential stages of the research and the logical progression between the distinct steps.

6.3.1. Case Study Analysis

Providing a case study overview (Yin, 2018), the study addressed the Research Question related to the urgent Open Innovation (OI) project outlined during COVID-19. The case study adopted an inductive approach (Gioia et al., 2013) to explore the High Intensity and Time Sensitive Project development process timeline (da Penha and ten Caten, 2023a) and recognize the critical dimensions of the QH model. Its analysis was conducted by focusing on the emergency initiatives implemented in the Brazilian project to address the escalating demand for Personal Protective Equipment (PPE) during the crisis. This step focuses on the project that exemplifies and explains the fast Quadruple Helix formation and describes the fast product development from its initial conception to final delivery.

Regarding data collection and selection criteria, the data collection was conducted through an interview process involving the four connections in leadership positions of each Helix: (i) a university professor and manager representing the academic helix; (ii) an agent of Society directly engaged in the project; (iii) an Army colonel representing the Government helix; and (iv) a spokesperson of one of the Companies involved representing the Industry helix. By including the representatives from each helix, it was possible to collect data from different points of view about the project from the perspective of individual actors in leadership roles, in line with the insights offered by Hoffmann (2007). All these leaders possessed decision-making authority and were responsible for driving changes within their respective helix.

Concerning the interview process, the questionnaire script for data collection is presented in Appendix 6A. It focused on explanatory questions such as "how" and "what" to deal with the tracing of operational processes over time (Yin, 2018). The questionnaire was designed to extract data to form an understanding of the Open Innovation development process. The interviews were conducted via video calls, recorded in audio format, and subsequently transcribed. Each participant completed three rounds of interviews, ranging from 34 min to 1 h and 3 min.

The leader of each helix was selected for their ability to provide a complete, top-down management perspective crucial to understand the dynamics, interactions, and actors involved in the PPE development project. Furthermore, as the project life cycle was extremely short (11 days), but with high daily intensity, and as each leader was dedicated exclusively to that project during the period because of the pandemic, each leader was able to report in detail the events and iterations that occurred each day. Our approach sought to capture a diverse range of knowledge and experiences relating to the project, thus reflecting the complexity and urgency of the situation.

The first round aimed to obtain daily empirical information from the project regarding the entry of each actor, their respective actions, and the distinct roles on each day of the rapid formation of the QH. On Day 1, University researchers, Society members, and volunteers started the project, focusing on developing face shields, data collection, and initiating fundraising and donation efforts. Industry started collaborating from Day 2, the same day as donations began. Until Day 8, the focus was on partnering between Companies and the University for large-scale production, as well as technical specifications and local logistics. Society was involved in mobilizing financial support and donations. The Government, especially the Brazilian Army, came together with greater protagonism on the 9th Day to assemble, sanitize, and distribute products. This initial round of interviews was conducted shortly after the project was completed, which allowed us to gather empirical information from each day of the project. This timely data collection was crucial as Brazil was experiencing a total lockdown at the time, and these leaders were the only ones within their respective institutions with the autonomy to make decisions and coordinate this unexpected urgent project. The empirical data obtained from the respondents, detailing each day of the project, were essential for the development of the visual structure that illustrates the detailed timeline of the project development process, as presented in Appendix 6B (Figure 6.14), depicting the rapid formation of the Helix Quadruple and extremely fast project execution, which are central to our research.

Pertaining to the data analysis, the collaborative nature of the urgent Open Innovation project was analyzed through the lens of the QH model. The research team began by coding the interview data into days to obtain a clear and accurate picture of how the QH formed. Next, the data were analyzed to identify patterns related to the daily challenges and actions faced by the project. We identified the emergent key dimensions while examining the interactions among Government, Academia, Industry, and Civil Society stakeholders. After that, to better understand the distinct roles of each helix, the project life cycle was classified into three phases (I, II, and III), brought together based on helix patterns observed over time. Utilizing an inductive approach, the researchers examined the data to generate the key dimensions pertinent to the Quadruple Helix model, which, in the next step, was represented in a framework. By analyzing the actions, inputs, and roles of different stakeholders of each Helix, with the urgent project divided into phases, the relevance of each stakeholder during the project life cycle was identified.

In relation to visual framework development, based on the inductive analysis, a visual framework was developed to illustrate the QH model, as presented in Appendix 6B (Figure 6.14). The detailed timeline of the development process for the urgent project was structured in a vertical format with events from the first to the last day, indicating the stages in the project's development. The timeline is organized into two columns, with icons indicating specific activities or components associated with each stage. Icons are used to visually represent different aspects of the project timeline. The left column lists

activities and the right column lists stakeholders involved at each stage. The framework illustrated the interactions among the helices and strengths offered by each helix. The visual framework outlines the different levels of participation by the stakeholders, with categories such as "Listening", "Creating", and "Implementing". By visualizing the complexity of the innovation ecosystem, the framework highlights the collaborative efforts required for the project's successful outcome. The interpretation of the results sheds light on stakeholders' partnership and the agile mindset in achieving the project's objectives.

The second round (first part of the risk assessment process) aimed to obtain the list of risks related to the urgent project. The list was identified with 32 risks and classified into 10 categories, including Image of the Institutions Involved, Logistics, and Stakeholders' Partnership. The third round (second part of the risk assessment process) aimed to ask about the perception of probability and impact of each risk. We detail these steps in Section 6.3.2. (Risk Assessment and Analysis).

6.3.2. Risk Assessment and Analysis

With respect to the Risk Assessment and Analysis Overview, in the context of the urgent Open Innovation (OI) project developed during the COVID-19 crisis, the second part of the study is a risk assessment and analysis conducted to map the potential challenges and uncertainties. This subsection systematically identifies and evaluates the risks in the rapid development of Personal Protective Equipment (PPE) in Brazil. Emphasizing the project's High-Intensity and Time-Sensitive nature, the assessment was fundamental in recognizing and categorizing the risks in line with the Quadruple Helix (QH) model.

In terms of the data collection and risk identification, the first part of the risk assessment process contemplates the data collection through semi-structured interviews with project stakeholders, as detailed in Appendix 6A. Leaders from each helix—Academic, Society, Government, and Industry sectors—identify the risks involved in the process based on their own perceptions (Dryhurst et al., 2020; Duan et al., 2020), thus facilitating the identification of risks associated with the project (Sanchez-Cazorla et al., 2016). These identified risks were then classified into categories that were later integrated into the theoretical framework and support the narrative findings.

In a second round of interviews, the interviewees were again asked about the perception of probability and impact for each risk (Markmann et al., 2013), according to the scale presented in Table 6.21. This scale is defined by qualitative or semi-qualitative methods. Qualitative methods of risk analysis define levels of judgment for the probability of occurrence (e.g., from "very rare" to "very probable", or from "improbable" to "frequent") and the severity of impact (e.g., from "too low" to "very high," or from "minor" to "severe") - (Cagliano et al., 2012). The semi-quantitative risk analysis methods use a numerical scale for probability and impact (Cagliano et al., 2012; Ni et al., 2010). The analysis considered four dimensions of potential consequences: financial, reputational, health-related, and temporal impacts on the project. These dimensions were defined from the first round of interviews.

Table 6.21 - Probability and impact scale. Source: Li et al. (2018).

Scale	Probability	Impact
1	Improbable	Minor
2	Remote	Medium
3	Rare	Significant
4	Probable	Major
5	Frequent	Severe

As for the Risk Index Calculation, each risk was evaluated and assigned a risk index - RI (Ni et al., 2010), calculated by multiplying its impact and likelihood. This index allowed for prioritizing risks based on their criticality. The final impact and probability were calculated using the average of the impact and probability estimated by each interviewee (Figure 6.12). We calculated the local risk index for each group, along with a global risk index (Appendix 6C).

The risk matrix (Li et al., 2018; Ni et al., 2010), also known as the risk assessment matrix, depicted as a two-dimensional plot, was constructed to visualize each risk's probability and impact (Qazi and Akhtar, 2018) to estimate the degree of risk (Cagliano et al., 2012). It included additional dimensions such as risk names and categories (Table 6.25). The risk categories were chosen using the existing literature (e.g., partnership and institutional image) and the new groups were discovered. In this matrix, each risk is represented by a symbol with an "R" followed by a number (for example, R1, R2, etc.), indicating the different risks identified. The symbols represent the risk categories. The risk matrix is shaded in gray levels from light to dark, indicating zones of severity, with darker areas representing higher combinations of impact and probability. For example, risk R29 is in the darker area in the upper right corner, indicating that it is perceived as having a high probability of occurrence and a high impact. On the other hand, risk R10 is in the lower left corner, indicating lower probability and impact.

The multiplication formula (Ni et al., 2010) is used for the risk index for prioritizing risks (Koivisto et al., 2009; Li et al., 2018). This research utilizes the criterion of 30% more significant to identify the critical risk set. The criterion used is, thus, $RI > 12.25$, where $P = 3.5$ and $I = 3.5$. Furthermore, a criterion of 20% more significant is applied to select the unacceptable risk set, thus, $RI > 16$, where $P = 4$ and $I = 4$. In the face of unacceptable risks, regardless of the cost, mandatory safety measurements should be carried out to diminish the risk level to a critical level (Ruan et al., 2015). Then, we use the symbol "$\succ$", indicating the ordinal scale of the relative importance of the risk. Therefore, it denotes that the risk on the left has a higher priority than the risk on the right. For example: $R29 \succ R27$. This scale is derived from the utility indifference curves (Qazi and Akhtar, 2018; Ruan et al., 2015), which are based on economic utility theory (Besanko et al., 2020, p. 637; von Neumann and Morgenstern, 1944).

Regarding the Risk Classification Procedure (Richert and Dudek, 2023) as "Internal" (originating within the project) and/or "External" (originating outside the project), we follow the steps below. First, we define the two categories. Internal Risks are defined as those originating from within the project's scope, such as team dynamics, decision-making, and resource management, as well as operational, safety, and security risks (Sabokbar et al., 2016). As we are analyzing the project within the Quadruple Helix context, the project encompasses the four helices. External risks are those influenced by factors outside the project's immediate control, such as political, economic, social-cultural, and environmental risks (Sabokbar et al., 2016), as well as media, public perception, and regulatory bodies. A new column, titled "Risk Origin," was added to Table 6.25. We then individually reviewed and analyzed each risk to verify whether its origin was internal or external to the project. Two different researchers assigned the rating to each risk. As the classification of some risks can be subjective and depend on the project context and the expert's perspective, when researchers disagreed, a third researcher was called in to decide on a definitive categorization. We present the discussions separating the risks into these two broad categories. The division of risk into external and internal introduces the possibility of distinguishing the main risks in these two areas related to the QH model.

Once the broad risk categories (internal or external) and subcategories (e.g., partnership, equipment, production) have been identified, to present suggestions and recommendations for similar projects in the future, we revisit the analysis of stakeholder dynamics and review the life cycle of the project; based on this, we formulate possible risk mitigation strategies. First, we review the interactions and roles of different stakeholders in the QH model to understand how these dynamics contribute to or mitigate risks. We then examine the project lifecycle to identify the most relevant suggestions for each risk

classification. Finally, based on this analysis, we suggest strategies for each aspect of risk classification.

6.3.3. Theoretical Framework Development

This research aims to refine the theoretical framework initially proposed by Pirlone et al. (2020) by integrating risk management into the QH model based on a deep understanding of how this project emerged and the crucial characteristics of this formation. It expands the understanding of the micro-dynamics of Open Innovation with the Quadruple Helix framework as the way to achieve sustainability. This profound understanding helps us see new possibilities and ideas for organizational studies that are often in the background or invisible in the foreground (Kessler, 2013, p. 592). To gather empirical evidence, this work used qualitative research methods, as per de Ven (2007) and Yin (2018), to observe, examine, and develop a model that is a partial representation of theories (de Ven, 2007).

With regard to the case study and risk analysis synthesis, this step summarizes the findings of the narrative case study with the risk analysis during the execution of the urgent Open Innovation project with the Quadruple Helix model. To build the model, the researchers confront the participants' perceptions concerning the urgent OI project (de Ven, 2007). By considering the points of contact and interaction among the stakeholders, the framework enables a detailed perspective on the project from this point of view. Consequently, it combines the "how" aspect, as emphasized by Yin (2018), with the incorporation of the risk assessment approach from the participants' point of view.

Based on the theoretical framework presented by Pirlone et al. (2020) in the context of the Quadruple Helix model, this approach provides an enriched understanding of how the urgent Open Innovation process happens. By examining the project phases, crucial aspects of the interaction, project-related factors, extracting impact dimensions, and possible consequences emerge for the risk analysis (Figure 6.11). The research extends these results by integrating risk and their categories, resulting in a novel map of the micro-dynamics of OI with the QH model. The final framework summarizing the findings is presented in Figure 6.13.

6.4. RESULTS

The findings offer valuable insights into the understanding of urgent Open Innovation (OI) projects with the Quadruple Helix (QH) model, with a particular emphasis on stakeholders' interactions and risk assessment. As a consequence, it reveals the perspective of an agile mindset in an urgent project.

6.4.1. Case Study Analysis

To address the Research Question, we analyzed an emergency project, called GRU, established to meet the high Brazilian demand for the face shield product during the pandemic. A total of 278,137 units were produced and donated to thousands of health professionals working on the front lines in eight different Brazilian States: São Paulo, Rio Grande do Sul, Amapá, Amazonas, Alagoas, Goiás, Paraná, and Rondônia. The project involved more than 60 people, with a budget of over BRL 220,000.00. It covered 498 institutions and hospitals in 470 cities. The GRU Project's primary objective was to develop, manufacture, and supply face shields. Assessment of the empirical data allows a complete examination of the collaboration among all Quadruple Helix Dimensions in the urgent OI ecosystem.

The project started with a group of volunteers at the beginning of the pandemic. In the initial stage, different face shield prototypes were manufactured using 3D printing technology. To ensure their usability and efficacy, extensive tests were conducted within hospitals. With users' feedback collected and analyzed, it was possible to refine the

design, optimized with a particular attention to comfort and virus protection, required for the situation.

The final design of the GRU face shield model comprised three main components: a forehead piece, a clip/strap mechanism, and a visor. To facilitate large-scale production, the final design and manufacture of the GRU model was transitioned to the injection process by partner Companies, which allowed for much faster and more efficient production to satisfy the exponential demand for visors at the beginning of the pandemic. The project's design was recognized with the Bornancini Design Award 2020 (Association of Design Professionals of Rio Grande do Sul, 2020) in the COVID Professional Category and the Petzold Professional Award for Outstanding COVID Action. These prizes highlight the significant contribution of the GRU initiative in the scientific, technological, and design domains.

In the detailed calendar of urgent project development process (Appendix 6B), one can observe the entry of each actor, represented by the image of the helical formation to which they are related, and their respective actions on each day of the rapid formation of the QH. Figure 6.14 provides a high-level overview of the project lifecycle, illustrating the complexities of product development and the collaboration interfaces and review required to deliver the product to healthcare professionals. The University's Engineering Department developed the project, using the agile mindset (Kannan et al., 2017; Niederman, 2021) to drive the project, achieving a lifecycle of only 11 days. Stakeholders' actions and inputs throughout the process are illustrated in a vertical timeline from day 1 (D1) up to day 11 (D11). To better understand the daily actions of the urgent agile project and the distinct roles of each Helix, the project was separated into three phases (I, II, and III), determined based on empirical patterns of the helices over time.

Phase I of the project's development started on a Saturday (D1). It was driven by research professors motivated by the immediate need to protect healthcare professionals who had difficulties acquiring Personal Protective Equipment (PPE) in their hospitals due to the exponential increase in local and global demand. On that day, a team of researchers collaborated with members of the University's research laboratories and connected with a Society player through a group on the WhatsApp instant messaging application. D1 marked the beginning of data collection for the face shield product development, forming partnerships with stakeholders, and the production study. This phase was characterized by the University and Society's leading role. The University launched a campaign to encourage the population to contribute to this initiative, while Society played a leading role in finding donors, foundations, and equity fund resources for gathering capital investments. Society actors involved healthcare professionals and a group of volunteers made up of professors, employees, and University scholarship holders, aligned with the collective group Brothers in Arms. One of the interviewees pointed out that "*There was a need to expand the manufacturing scale. Even due to the limitation of existing equipment at the University and, ideally, through partnerships… using the machinery of a Company that volunteered, more materials were also purchased or donated*". Therefore, expanding manufacturing required partnerships for equipment and material acquisition and use due to the limitations at the University.

In phase II (from D3 to D8), digital communication resources were utilized to search for, reach, and establish connections with Companies interested in collaborating with the University to form immediate partnerships to scale up the product's manufacture. The exchange of information with Companies made it possible, through the application of Open Innovation, to develop a face shield model for large-scale production by industries possessing compatible production lines and local logistics capabilities. Digital communication resources were also employed to disseminate information about the project to Society, given the need to integrate it, collect donations, and enhance collaborations essential for the project's development and adaptability, as well as to manufacture the product at the University and deliver it to the target audience. This phase was characterized by the connection of the third Helix: Industry. This collaboration with Industry partners enabled the first manufacturing at scale to be achieved. Thus, this phase

involved using digital communication resources to partner with Industry for large-scale production while engaging Civil Society for support.

As to how Industry leaders collaborated closely with the University, "Companies T, S, C" are mentioned at various stages, indicating that specific Industry participants were involved throughout the urgent project. Collaboration between Industry and University helices was focused on activities such as "Data Collection" (D3), "Technical Specifications" (D4), "Preparation for Production" (D5), "Production Standardization" (D5), "Logistics" (D5), and "Definition of Model for Production" (D6 and D7). Furthermore, the presence of a "Graduated Startup" alongside University and Companies at various stages highlights the bridge between academic research and practical industrial application of the urgent project.

Industry leaders collaborated with Society through the following interactions: donations, the Brothers in Arms collective, and Equity Fund. From D2 onwards, donations started, and these continued until the end of the project. This indicates that Industry both received and provided donations and contributed to societal efforts, pointing to a financial and resource-based collaboration with the community. Company T, for example, donated at least 50,000 complete face shields plus straps out of a total of 140,000 produced. Another Company donated around 90,000 forehead pieces. The Brothers in Arms group helped mobilize community financial support. This shows that Industry leaders worked alongside volunteers to implement the project. The mention of an "Equity Fund" (D3, D4, D5, D6 and D7, D8, D9, D11) points towards investments made by societal actors into the PPE development project, once again reflecting a financial collaboration between Industry and Society.

Concerning Industry interaction with the Government, the involvement of both Industry and University in the "Regulatory Agency" (D4, D5, D6 and D7, D9) suggests that Industry leaders worked within the guidelines set by the Government to ensure standard compliance.

In phase III (D9 to D11), a connection was made on Sunday with the Government through a messaging application to a figure of the Brazilian Army. It was necessary to count on the support of the military for the assembly and cleaning/sanitizing of the products manufactured by the partner Companies and for distribution in Brazil due to its logistical presence throughout the national territory. The formation of this new helix connection made it possible to achieve the second product scale. One of the interviewees highlighted that: "*the project wouldn't have gained the scale that it gained if it hadn't been for that contact … on Sunday*". The establishment of this helix connection made it possible to further increase the scale and reach of the product, as well as logistical and distribution support for deliveries over continental distances in Brazil, which has an area of approximately 8,515,767 km^2 (Martins and James, 2020).

Concerning how the Government interacted with other sectors of Society, the "Government" is represented by the involvement of "Regulatory Agency" (D2 to D8), "Military Forces" (D9), and "State Civil Defense" and "State Secretary of Health" (D11). However, the Government figures took a much greater role in the latter stages, beginning with "Assembling" (D9) and "First Delivery" (D11).

On the University's interaction with the Government, the University's engagement with regulatory agencies at various stages indicates close interaction to ensure that the development of PPE met Government standards and regulations. The presence of the State Secretary of Health and State Civil Defense at the final stage indicates that the University interacted with these bodies to start the first delivery of the urgent project outcomes, which involved coordination with health and emergency services.

Analyzing these three phases, it is noted that these achievements were made possible by using an instant messaging app, an agile mindset, and the imminent necessity to safeguard the lives of healthcare professionals. This approach allowed for time to be gained by moving beyond the formal steps that a project of this nature would have required under normal circumstances. Moreover, instant digital communication enabled

the helices to perform as a network system where each actor could access any other instantaneously.

The extremely high speed of collaboration in the project also brought associated risks (Appendix 6C). Respondents revealed concerns about potential financial, time, reputation, and health consequences. The absence of barriers between institutions is also noteworthy because the managers were already acquainted and had mutual professional trust from previous work, projects, and partnerships. One of the participants stated that "*it was a practical test for the institutional relationship, that worked*". Trust emerged as a critical element, facilitating stakeholder collaboration, knowledge sharing, and mutual understanding.

This comprehensive analysis of the urgent OI project with the QH model showed that the project developed during the COVID-19 pandemic required rapid and well-coordinated actions and collaboration among stakeholders from Government, Academia, Industry, and Civil Society. Even with a superfast but relatively straightforward product, the Quadruple Helix framework shows the complexity of this innovation ecosystem, identifying strengths offered by each helix, as illustrated in the framework (Figure 6.14). Effective and instant communication ensured a continuous and intense flow of information, enabling coordination and alignment of extremely time-sensitive goals. The extremely agile mindset adopted in the urgent OI project allowed for adaptive responses to rapidly changing circumstances. Finally, the stakeholders' partnerships played a vital role, leveraging the strengths of each helix to ensure the successful outcome of the project.

6.4.2. Risk Assessment and Analysis

Thirty-two (32) risks were identified and classified into ten (10) categories (Appendix 6C). These categories are related to (i) the stakeholders' partnership (PA); (ii) the image of the institutions involved (IM); (iii) the public equipment (EQ) used for project development, involving laboratories and materials in general; (iv) the production (PR), specifically concerning tools and assembly; (v) the project (PJ), related to decision-making and the proposed model; (vi) the people (PE) participating directly or indirectly; (vii) the patents and intellectual property (IP); (viii) the logistics (LO); (ix) the Health Surveillance Agency (AN) in Brazil (Agência Nacional de Vigilância Sanitária—ANVISA), responsible for the products' technical and sanitary specifications; and (x) the cleaning/sanitization (SA) of laboratories, materials, and products.

The risk index, RI (Ni et al., 2010), as presented graphically (Figure 6.12), provides a comprehensive assessment of risks associated with this urgent OI project. Critical risks provide a better understanding of the emergency. The risk index result indicates that risks R28 (12.4), R17 (13.2), R5 (14.3), R14 (14.6), R6 (14.8), R27 (15.1), and R29 (17.3) are the most critical (Appendix 6C). Among these, the logistical risk of delaying the personal protective equipment (PPE) delivery and losing the task force's effectiveness (R29) appears as the most critical or unacceptable (Ruan et al., 2015). Qazi and Akhtar (2018) define unacceptable as a risk zone where it is essential to reduce the risks to a critical level at any cost.

Based on the risk index (RI), the risks were prioritized from highest to lowest: $R29 \succ R27 \succ R6 \succ R14 \succ R5 \succ R17 \succ R28 \succ R8 \succ R12 \succ R22 \succ R19 \succ R26 \succ R13 \succ R32 \succ R9 \succ R18 \succ R25 \succ R11 \succ R20 \succ R3 \succ R2 \succ R24 \succ R1 \succ R31 \succ R23 \succ R7 \succ R30 \succ R21 \succ R4 \succ R10 \succ R16 \succ R15$. The local risk index was also analyzed within each group (Appendix 6C), resulting in the following priority:

$$SA \succ LO \succ AN \succ PA \succ IM \succ PE \succ EQ \succ PR \succ PJ \succ IP$$

This shows that equipment, production, project, and intellectual property appear with less criticality. Sanitation (SA) appears as a critical group. Furthermore, critical risks appear in six categories.

Regarding the classification of risks into internal and external, as presented in Table 6.25, we consider the nature of each risk and whether it originates within the project or from external factors.

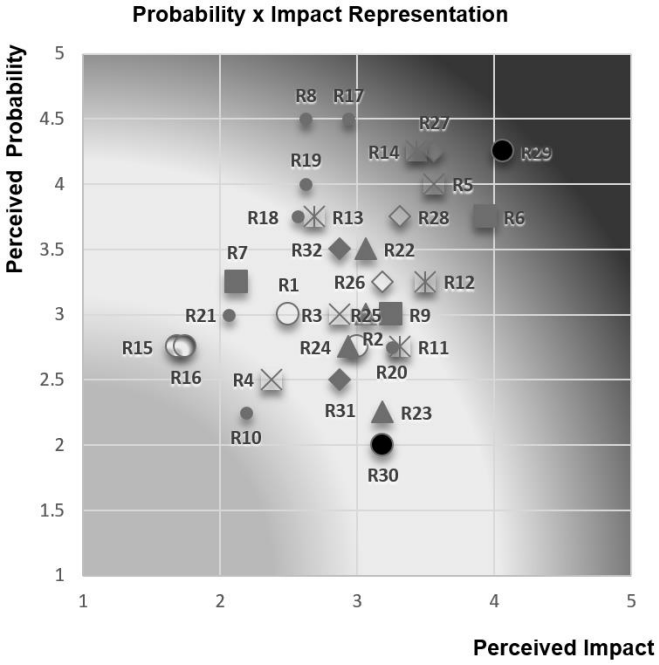

Figure 6.12 - Spatial representation of the probability-impact relationship for each of the 32 identified risks and the categorization of risks.

In relation to internal risks, those are intrinsic to the project operation and involve aspects that are directly under the control and influence of the project team within the QH model. They include equipment management (EQ), production processes (PR), project management (PJ), team dynamics and participation (PE), intellectual property handling (IP), health and safety practices (SA), partnership dynamics within the project (PA), and logistics concerns (LO). Risks related to equipment (R22, R23, R24, R25) are internal, as they pertain to the management, usage, and functionality of the project's own equipment and resources. Production (PR) risks (R31, R32) are internal, as they are associated with the project's internal production activities and processes. Project-related risks (R1, R2) are internal, originating from the project's internal decision-making and project management processes. The researchers disagreed on R2 (Risk of the product not serving its purpose), requiring a third researcher to decide. Risks involving people (R3, R4, R5) are internal, because they are related to the dynamics, management, and participation of the project team and volunteers. Intellectual property (IP) risks (R15, R16) are internal. Sanitation (SA) risks (R26, R27, R28) are internal, as they focus on the project's internal health, safety, and sanitary protocols practices.

The classification of some risks, particularly those related to partnerships (PA) and logistics (LO), may vary based on the context and specific project model. Because of the QH model framework and the interaction between the helices, these were defined as internal due to their dependence on the dynamics and management internal to the theoretical model. Partnership (PA) risks (R6, R7, R9) are typically internal as they are related to internal dynamics and agreements within the project team or between project partners within the QH model. A third researcher resolved disagreements on partnership-related risks R6 (Risk of breaking the partnership), R7 (Risk of not signing a Protocol of Intent between the institutions involved), and R9 (Risk of not reaching consensus on joint product development). In an isolated project they could be considered external risks, but

in the context of the QH model they were considered internal risks. The same logic applies to Logistics (LO) risks (R29, R30).

External risks that involve compliance with guidelines and requirements set by external authorities, which are not under the direct influence or control of the project team within the theoretical model, include aspects such as institutional image (IM) and compliance with regulatory standards (AN). Institutional Image (IM) risks (R17, R18, R19, R20, R21, R10, R8) are considered external, as they involve factors such as media representation, public perception, and external stakeholder reactions. This dispute was solved in R21 (Risk of improper use of the product). ANVISA (AN) risks (R11, R12, R13, R14) are related to compliance with external regulatory standards and approvals from regulatory bodies such as ANVISA. This dispute was solved in R14 (Risk of lack of inputs).

6.4.3. Theoretical Framework Development

The present paper presents a unified theoretical framework as a finding summary, as illustrated in Figure 6.13. It helps understand the complete development of the urgent OI project. Summarizing the findings elucidates the relationship between the fast and dynamic nature of innovation with the Quadruple Helix theoretical model and risk management during a crisis. Therefore, based on the empirical research findings, the conceptual framework (Figure 6.13) contributes to advancing the theory by gathering previous research from Pirlone et al. (2020) and Popa et al. (2021).

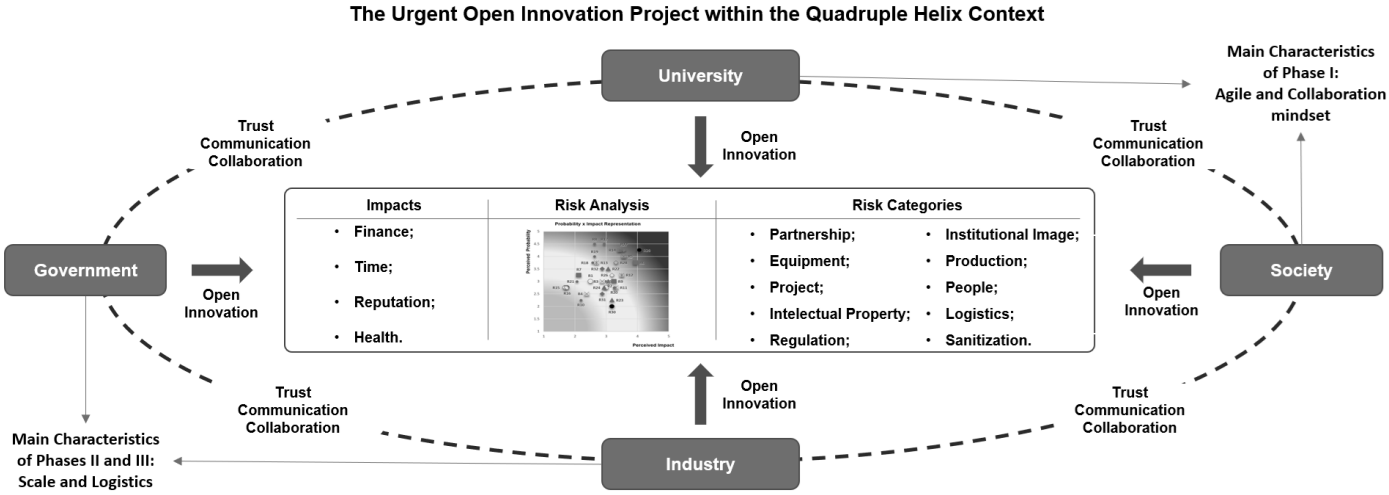

Figure 6.13 - Conceptual framework of the urgent Open Innovation in the fast Quadruple Helix formation context.

This theoretical framework captures the Quadruple Helix perspective on stakeholders, risks, and an agile mindset during the analyzed High-Intensity and Time-Sensitive Open Innovation project, thereby consolidating the empirical evidence of a project with a high degree of urgency, extremely short duration and very high speed (da Penha and ten Caten, 2023a). The model also suggests crucial components such as trust, collaboration, communication, agility, stakeholder partnerships, scale, and logistics. Considering these elements, the framework provides a view of urgent project management within the fast-paced Quadruple Helix formation. Moreover, the theoretical model delineates the interdependencies and interactions between the Armed Forces (Government), Industry, University, and Citizens helices, illustrating how each of these elements contributed to delivering successful outcomes.

6.5. DISCUSSION

This section discusses the findings of the case study and the risk analysis. It addresses the main characteristics emphasized in the case study. Additionally, it explores the ten risk categories and their respective risks identified in the Open Innovation literature. This comparative analysis enables us to compare the risks and categories found in the literature and the novel identified risks associated with an urgent project conducted during a pandemic.

6.5.1. Open Innovation, Agility, Key Aspects and Gaps

The use of digital communication resources emerged as a crucial factor in enabling information exchange and coordination among the stakeholders. These results align with the existing literature, which emphasizes the importance of communication technologies in facilitating innovation processes, as highlighted by Dodgson et al. (2006) and Huizingh (2011), and on effective Open Innovation (Wang et al., 2023). Instant digital communication worked as a network to instantaneously connect all project levels; Papa et al. (2021) explored knowledge exchange in complex collaborative networks. This phenomenon bolstered the intra-organizational level of analysis, as presented by Bogers et al. (2016). However, it also extended beyond the organizational boundaries, encompassing the stakeholders' perspectives. The indispensability of this connectivity is evident; it would not otherwise have been possible to start and execute the project because of the physical distancing imposed by the pandemic crisis. Thus, the findings are consistent with prior research conducted on Open Innovation (Chesbrough, 2003; Chesbrough et al., 2006; Huizingh, 2011).

The findings show that adopting an agile mindset in the project's development is also noteworthy, as it enables adaptive responses to rapidly changing circumstances. This observation is consistent with prior contributions that have acknowledged the value of agile methodologies in Open Innovation initiatives, as presented by Pellizzoni et al. (2019), Vesci et al. (2021), and Khafri et al. (2023). The project's three-phase approach exemplifies the fast nature of the OI process, where collaboration and partnerships rapidly evolve over time to achieve larger-scale production and logistical support. Therefore, this aligns with previous studies emphasizing the dynamic nature of OI processes and the need for continuous collaboration and adaptation.

The literature sheds light on several key aspects within the QH model. The importance of necessity has been emphasized (da Penha and ten Caten, 2023b; Ziakis et al., 2022), along with the crucial role of communication and knowledge exchange (Leydesdorff et al., 2014; Zhu and Park, 2021), collaboration (Kronblad and Envall Pregmark, 2021; Ponchek, 2016), agility (Xue and Gao, 2022), partnership (Bellandi et al., 2021), and scale (Barbulescu and Constantin, 2019). Furthermore, the literature also puts light on trust dynamics as a major risk in innovation (Fulop and Couchman, 2006) and discusses the role of necessity as a potential driving force (Ankrah et al., 2013). Despite an extensive literature search, no specific research articles were found addressing logistics within the context of the Quadruple Helix model. Such a gap presents an opportunity for future research in this area.

The evidence reinforces the individual actors' aspects (Ankrah et al., 2013) as motives for collaboration engagement at the organizational level (Locatelli et al., 2021). Additionally, the research evidence also reinforces the belief that trust is essential in initiating and sustaining collaboration (Ankrah et al., 2013). Moreover, the benefits of the partnerships have been found to outweigh the associated risks (Harman and Sherwell, 2002), supporting the notion of trust as a critical element in such contexts (Malik et al., 2021; Valackienė and Nagaj, 2021). Due to existing professional relationships and mutual trust, the absence of barriers between institutions in this project highlights the importance of established networks and previous collaborations in fostering effective OI practices.

When analyzing the impacts of the urgent OI project from a non-commercial perspective, the study has shown the importance of the financial consequences, as emphasized by the participants in the case study. This empirical evidence aligns with the literature as a risk category, as pointed out by some authors (Ankrah et al., 2013; Fulop and Couchman, 2006). However, the participants did not view financial impacts as a risk to the execution of the urgent project. The literature shows that urgent projects often necessitate the allocation of resources in an uneconomical manner (Wearne and White-Hunt, 2014), and that the speed of execution takes precedence over cost considerations (Wearne, 2006; Zidane et al., 2018). Additionally, due to being a High-Intensity Time-Sensitive Project, characterized by tight deadlines and a high level of urgency, managers seemed to opt for "near maximum speed," increasing the total cost of the project (da Penha and ten Caten, 2023a). This contradiction in the existing literature calls for further exploration into the factors influencing participant's perspective.

6.5.2. Global Perspectives vs. Brazil's GRU Project

The comparison of Brazil's PPE development process with those of other nations reveals diverse approaches. While other initiatives also adopted collaborative design and production (O'Connor et al., 2022; Viseur et al., 2023), rapid prototyping and agile approach (Kurtz et al., 2022; Nilasaroya et al., 2023), use of 3D printing technology (Amir and Amir, 2022; Gunputh et al., 2023; Kantaros et al., 2021), and user feedback in iterative design (Agarwal, 2022), each project employed distinct approaches to design and production. Furthermore, Brazil's project differed notably in other aspects. Initially employing 3D printing, the GRU Project moved within days to injection molding for mass production, a unique strategy compared to other countries. Furthermore, the project was much larger in scale and speed, producing more than 278,000 units, distributing them across several states in Brazil, and involving significant financial and human resources, while other studies were more localized and less rapid, as shown in Table 6.22.

Table 6.22 - Comparative analysis of PPE development processes: Global perspectives vs. Brazil's GRU Project.

Source	Country	Key Focus of Development Process	Comparison with GRU Project (Brazil)
(Viseur et al., 2023)	France	Collaborative design and production using 3D printing, local logistics.	Collaborative design and local production. Smaller scale and local reach compared to GRU's large-scale production and wide geographic distribution. Less agility compared to GRU.
(Nilasaroya et al., 2023)	Australia	Rapid design and manufacture of standard and ENT-specific face shields, compliance with standards, local manufacturing.	Rapid design approach. GRU's transition to injection molding for scale surpasses this project's scope.
(Müller et al., 2023)	Multi-country	Ad hoc supply chains, rapid product development, supply chain agility.	Rapid response and supply chain agility. GRU's integration of different stakeholders is more comprehensive. Multi-country focus but specific production numbers not provided.
(Gunputh et al., 2023)	United Kingdom	Development of a one-size-fits-all face shield, ergonomic considerations, user evaluation.	Focus on usability and comfort. GRU's larger scale and societal involvement are additional aspects.
(O'Connor et al., 2022)	Ireland	Rapid prototyping and production, local manufacturing.	Rapid production and local production. Produced 12,000 units, significantly less than GRU's 278,137 units; limited to regional distribution. GRU Project's scale and multi-stakeholder collaboration are broader.

Source	Country	Key Focus of Development Process	Comparison with GRU Project (Brazil)
(Kantaros et al., 2021)	Greece	FDM 3D printing equipment to produce 800 protective face shields.	3D printing, much smaller scale compared to the GRU Project, producing 800 face shields. The financial aspects of the project show a detailed cost analysis, which is a unique aspect compared to the GRU Project.

Table 6.22 provides a comparative analysis of Personal Protective Equipment (PPE) development processes, as detailed in various academic papers, in relation to the GRU Project in Brazil during the COVID-19 pandemic. The Key Focus of Development Process column describes the primary approach and methods employed in each country's PPE development process. The Comparison with GRU Project (Brazil) column provides a comparative analysis of each country's initiative against the GRU Project in Brazil. The comparison considers factors such as the scale of production, collaborative efforts, technology used (such as 3D printing and injection molding), agility of response, stakeholder involvement, and focus on usability and comfort.

6.5.3. Internal Risks

Internal risks (Sabokbar et al., 2016) in the project are identified as those originating from within the project's scope, encompassing aspects such as team dynamics, decision-making, resource management, and other internal processes. They include Stakeholders' Partnership, Public Equipment, Manufacturing and Project, Human Resources, Intellectual Property, Logistics and Distribution, and Sanitation Risks.

6.5.3.1. Stakeholders' Partnership Risks

The trust dynamics among partners (Fulop and Couchman, 2006; Harman and Sherwell, 2002) and open communication (Wang et al., 2023) seems to impact the beginning of the partnership, helping to minimize the partnership dissolution risk (R6). Also, the trust aspect of the interaction seems to exclude the opportunistic behavior described by Al-Tabbaa and Ankrah (2016), even without a formal Protocol or Memorandum of Understanding (R7) that would precisely determine the obligations of each actor involved. Results show that the high incentive of protection during a pandemic can surpass collaboration problems when it involves complex or novel ventures, such as R&D projects (Fulop and Couchman, 2006), rapidly solving conflicts supported by the effective and open communication channel (Wang et al., 2023) and reaching on joint product development (R6) based on the dynamic of confidence (Al-Tabbaa and Ankrah, 2016). The risk of opportunistic behavior and the need for effective communication are consistent with the concerns about conflicts of interest and the importance of Open Innovation strategies (Fulop and Couchman, 2006; Wang et al., 2023). The partnership-related risks associated with the urgent project remain consistent with those in traditional projects. However, what changes is the underlying motivation that enables actors to establish and continue the partnership despite the risks, thereby overcoming conflicting priorities even without contractual formalization.

6.5.3.2. Public Equipment Risks

The management of public equipment involves four risks, as presented in Appendix 6C. However, the existing literature highlights the value of equipment, laboratories, and industrial sectors (Wynn, 2018) in various contexts, such as technology transfer projects (Fernández-Esquinas et al., 2016) and cooperation factors between University and Industry (Nsanzumuhire and Groot, 2020; Suh et al., 2019). Thus, this research offers a novel perspective by analyzing the risks associated with equipment beyond its monetary value. Specifically, the evidence acknowledges the risk of non-utilization (R22) and equipment misuse (R24 and R23).

6.5.3.3. Manufacturing and Project Risks

The findings highlight two potential risks associated with the manufacturing process: the manufacturer's lack of a suitable tool for the project execution (R31) and the possibility of incorrect assembly between the visor and forehead (R32). As far as we searched, the specific literature reveals that neither of these risks has been directly or indirectly addressed. In this case, the main point in the literature regard innovation implementation (Elia et al., 2020; Siyanbola et al., 2012) and scientific production (Azagra-Caro et al., 2019), for example.

There is no reference to design/project-related risks about the project model (R1) and purpose (R2) in the existing literature. Previous studies are related to technology transfer projects (Wynn, 2018), for example, and the risk of non-performance of the technology or losing its innovative edge (Ankrah et al., 2013; Lee and Win, 2004). Project-related risks are consistent with each other (7.5 and 8.3). However, risks associated with projects are extensively discussed in the broader literature, as indicated by Ball and Watt (2013), the Project Management Institute - PMI (2017), and Ruan et al. (2015). Like production-related risks, risks related to the project have not received attention in the specific literature since they are at a research level beyond the organizational level, which traditionally remains in the sphere of technology transfer (Wynn, 2018).

6.5.3.4. Human Resources Risks

In another context, citations associated with the people category can be found in the literature (Al-Tabbaa and Ankrah, 2016). The extant literature covers research on people seeking opportunities for collaborative knowledge generation (Iskanius and Pohjola, 2016), of people and knowledge in the context of global University partnerships (Heitor, 2015), or in organizational change (Rebora and Minelli, 2012), for example. Al-Tabbaa and Ankrah (2016) pointed out risks referred to as underpinning challenges, such as misinterpretation, expected responsibility of members, different and contradicting priorities, and trust. Notice that characteristics of the interaction, such as trust and collaboration, were also commented on by Al-Tabbaa and Ankrah (2016); these when combined, could explain the Open Innovation. However, the findings show psychological/emotional (R3 and R5) and legal aspects of the interaction (R4). In general, the managers and participants who worked on this project learned how to overcome risks and difficulties, ultimately saving time in addressing potential risk scenarios.

6.5.3.5. Intellectual Property Risks

The relevance of the intellectual property cluster in risk analysis was found to be relatively low (R15, 4.6; R16, 4.8), with the smallest variation between them. This indicates that competitors' concerns, as pointed out by Ankrah et al. (2013), were not a priority in this particular project because it did not intend to proceed to commercialization. Previous studies (Harman and Sherwell, 2002; Sohn and Lee, 2012; Soranzo et al., 2016) provide examples supporting this notion. They point to problems that can be encountered in the release of research information of a sponsor or product, confidentiality problems for researchers, and the possible consequences of fractured relationships between sponsors and researchers. Furthermore, Ankrah et al. (2013) highlighted the risks associated with the diminished control or leakage of proprietary information and the dilemma of withholding the publishing of their results until patenting has taken place and the knowledge becomes obsolete (Blumenthal, 2003). Thus, these findings reinforce the importance of intellectual property in interactions, even in non-commercial projects, as the existing literature corroborates. During the peak of the pandemic, several Companies released their patents, as occurred with the regulation of the National Health Surveillance Agency (ANVISA). This helps explain this category's relevance.

6.5.3.6. Logistics and Distribution Risks

Previous studies have already acknowledged the risks of cooperation within the supply chain context (Klimczak et al., 2017) and within the context of the goal of collaboration with the University (Freitas et al., 2013), for example. However, this article emphasizes the importance of saving time in this urgent cooperation, with findings revealing the risk of delay (R29) and displacement (R30). Also, it is noteworthy that the risk of delay (R29) is the only unacceptable risk (Ruan et al., 2015), and it is therefore essential to reduce it at any cost. It helps to explain and reinforce the perspective of a high intensity and time sensitive sector within the analysis of urgent projects (da Penha and ten Caten, 2023a).

6.5.3.7. Sanitation Risks

The analysis of urgent Open Innovation projects, particularly during the COVID-19 pandemic, highlights a significant yet underrepresented aspect in existing literature: the risks associated with sanitation practices. Despite being well characterized as internal risks (Sabokbar et al., 2016), this study underscores their critical nature, especially in environments such as University laboratories, where the project development took place. Our findings reveal that risk perception in High-Intensity Time-Sensitive Projects in a pandemic context, such as the one under study, markedly differs from those encountered in less time-critical initiatives. Sanitation risks, particularly those related to maintaining sterile conditions (R26) and avoiding contamination during the production and handling process (R27), emerged as paramount. Moreover, the risk of failing to properly sanitize materials and products (R28) was identified as a higher priority, appearing in a critical group. These findings amplify the importance of robust sanitation protocols in pandemic-responsive projects, where the risks of contamination and inadequate sanitization processes carry potentially more severe consequences.

6.5.4. External Risks

External risks (Sabokbar et al., 2016) are those influenced by factors outside the project's immediate control. They include Institutional Image (IM) Risks and ANVISA (AN) Risks.

6.5.4.1. Institutional Image and Reputation Risks

The literature has already highlighted institutional risks faced by universities and their research staff, particularly concerning their reputation (Fulop and Couchman, 2006; Harman and Sherwell, 2002). The findings revealed the existence of seven risks associated with the image of the institutions (Appendix 6C). Notice that the image risk category was the biggest risk group. This emphasizes the concern perceived by the interviewees about this cluster. It is noteworthy that previous authors have already recognized the relevance of the image issue, e.g., enhancement of corporate image (Ankrah and AL-Tabbaa, 2015) and reputation by associating with a prominent institution (Siegel et al., 2003). However, these authors did not address the risks involved. Furthermore, in a different direction, Harman and Sherwell (2002) pointed out that in an urgent project, senior management did appear to be fully aware of the possible dangers before the case became highly publicized, thus avoiding any controversy. The evidence reinforces the importance of institutional image and reputation, contributing to a list of risks that had not been discussed in specific literature.

6.5.4.2. Regulation Risks

Risks associated with compliance and interaction with regulatory bodies, in this case the Brazilian National Health Surveillance Agency (ANVISA), are external, stemming from the need to align with established regulatory standards and obtaining necessary approvals from ANVISA. These results are in line with the external risks of Government

regulations (Alonso and Bressan, 2016) and indirectly affect public perception and trust issues (Guertler and Spinler, 2015) already highlighted in the Institutional Image and Reputation category. The findings highlight the role of ensuring product specifications (R11), adherence to regulatory frameworks (R12), and managing inputs (R13 and R14). These elements identified as the third most critical risk category in the context of the pandemic.

6.6. RISKS MITIGATION STRATEGIES WITHIN THE CONTEXT OF THE QH MODEL

Based on the analysis and discussion of the urgent Open Innovation project carried out under the Quadruple Helix (QH) model, this experience can be valuable for other urgent projects regarding the application of risk management techniques. By studying the identified risks and their respective categories, researchers were able to present recommendations and suggestions that aim to assist managers in developing and implementing risk mitigation strategies in similar contexts.

Table 6.23 summarizes the main suggestions for risk mitigation strategies for urgent projects within the QH model. Risk mitigation involves trust and open communication, equipment, and project management, cultivating a team environment, attention to intellectual property, sanitation practices, supply chain planning, distribution and logistics, proactive management of image and reputation, and regulatory compliance. Each aspect must be adapted to the specific needs and dynamics of the project and its stakeholders.

Table 6.23 - Risk mitigation strategies within the context of the QH model.

Risk Origin	Classification	Suggestions for Risk Management in Similar Projects
Internal	Partnership (PA)	Foster trust and open communication among project partners to manage expectations and reduce partnership dissolution risks.
	Equipment (EQ)	Implement equipment management practices including monitoring, maintenance, and training for proper handling.
	Production (PR) and Project (PJ)	Develop a fast, comprehensive, and time-sensitive project management plan with agile methodologies for flexibility. Ensure ongoing oversight to maintain alignment with objectives.
	People (PE)	Cultivate a collaborative work environment. Address emotional and legal aspects to enhance team dynamics and efficiency.
	Intellectual Property (IP)	Manage intellectual property, including protecting proprietary information and balancing the timely dissemination of research.
	Sanitation (SA)	Use strict sanitation practices, especially on health-sensitive projects, to mitigate contamination risks.
	Logistics (LO)	Establish strategic relationships with supply chain, distribution, and logistics partners, for clear communication and shared objectives. Optimize internal coordination and logistics processes to prevent delays and bottlenecks.
External	Institutional Image (IM)	Implement a proactive communication strategy to manage institutional image and reputation, engaging actively with media and external stakeholders.
	ANVISA * (AN)	Develop compliance processes, continuously monitor regulatory changes, and establish open communication with regulatory bodies.

* National Health Surveillance Agency (Agência Nacional de Vigilância Sanitária–ANVISA).

6.7. PARTIAL CONCLUSIONS

This research on an emergency Open Innovation (OI) project during the COVID-19 pandemic within the context of the Quadruple Helix (QH) model yielded significant insights into the management of urgent innovation projects. The application of the QH theoretical model was essential for understanding the complex interactions between Government, Academia, Industry, and Civil Society. Furthermore, it facilitated a detailed understanding of the project lifecycle, highlighting the vital role of stakeholder collaboration in the face of a crisis.

Key findings include the agility and adaptability in managing high-intensity, time-sensitive projects. The crisis context demanded agile actions, collaboration, and fast communication among stakeholders. The key elements of trust, collaboration, communication, agility, partnerships with stakeholders, scale, and logistics emerged as critical factors in successfully delivering the urgent OI project. These elements interplay to create an enabling environment for innovation and successful implementation of the project. By providing an in-depth urgent OI project management description, this paper offers an understanding on how the risk context was created while unveiling a deeper meaning and details of such projects.

In the Quadruple Helix model context, risks can manifest in various dimensions. This study identified thirty-two risks and ten categories inherent to urgent OI projects contributing to a comprehensive risk management framework. Understanding these risks is essential to developing proactive mitigation strategies like those presented in this study, promoting collaboration, and improving high-intensity time-sensitive project outcomes. Interestingly, risk categories known in the literature from a non-urgent perspective, such as socio-ethical and natural risks, were not of the participant's concerns. Traditional risks, such as equipment, production, project, and intellectual property, are deemed less critical. Less prominent categories in literature appear with more criticality. Ultimately, the temporal aspect is the most critical one in this extremely urgent project.

The framework proposed offers a representation of the urgent Open Innovation project, specifically related to risks, with the context of the fast Quadruple Helix formation. It expands the framework of Pirlone et al. (2020) about the relationship between risk and the Quadruple Helix model, expanded here similarly to Popa et al. (2021) in the healthcare domain, and extended in this research on extremely urgent projects. Furthermore, it expands the traditional QH theory by incorporating Risk Analysis to investigate urgent projects with an Open Innovation development process.

Finally, this research contributes to the literature on the Quadruple Helix model by providing valuable insights into managing urgent OI projects during crises. The findings underscore the significance of stakeholder collaboration and risk management in such projects. It also expands the urgent project literature by explaining precisely how the OI project is formed from the leadership perspective, overcoming the challenges such as rapid development, material sourcing, funding constraints, scaling manufacturing, usability and efficacy, logistical complexity, communication and coordination, risk management, trust building, technological constraints, and adaptability. The main contribution was to explore the challenges presented by an extremely urgent Open Innovation Project during the COVID-19 pandemic, shedding light on the fast and dynamic nature of innovation in times of crisis. The case study validates the effectiveness of the QH model in extremely urgent, complex ecosystems requiring extremely rapid innovation in an extremely short duration. By focusing on the risks of interaction in an urgent project related to the QH model, this paper contributes to a list of risks that can be improved in future research. We hope this study proves beneficial to researchers, policymakers, and practitioners engaged in high intensity Open Innovation time-sensitive projects in times of urgency and emergency.

We acknowledge the limitations of our research. The total number of interviewees was restricted. However, because each participant completed different rounds of interviews, the initial round of interviews was conducted right after the completion of the

project, and we were able to access the highest management of each institution with decision-making and management authority and knowledge of the entire project process during the pandemic crisis; this allowed us to gather very recent and detailed information about the extremely urgent project. Future research could expand the number of participants or include individuals from different levels within each helix to gain a more comprehensive understanding. We were unable to carry out this approach due to the complete lockdown imposed during the pandemic.

6.8. APPENDIX 6A: Questionnaire Script for Case Study and Risk Identification

Table 6.24 presents the set of questions designed to gather detailed data into the initiation, execution, and risk factors associated with the project. It presents the method divided into two parts: the case study focuses on the developmental process and stakeholder engagement, while the risk identification aims to capture the perceived risks involved in the collaboration.

Table 6.24 - Case study and risk analysis question script.

Method	Question Script
Case Study	(i) Explain, in your own words, how you started the process of developing the Face Protector. (ii) What was the interest in participating in this project? What was the first contact made with the University? (iii) In your opinion, where did this demand come from at the University/Company/Army/Society? (iv) How many people from the institution participated in the process? What are the roles/positions of those involved in this work? (v) In addition to the University/Company/Army/Society, were other Companies or Institutions involved? Please quote which ones. (vi) Describe, objectively, the stages of the development process. (vii) What were the barriers and advantages that occurred during the process?
Risk Identification	What are the risks perceived by you in this interaction process?

6.9. APPENDIX 6B: Time-line and Stakeholders Involvement in the GRU Project

Figure 6.14 illustrates a detailed timeline for the GRU Project's development cycle. It begins with initiating partnerships and progresses through data collection, various stages of prototyping, comprehensive testing, and preparation for production. The visual narrative underscores the project's iterative essence, marked by continuous testing and feedback loops with the involved stakeholders. This reiterative process signifies the adaptive and responsive nature of the development to ensure efficacy and compliance. The diverse roles and contributions of stakeholders are symbolized by distinct icons, which provide a quick visual reference to their involvement and influence at various stages of urgent project development.

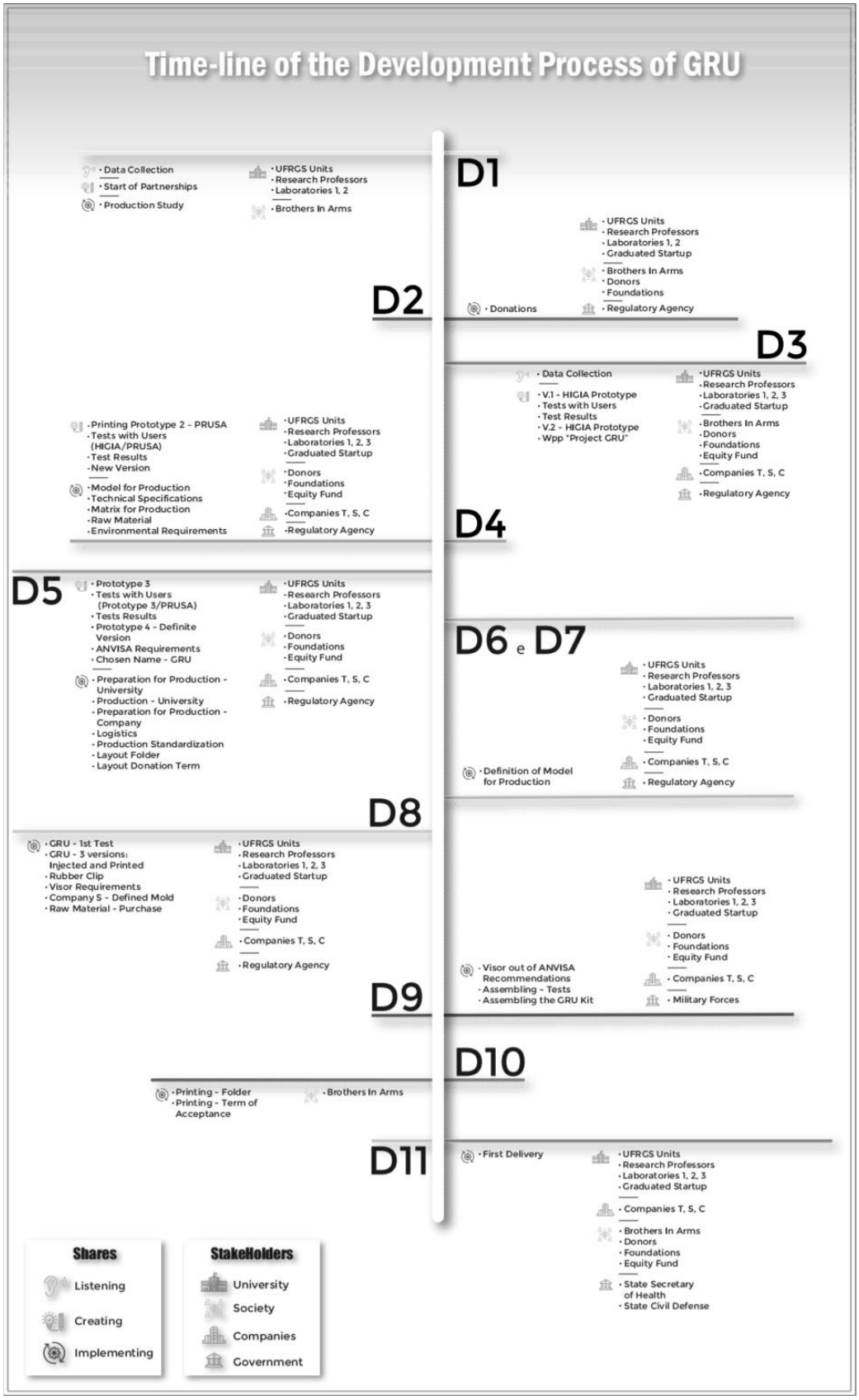

Figure 6.14 - Characterization of the helices, their actors, and the time-line in which each actor joins the project.

6.10. APPENDIX 6C: Risk Assessment in the Rapid Open Innovation Project

Table 6.25 systematically provides and categorizes risks associated with the execution of the rapid Open Innovation project during the COVID-19 pandemic, offering a quantified evaluation of each risk in terms of its impact, probability, individual Risk Index (RI), and average risk index for grouped risks, spanning multiple categories such as Partnership, Institutional Image, Equipment, Production, Project, People, Intellectual Property, Logistics, ANVISA compliance, and Sanitation.

Table 6.25 - Classification and quantitative assessment of risks in rapid Open Innovation project amid the COVID-19 pandemic: impact, probability, and group averages for Risk Index.

Classification	Risk	Risk Name	Risk Origin	Impact	*I*	Probability	*P*	*RI* $P \times I$	Group Average
Partnership (PA)	R6	Risk of breaking the partnership.	Internal	Major	3.94	Probable	3.75	14.8	10.5
	R7	Risk of not signing a Protocol of Intent between the institutions involved.	Internal	Medium	2.13	Rare	3.25	6.9	
	R9	Risk of not reaching consensus on joint product development.	Internal	Significant	3.25	Rare	3	9.8	
Institutional Image (IM)	R17	Risk of the media not highlighting the contribution of each of the entities involved.	External	Significant	2.94	Frequent	4.5 **	13.2	9.53
	R18	Risk of receiving the press without the consent of the University dean.	External	Significant	2.56	Probable	3.75	9.6	
	R19	Risk of disclosure of Company names without the consent of the parent Company.	External	Significant	2.63	Probable	4	10.5	
	R20	Risk of poor evaluation of the product by Society or by health workers.	External	Significant	2.63	Probable	4	10.5	
	R21	Risk of improper use of the product.	External	Medium	2.06	Rare	3	6.2	
	R10	Risk of image association between the Armed Forces and one of the participating Companies.	External	Medium	2.19	Remote	2.25	4.9	
	R8	Risk of misrepresentation of the purpose of the face shield development project by the press.	External	Significant	2.63	Frequent	4.5 **	11.8	
Equipment (EQ)	R22	Risk of not being able to open the 3D printing lab.	Internal	Significant	3.06	Probable	3.5 **	10.7	8.8
	R23	Risk of misuse of public equipment.	Internal	Significant	3.19	Remote	2.25	7.2	
	R24	Risk of using equipment from other University professors.	Internal	Significant	2.94	Rare	2.75	8.1	
	R25	Risk of using material from the warehouse stock of the School of Engineering and the central warehouse of the University.	Internal	Significant	3.06	Rare	3	9.2	
Production (PR)	R31	Risk of the manufacturer not having a tool to carry out the project.	Internal	Significant	2.88	Rare	2.5 **	7.2	8.65
	R32	Risk of incorrect assembly between visor and forehead.	Internal	Significant	2.88	Probable	3.5 **	10.1	
Project (PJ)	R1	Risk of error in decision-making about the project model.	Internal	Significant	2.5 **	Rare	3	7.5	7.9
	R2	Risk of the product not serving its purpose.	Internal	Significant	3	Rare	2.75	8.3	
People (PE)	R3	Risk of lack of appreciation of the people involved.	Internal	Significant	3	Rare	2.75	8.3	9.5
	R4	Risk of the participation of volunteer employees.	Internal	Medium	2.38	Rare	2.5 **	5.9	
	R5	Risk of conflict between project participants.	Internal	Major	3.56	Probable	4	14.3	
Intellectual	R15	Risk of not depositing intellectual property.	Internal	Medium	1.69	Rare	2.75	4.6	4.7

Classification	Risk	Risk Name	Risk Origin	Impact	*I*	Probability	*P*	*RI* $P \times I$	Group Average
Property (IP)	R16	Risk of breaking patents.	Internal	Medium	1.75	Rare	2.75	4.8	
Logistics (LO)	R29	Risk of delay in the delivery of personal protective equipment (PPE), losing the effectiveness of the task force.	Internal	Major	4.06	Probable	4.25	17.3	11.85
	R30	Risk of a problem occurring in the displacement of the material.	Internal	Significant	3.19	Remote	2	6.4	
ANVISA * (AN)	R11	Risk of having technical product specifications denied.	External	Significant	3.31	Rare	2.75	9.1	11.3
	R12	Risk of not having a product regulated by ANVISA.	External	Major	3.5 **	Rare	3.25	11.4	
	R13	Risk of using inputs other than the DRC of ANVISA, due to lack of supply.	External	Significant	2.69	Probable	3.75	10.1	
	R14	Risk of lack of input.	External	Significant	3.44	Probable	4.25	14.6	
Sanitation (SA)	R26	Risk of inadequate cleaning/sanitization of laboratories.	Internal	Significant	3.19	Rare	3.25	10.4	12.63
	R27	Risk of contamination of the team.	Internal	Major	3.56	Probable	4.25	15.1	
	R28	Risk of improper cleaning of the product after manufacture.	Internal	Significant	3.31	Probable	3.75	12.4	

* National Health Surveillance Agency (Agência Nacional de Vigilância Sanitária – ANVISA);

** The rounding scans were made for more for the qualitative classification. E.g., 3.5 ≅ 4.

7. ARTICLE 6: TEMPORAL RISK MANAGEMENT IN LAND MAPPING PROJECTS: A CASE STUDY OF THE AMAZON RADIOGRAPHY MEGAPROJECT

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Abstract (short):
Context: The execution of land mapping megaprojects in Brazil presents unique challenges due to its vast continental dimension. They are fundamental to infrastructure, construction, transportation, government planning, defense, and environmental studies. In this context, the "Radiography of the Amazon" megaproject, employing airborne radar image technology, aimed to map over 1,800,000 km², offering detailed land surveys at the cartographic scales of 1:50,000 and 1:100,000. Research problem: Although the existing literature covers several technological aspects of mapping large land areas, a research gap exists in identifying and understanding risks with temporal impacts and their mitigation strategies. Therefore, we focus on analyzing temporal risk management and urgency using the "Amazon Radiography" project as a case study. Method: Empirical data was collected through three rounds of interviews with project managers, coordinators, and technical managers, as well as analyzing project documents. The interviews ranged from one to two hours. We identify and categorize risks in each project phase. In the last round of interviews, interviewees presented suggestions for risk mitigation strategies. Results: The study identifies and categorizes the main risks observed in each phase of the land mapping megaproject management, classifying them according to the project objectives (strategic, operational, communication, compliance, and technology), in addition to understanding strategies for mitigating them. Contribution: This article fills practical gaps in the risk management domain for engineering megaprojects and provides managers with an understanding of its risks.
Keywords: Urgent Projects; Risks; Project Management

Article 6

Temporal Risk Management in Land Mapping Projects: A Case Study of the Amazon Radiography Megaproject

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Abstract: Context: The execution of land mapping megaprojects in Brazil presents unique challenges due to its vast continental dimension. They are fundamental to infrastructure, construction, transportation, government planning, defense, and environmental studies. In this context, the "Radiography of the Amazon" megaproject, employing airborne radar image technology, aimed to map over 1,800,000 km², offering detailed land surveys at the cartographic scales of 1:50,000 and 1:100,000. Research problem: Although the existing literature covers several technological aspects of mapping large land areas, a research gap exists in identifying and understanding risks with temporal impacts and their mitigation strategies. Therefore, we focus on analyzing temporal risk management and urgency using the "Amazon Radiography" project as a case study. Method: Empirical data was collected through three rounds of interviews with project managers, coordinators, and technical managers, as well as analyzing project documents. The interviews ranged from one to two hours. We identify and categorize risks in each project phase. In the last round of interviews, interviewees presented suggestions for risk mitigation strategies. Results: The study identifies and categorizes the main risks observed in each phase of the land mapping megaproject management, classifying them according to the project objectives (strategic, operational, communication, compliance, and technology), in addition to understanding strategies for mitigating them. Contribution: This article fills practical gaps in the risk management domain for engineering megaprojects and provides managers with an understanding of its risks.

Keywords: Mapping Projects, Amazon Radiography, Megaprojects, Risk Management, Megaproject Management, Time Management, Radar, Synthetic Aperture Radar, Project Management.

7.1. INTRODUCTION

Megaprojects produce large-scale, complex, and one-off capital investments across various public and private sectors (Denicol et al., 2020). These are high-cost projects that often involve social, technical, economic, environmental, and political challenges (Boateng et al., 2015). They are generally extremely risky ventures and focused on infrastructure projects (Denicol et al., 2020), such as tunnels and road structures (Bayer et al., 2017; Gosar, 2012), dams (Closson et al., 2003, p. 20), or railway, bridge, and subway projects (Malik et al., 2019). Some of these megaprojects are large infrastructure programs used as umbrellas for subprojects that, among others, use radar imaging technologies, such as the San Benedetto Tunnel Project (Bayer et al., 2017; Gosar, 2012), Riyadh Metro Project (Cueto et al., 2018), National Capital Territory Project (Malik et al., 2019), and the System for the Surveillance of the Amazon (Sistema de Vigilância da Amazônia - SIVAM) Project (Ferraro et al., 2007). Despite using projects and programs as synonyms, they are programs, considering the theoretical lens of project management, as these megaprojects have multiple interdependent projects with a common goal.

Of these projects, only the System for the Surveillance of the Amazon Megaproject has a terrestrial mapping sub-megaproject executed with radar imaging technologies,

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which in turn is also a program with a series of subprojects such as the technological updating of aircraft to carry out terrestrial imaging and cartography. This radar imaging technology sub-megaproject called "Radiography of the Amazon" (Castro-Filho and Rosa, 2017) focuses on a significant technological endeavor. It was designed to address the "Cartographic Void of the Amazon" (Correia, 2011). This megaproject has the mission of mapping an area of over 1.8 million square kilometers, equivalent to the combined territories of Portugal, Spain, France, Italy, Switzerland, Belgium, Netherlands, and United Kingdom. It employs airborne Synthetic Aperture Radar (SAR) to produce cartographic products. It represents an effort to map the Amazon region's complex terrain (Clement et al., 2009), characterized by dense forests and logistical challenges due to limited land access and reliance on navigable rivers.

The megaproject's execution from 2008 to 2020 involved substantial technological, logistical, and financial efforts, including upgrades to R99-B aircraft for cartography, extensive aerial surveys, and producing a wide array of cartographic products (Brazil, 2008). With a total financial investment reaching R$ 350 million (BRL), the project delivered significant outputs such as topographic maps, orthoimages, digital models, and vegetation stratification files, contributing to Brazil's environmental monitoring and national security capabilities (Brazil, 2008). Hence, a program of gigantic magnitude and complexity, as are many projects of this kind in Brazil due to its continental dimensions of the fifth largest country in area and the largest country in forest biome to be mapped worldwide (Ferraro et al., 2007). These programs become megaprojects of continental dimensions, allowing for enormous theoretical and practical studies from the perspective of project management.

Risk and uncertainty are some of the main causes of adverse outcomes in megaprojects (Denicol et al., 2020). Notwithstanding, despite technological advances, results, and delivered products, managing risks associated with mega mapping projects in extensive areas remains a challenge. The literature on risks in these projects focuses mainly on scientific and technological aspects (Bayer et al., 2017; Malik et al., 2019; Shirzaei and Bürgmann, 2018), with no attention to project management risks. This gap underscores the need for research on risk management strategies to overcome the complexities and uncertainties inherent in megaprojects such as the "Radiography of the Amazon." Therefore, although existing literature covers many aspects of mapping large land areas, there is a gap in understanding risks and their management and mitigation in such projects. Furthermore, it allows us to position the study in a more specific gap to understand how the public sector collects and manages risks and uncertainties in land-mapping megaprojects.

As many researchers continue to deepen into infrastructure mega projects, there is a need for research that will allow a better understanding of practical and theoretical topics related to megaprojects, mega programs, and complex projects. In this domain, many practice-oriented studies focus on risk management through risk identification (Chang et al., 2020) and response. Still, projects of this magnitude are executed with a high risk of exceeding the original schedule and budget (Boateng et al., 2015). Accordingly, many studies approach project performance based on cost (Kim and Lee, 2019) and risk prioritization (Boateng et al., 2015). No article has, however, analyzed risk in land-mapping megaprojects. To fill that gap, we turned to the governmental sector, Brazil's only manager of mapping megaprojects, as far as we know.

Brazil has approximately 8,515,767 km^2 (Martins and James, 2020). For decades, academics and policymakers have been interested in the dynamic socioeconomic, demographic, and spatial aspects of the highly active rainforest in the Brazilian Amazon (Sathler et al., 2019). The Legal Amazon has an area of approximately 5.2 million km^2 (Ferraro et al., 2007), of which about 1.8 million km^2 did not have terrestrial cartographic information (Brazil, 2008). As such, it was decided to study the Amazon Mapping Project (Castro-Filho et al., 2013; Castro-Filho and Rosa, 2017; Correia, 2011), the largest mapping project in forest area in the world, challenging due to the type of forest biome and the size of the work area. In addition, there is an enormous technological challenge to using

Synthetic Aperture Radar (SAR) data from Polarimetic X and P bands (PolInSAR) acquired by the Amazon Radiography Project of the Directorate of Geographical Service of the Brazilian Army - DSG (Castro-Filho et al., 2013), responsible for executing the project. Therefore, keeping the cartographic base updated is a constant challenge.

Then, the following Research Question can be proposed: *How do temporal risks affect urgency and completion schedule in large land mapping projects, and what strategies can help mitigate these temporal impacts?*

Seeking to analyze these continental-dimension projects, the obtention of empirical data was necessary to map the challenges and understand the perspective of someone who would take on and manage risks in this type of project.

The assessment of the strategic value of the organization's risk management process is relatively low for most organizations (Beasley et al., 2020). Enhanced knowledge of the organization's dangers will offer valuable insight into the strategic planning process, enabling management and the board to create strategic objectives and initiatives while considering the risks. A robust risk management process, if successful, can be a valuable strategic tool for management (Beasley et al., 2020).

This paper contributes to risk management in large-scale land mapping projects, particularly in environments with significant technological and logistical challenges. Firstly, using the "Amazon Radiography" Project as a Case Study provides information for identifying, categorizing, and mitigating temporal risks in megaprojects. This analysis enhances our understanding of risk impacts across different project phases. Finally, it proposes risk mitigation strategies that can be adapted by other similar projects in the context of risk management in land mapping megaprojects.

7.2. THEORETICAL BACKGROUND

This section lays the foundation for radar imaging technologies' technological, managerial, and risk-related aspects in large-scale mapping projects. Firstly, it overviews the major radar imaging technology applications in megaprojects, presenting global projects that leverage this technology. Then, it shifts focus to Brazil, describing systematic land mapping projects that leverage radar technology. It presents the country's three major mapping projects, explaining their scale, technological inputs, and objectives. Additionally, this section explores the risks associated with radar megaprojects.

7.2.1. Major Radar Imaging Technology in Megaprojects

Some of the most significant projects utilizing radar imaging technology are the San Benedetto Tunnel in Italy that focus on highway improvements (Bayer et al., 2017; Gosar, 2012), the Dyke Project in Jordan that aims to map dam deformation precursors (Closson et al., 2003), the Riyadh Metro Project in Saudi Arabia (Cueto et al., 2018), the National Capital Territory Project in India that represents infrastructure advancements in public rail and major urban infrastructure, respectively, including railway lines, bridges, and subway bridges (Malik et al., 2019), the Alaskan Way Viaduct replacement project in Seattle, USA, that demonstrates urban infrastructure monitoring (Samsonov et al., 2016), the Mentougou mining area in Beijing, employing radar technology for geological analysis (Tan and Qiao, 2020), and the public administration and defense project that benefited substantially from radar imaging in the System for the Vigilance of the Amazon (SIVAM) project in Brazil (Ferraro et al., 2007), which is a high-technology initiative for monitoring and controlling the Amazon region's vast land, air, and water resources.

Additional projects include monitoring in San Francisco Bay, USA (Shirzaei and Bürgmann, 2018), and ice cap dynamics in Svalbard (Dunse et al., 2015), indicating the technology's wide-ranging impact from urban planning to environmental protection and defense.

Among those, some are megaprojects, or large programs, as the examples of the San Benedetto Tunnel Project (Bayer et al., 2017; Gosar, 2012), the Riyadh Metro Project (Cueto

et al., 2018), the National Capital Territory Project (Malik et al., 2019), and the System for the Vigilance of the Amazon (SIVAM) Project (Ferraro et al., 2007).

Finally, such projects are related to three market sectors (Construction, Mining and Quarrying, and Public Administration and Defence) and city planning.

7.2.2. Systematic Land Mapping Projects in Brazil

Specifically in Brazil's context, systematic territorial mapping serves a wide array of purposes, from infrastructure development and agricultural planning to military operations and environmental management. Systematic territorial mapping projects are used as the cartographic database for (Brazil, 2008): infrastructure, demarcation of settlement areas, mining, agribusiness, elaboration of ecological, economic and territorial planning, territorial security, production flow, and regional development. They are also used for Environmental and Public Management in general. In projects with radar technology, they are used, for example, for biomass calculation (Castro-Filho et al., 2013).

The knowledge of detailed and accurate terrain information allows for military employment applications to support decision-making, terrain knowledge and combat functions (Exército Brasileiro - Brazilian Army, 2014), command and control (situational awareness and decision-making), logistics (deployment areas, transport hubs and establishment of logistical facilities), movement and maneuver (strategic displacement of means, transport system management), fires (target acquisition and visualization), protection (threat identification, local security measures) and intelligence.

Brazil's three major mapping projects, characterized by unique partnerships, technological inputs, and objectives, are the COPEL Mapping Project, the Bahia Mapping Project, and the Amazon Radiography Project.

The COPEL Mapping Project (Cartography Council of the State of Paraná, 2010), spanning from 1989 to 2004 in the state of Paraná, was a collaboration among the state government, the Geographical Service Directorate (DSG), and the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE), aimed at updating systematic planialtimetric survey to meet current standards at a 1:50,000 scale, with a focus on technical specification.

The Bahia Mapping Project (França et al., 2019; Penha et al., 2012), running from 2009 to 2020, involved the DSG and the State of Bahia, utilizing the Airborne System for Acquisition and Post-processing of Digital Images (Sistema Aerotransportado para Aquisição e Pós-processamento de Imagens Digitais - SAAPI) for digital stereophotogrammetry, producing digital surface models and orthoimages, with an emphasis on Technical Specifications for Structuring Vector Geospatial Data (Especificações Técnicas para Estruturação de Dados Geoespaciais Vetoriais – EDGV) across various cartographic scales and areas totaling 567,692.669 km².

The Amazon Radiography Project (Brazil, 2008; Castro-Filho et al., 2013; Castro-Filho and Rosa, 2017; Correia, 2011), from 2008 to 2020, covered the vast Legal Amazon area with 1.8 million km², employing airborne Synthetic Aperture Radar (SAR) in different bands for forest and non-forest areas, aimed at generating nearly 20,000 cartographic products, including topographic maps, orthoimages, and digital models, under the technical and financial sponsorships of multiple sources (Brazil, 2008; Correia, 2011).

These projects represent a significant investment in Brazil's cartographic and environmental monitoring capabilities, leveraging advanced technologies and inter-institutional collaborations to produce a wide range of cartographic products.

7.2.3. Risks in the Context of Radar Megaprojects

The studies show articles on risks (Shirzaei and Bürgmann, 2018), all related to pure sciences, even excluding articles from astronomy and astrophysics, health and biology, optics, and physics. The papers cited risks of sliding (Bayer et al., 2017), subsidence risks (Malik et al., 2019; Samsonov et al., 2016; Shirzaei and Bürgmann, 2018), and flood risks

(Shirzaei and Bürgmann, 2018). The study of flood risks (Shirzaei and Bürgmann, 2018) and geological risks (Closson et al., 2003; Cueto et al., 2018; Gosar, 2012) through remote sensing images appears prominent in the context of risks in radar technology. However, as far as we searched in the literature, this research did not find scientific articles in the management area.

7.3. FRAMEWORK FOR COMBINING PROJECT AND RISK MANAGEMENT

This research integrates theoretical perspectives from Risk Management and Project Management to reveal the challenges in managing large-scale mapping projects. The combination of these theoretical lenses offers an understanding of the complexities of strategic and operational decision-making, technology adoption, stakeholder engagement, and project lifecycle management.

Project Management (Cicmil and Hodgson, 2006; Jugend et al., 2014), in its traditional approaches, is rooted in conventional methodologies, emphasizing design, regularity, and control. It is the foundation for analyzing the project's life cycle, covering design/conception/initiation, planning, execution, and closure phases (Project Management Institute - PMI, 2017). The theory emphasizes defining objectives, aligning resources, and managing risks across these phases. Each phase presents distinct challenges, risks, and opportunities. It aligns with research by Denicol et al. (2020) that highlights the causes and cures in managing megaproject complexities. In this context, the Project Management Theory provides the life cycle structure and the perspectives according to the project objectives (e.g., strategic, operational, compliance, technology).

Risk Management is the foundation for recognizing, evaluating, and reducing risks (Committee of Sponsoring Organizations of the Treadway Commission - COSO, 2017). Risk refers to the likelihood of an adverse occurrence within a designated period or the chance of deviation from an anticipated outcome (Guertler and Spinler, 2015). It contemplates the data collection for risk identification (Sanchez-Cazorla et al., 2016). For example, this theory plays a role in comprehending uncertainties linked to new technology, strategic decision-making, and operational implementation. Leaders assess the risks of the process according to their perspectives (Dryhurst et al., 2020; Duan et al., 2020), thereby making it easier to recognize the risks related to the project (Sanchez-Cazorla et al., 2016).

Therefore, this research integrates two theoretical lenses to analyze the land mapping megaproject: Risk Management Theory and Project Management Theory. The latter focused explicitly on the project's life cycle stages. These theoretical approaches were further supplemented by the insights derived from the risk perceptions of project participants. Based on this conception, the framework (Figure 7.15) presents three major components: Project Management (Leftmost and Rightmost), Risk Management (Risks, Impacts, and Causes), and Summary (Threats and Opportunities, Impacted Dimensions, and Types).

The Leftmost Project Management Component focuses on the *lifecycle* of the project, which includes: (i) Design (the project's initial phase where conceptualization occurs); (ii) Planning (defining the roadmap, scope, schedule, and resources); (iii) Execution (the implementation of the project plan); and (iv) Closure (finalizing all activities, handing over deliverables, and closing the project). The *Risks* Component focuses on identifying potential risks that could impact the project. The *Impacts* emphasizes understanding the potential consequences and effects of risks. The *Causes* component delves into identifying the root causes and conditions that can lead to risks in the project. The Rightmost Project Management Component provides *perspectives* on project management objectives (e.g., technical, strategic, project, operational).

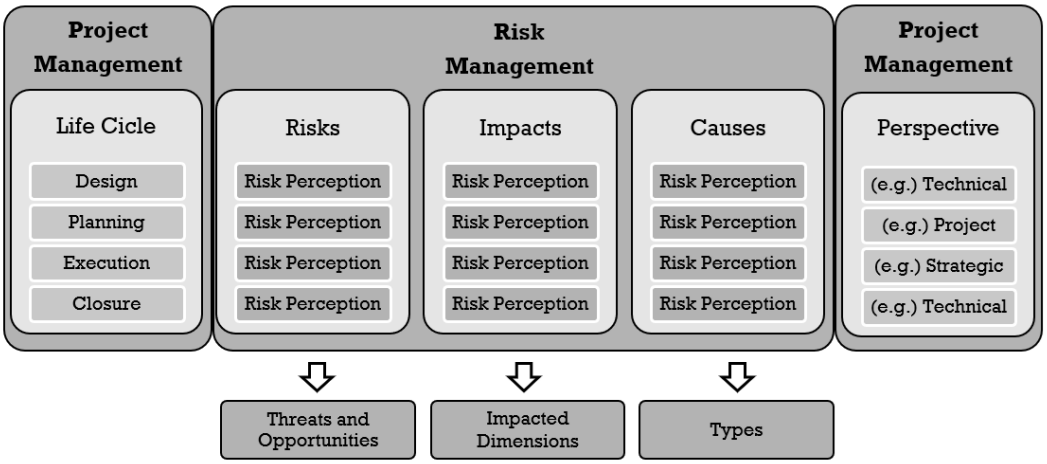

Figure 7.15 - Initial framework based on two theoretical lenses: Risk Management Theory and Project Management Theory.

This initial framework was used to complement the practical understanding of the potential risks of a mapping megaproject from the perspective of project practitioners. Using this framework, it was possible to analyze temporal risks and their possible impacts on the project's urgency. The analysis of the project execution was carried out with a macro-phase view of the project management lifecycle without highlighting the intermediate phases of geoinformation production to which the macro phase refers (e.g.): data acquisition, data processing, data management, data analysis, and construction of cartographic products.

Integrating these two theoretical lenses reveals that mapping projects requires a risk management framework aligned with the project management lens. The complex interplay of various risks necessitates an approach to managing projects at scale, mainly when novel technologies are involved. This integration reflects findings by Boateng et al. (2015) on the need for coordinated project management and risk management strategies to achieve desired outcomes in megaprojects. The approach provides a structured means of analyzing risk identification and mitigation within the context of large-scale, technologically advanced projects.

7.4. RESEARCH METHOD

To answer the research question, we employed Risk Analysis in the context of the Amazon Radiography Megaproject in four steps to map the potential challenges and uncertainties: Risk Identification, Analysis, Classification, and Risk Mitigation Strategies Development.

7.4.1. Participants

The data collection phase involved interviews with individuals experienced in managing Brazilian Army mapping projects to ensure advancement in this sector. Five participants were selected based on their experience and decision-making roles and were all appointed by project directors. The data was accessed by directly contacting each chief manager and project manager.

The interviews were conducted with the following profiles (Table 7.26): one technical manager, two project managers, and two area coordinators. The interviews were conducted at multiple organizational levels to achieve a complete view of the problem.

Table 7.26 - Number of interviewees, their role, and the duration of each interview.

Number of Respondents	Respondent's role in the Project	Duration of each interview
1	Technical Manager	1h30min
2	Project Manager	1h:38 and 1h
2	Area Coordinator	1h:51 and 2h

Before participating in the research, all participants received informed consent information describing the study's purpose, scope, and confidentiality protocols. Their participation was voluntary, and they were guaranteed the anonymity of their responses. They also provided demographic and historical information to contextualize their responses.

7.4.2. Data Collection

This subsection outlines the methodology for collecting data to identify risks in the Amazon Radiography Megaproject.

7.4.2.1. Primary Data: Individual Interviews

Semi-structured interviews were conducted to collect empirical data and obtain a more comprehensive understanding of the experiences and viewpoints of the project's military personnel. The interviews allowed open discussions, allowing participants to elaborate on their experiences, challenges, and risks in managing this megaproject. All interviews were conducted by videoconference, with audio recording, allowing a broad conversation on the subject from a script of questions that guides data collection (Table 7.27).

Table 7.27 - Structured Interview Questions for Exploring Risks and Challenges in Mapping Megaproject Management.

Type	Questions
Preliminary questions	1) What large project have you implemented or been working to implement? 2) What were your activities and responsibilities in the project? 3) What are the biggest challenges of this implementation?
Exploratory questions	1) What risks would you highlight in the project? 2) What risks would you highlight in conceiving the project at the start (purpose, viability analysis, requirements, available resources)? Why do they occur? What are their impacts? 3) What risks would you highlight in planning and design (who, what, where, when, which, and why), cost, measurement of the success of a goal, timeframe to achieve the goal? Why do they occur? What are its impacts? 4) What risks would you highlight in the execution of the project (production, test, develop teams, project management plans, meetings, update project schedule, modify project plans as needed)? Why do they occur? What are its impacts? 5) What risks would you highlight regarding performance and monitoring (objectives, quality deliverables, cost tracking resources, project performance, key performance indicators)? Why do they occur? What are its impacts? 6) What risks would you highlight in delivering and closing the project (final test, maintenance, reporting, post-action analysis, lessons, improvements for future projects)? Why do they occur? What are its impacts?
Closure question	7) In addition to the risks you mentioned earlier, are there others that you believe should be listed or commented on?

For the preliminary questions, an introduction was made with the presentation of the project and research objectives. It aimed to establish a baseline understanding of the interviewee's involvement and perspective on the project. The core list of questions included the main exploratory issues that guided data collection. It focuses on identifying, understanding, and elaborating on the risks and challenges associated with various stages of the project management lifecycle. The closure question seeks to uncover any additional risks not previously mentioned. Finally, all interviewees were contacted in a second round while structuring the research results to eliminate specific doubts.

7.4.2.2. Secondary Data: Documentation Review

The case study used a document review based on public documents as secondary data to map the project's structure, goals, and execution.

The document review focused on the following sources: (i) Official public information, including government reports, project documents, and official communications that provide direct information about the project's objectives, planned deliverables, and progress. Examples include data from Brazilian government agencies such as CENSIPAN, DSG, and other institutions involved in the project. (ii) Academic literature and technical reports that provide the project's methodologies, technical specifications, challenges, and outcomes. Sources such as Clement et al. (2009), Ferreira et al. (2008), Castro-Filho and Rosa (2017), and others helped us to contextualize the project's goals and technological advancements. Moreover, (iii) Laws, decrees, and other legal documents that outline the project's regulatory framework were analyzed to understand the government's requirements and expectations.

Through this documentation review, we aimed to: (i) Identify the project's scope, objectives, deliverables, and the specific roles of involved entities to understand how the project aligns with national cartographic goals; (ii) Analyze the legal and regulatory demands set forth by the government to contextualize the project's compliance and policy alignment; (iii) Evaluate the project's execution, from inception to closure, to understand how it met its intended goals, timelines, and budgets; and (iv) Recognize the project's use of advanced technologies, such as PolInSAR and SAR, to assess their impact on the project's deliverables and cartographic advancements.

7.4.3. Data Analysis

The data analysis and categorization process followed an iterative approach, comparing risk categories, their causes, and impacts across different stages of the project life cycle. The analysis also involved contrasting these findings with existing literature to uncover unique or less recognized risks for large-scale mapping projects to be presented in the narrative framework.

7.4.3.1. Risk Classification Procedure

Using the framework mentioned above, data was classified into larger groups by types of risks, causes, and impacts. The classification took into account the project's objectives. It categorized the data based on the following: (i) Types of Risk - risks impacting the project, such as process design issues, capacity problems, HR challenges, and political uncertainties; and (ii) Types of Causes (Denicol et al., 2020): (i) stakeholder engagement and management; (ii) risk and uncertainty; (iii) leadership and capable teams; (iv) decision-making behavior; (v) integration and coordination of the supply chain; and (vi) strategy, governance, and purchasing. Table 7.29 (Appendix 7A) outlines the risks regarding corporate objectives, external and internal risk categories, complemented by the categories identified by the authors.

7.4.3.2. Narrative Framework

Based on the graphic framework presented in section 7.3, we provide the results in a narrative framework form.

The narrative structure is organized to reflect the sequential phases of the project—design, planning, execution, and closure—each explored under the dual lenses of Project and Risk Management.

The research dives into the specifics of each phase, detailing the inherent risks and opportunities identified through interviews with project participants.

The narrative framework synthesizes the data collected, summarizing the risks and opportunities across the project-impacted dimensions, such as time, cost, and human resources. It examines how these dimensions can influence the project's success or failure.

7.4.3.3. Analysis of Temporal Risks and Urgency

We analyzed the temporal risks affecting the megaproject and their implications for the project's urgency. The aim was to explore how these risks impact timelines. We analyzed the previous results and the interview transcripts to identify recurring themes related to temporal risks. We split the analysis regarding the threats related to time, impacted dimensions related to time, vulnerabilities or causes related to time, and time-related opportunities.

Then, we categorized the temporal risks according to their impact on the project's timeline, such as project planning risks (inadequate planning and strategic decision-making), technological risks (introducing delays due to technological novelty and system availability), and HR risks (turnover and knowledge loss affecting project timelines). We present them in the context of technology, management, external factors, and processes.

We also present possible ripple effects, such as timeline delays affecting project costs, quality, and HR utilization. For example, cost impacts (prolonged timelines inflate project budgets due to extended personnel use), quality impacts (delays lead to rushed work and compromised quality), and HR impacts (extended timelines demoralize staff and lead to increased turnover).

Ultimately, we discuss how the temporal risks identified in this paper can potentially increase the project's urgency.

7.4.4. Risk Mitigation Strategies Development

This last section provides strategies for mitigating risks identified in the land mapping megaproject, which has been developed based on the risks identified in the investigation. It analyzed qualitative data to identify key themes related to risk mitigation. Based on the data analysis, strategies were developed that focused on the following themes: technology, project management, knowledge management, processes, quality control, human resources, planning and control, contract management, and training and development. We consider the following improvements: (i) specific mitigation strategies for each theme identified and (ii) improvements to project management processes.

7.5. RESULTS

First, we provide an overview of the “Radiography of the Amazon” Megaproject by analyzing official public documents, articles, laws, and decrees. It outlines the project's goals, methodologies, and outputs in enhancing Brazil's cartographic and geographical data infrastructure.

Next, we proceed by analyzing the gathered data to identify the risks, associated threats, opportunities, and impacted dimensions, categorizing them according to the distinct phases of the project's life cycle and its perspectives on project management. These results are presented within the narrative framework.

7.5.1. The "Radiography of the Amazon" Megaproject

To give perspective to the "Radiography of the Amazon" Megaproject, it corresponded to the cartographic void, divided into: (i) 1,142,000 km² of forest area (Brazil, 2008), approximately the same size as the sum of the areas of Portugal (92,226 km²), Spain (505,944 km²), France (543,965 km²); and (ii) 658,000 km² of non-forest area (Brazil, 2008), equivalent to the sum of the areas of Italy (302,073 km²), Switzerland (41,285 km²), Belgium (30,528 km²), Holland (41,543 km²) and United Kingdom (242,495 km²).

The project was inspired by the RADAM Brazil Project, its predecessor in the Amazon region, which was started in 1970 by the Brazilian Institute of Geography and Statistics (IBGE). At that time, it was the first modern systematic mapping in the Amazon (Clement et al., 2009), with surveys of vegetation cover, geology, and soils through Side-Looking Airborne Radar – SLAR (Ferreira et al., 2008). The RADAM Project generated cartographic products on a 1:250,000 working scale, therefore, with low precision in a working area of approximately 6.6 million km² (Castro-Filho and Rosa, 2017). The SLAR sensor wave allowed the identification of areas rich in mineral resources and classifying different types of land use (Castro-Filho and Rosa, 2017).

The "Radiography of the Amazon" Megaproject aimed to map an area of 1.8 million km² that did not have adequate land mapping information, usually called the "Cartographic Void of the Amazon" (Correia, 2011). The project started in 2008 (Castro-Filho and Rosa, 2017), carrying with it the challenges inherent to the Brazilian Amazon region, characterized by being an area of dense forest, difficult land access, with low density of road and rail modals, insufficiently supplied by navigable rivers of the region, such as the Amazon River, the largest navigable river in the world, with 6,400 km from a point in the Peruvian Andes to the Atlantic Ocean (Martins and James, 2020). Even though it is a naturally navigable river, without the need for man-made adjustments (Pompermayer et al., 2014), many logistical challenges are related to inland waterway navigation in the region (Favacho et al., 2016). That is, with several technical and logistical challenges to be overcome throughout the project, seeking a more accurate understanding of the Amazon region.

The Amazon Mega Mapping Project, called "Amazon Radiography," was a subproject created from the Amazon Cartography Project, composed of three (3) subprojects (Brazil, 2008): Land Cartography (called Amazon Radiography), executed by the Directorate of the Geographic Service of the Brazilian Army (DSG), with the support of the Brazilian Air Force (Força Aérea Brasileira - FAB); Geological Cartography, performed by the Geological Service of Brazil (Companhia de Pesquisa de Recursos Minerais - CPRM); and Nautical Cartography, executed by the Directorate of Hydrography and Navigation of the Brazilian Navy (Diretoria de Hidrografia e Navegação - DHN). For the coordination of the project, a Project Coordination Committee was established, chaired by CENSIPAN, and composed of members of DSG, CPRM, FAB, and DHN (Brazil, 2008). The Brazilian company BRADAR was contracted for forest area imaging and was responsible for airborne imaging technology PolInSAR (Castro-Filho and Rosa, 2017).

7.5.1.1. Schedule of Physical Execution, Delivery of Final Products, and Financial Overview

The total financials were found to be R$ 350 million - BRL (Brazil, 2008).

The Schedule of Physical Execution and Delivery of Final Products from 2008 to 2014 (Brazil, 2008) involved a detailed plan for enhancing cartographic and geographical data infrastructure in Brazil, with a total expenditure reaching R$ 98,718 million (BRL). This plan covered several critical operations, including the acquisition and/or maintenance of software and hardware over the seven years, to keep the technological framework up-to-date. Infrastructure adequacy was addressed in the initial five years, focusing on preparing and improving physical facilities to support the project's goals.

A significant upgrade was made to the R99-B aircraft in 2009 and 2010, alongside a concurrent upgrade to the processing systems, ensuring the data captured by aerial surveys was efficiently processed. The R99-B aircraft was also validated for cartography in 2008, marking its readiness for operational deployment. Aerial surveys conducted by private initiatives were a continuous effort from 2008 to 2012, contributing considerably to the project's data collection phase. This effort was complemented by the recognition, signaling, and measurement of control points, essential for ensuring the accuracy and reliability of the cartographic data collected.

The Amazon Protection System (Sistema de Proteção da Amazônia - SIPAM) aerial survey utilizing the R99-B aircraft took place in 2013 and 2014, highlighting the project's focus on leveraging advanced technology for environmental monitoring and protection. It was paralleled by government efforts in SAR (Synthetic Aperture Radar) data processing and product delivery, along with the construction of cartographic products and the field validation of thematic data through reambulation[1] from 2013 to 2014.

Offset printing, which spanned from 2009 to 2014, ensured the physical dissemination of cartographic products, contributing to various applications from environmental management to national security.

The project achieved substantial outputs regarding final product delivery, including 610 topographic maps at a 1:100,000 scale and a delivery of orthoimages and digital elevation models at 1:100,000 (1,230) and 1:50,000 (4,924) scales. Vegetation stratification files were another significant output, totaling 6,354 files. The delivery schedule showcased a gradual increase in product complexity and detail, underscoring the project's commitment to enhancing Brazil's cartographic and geographical resource base. The overall effort culminated in producing and distributing 19,882 final products at an estimated cost of R$ 4,965.20 (BRL) per product, reflecting the extensive investment in Brazil's cartographic capabilities over the seven-year timeframe.

7.5.1.2. Products

The range of products the project delivers encompasses various technological outputs (Brazil, 2008; Castro-Filho and Rosa, 2017) that are essential for societal and environmental applications.

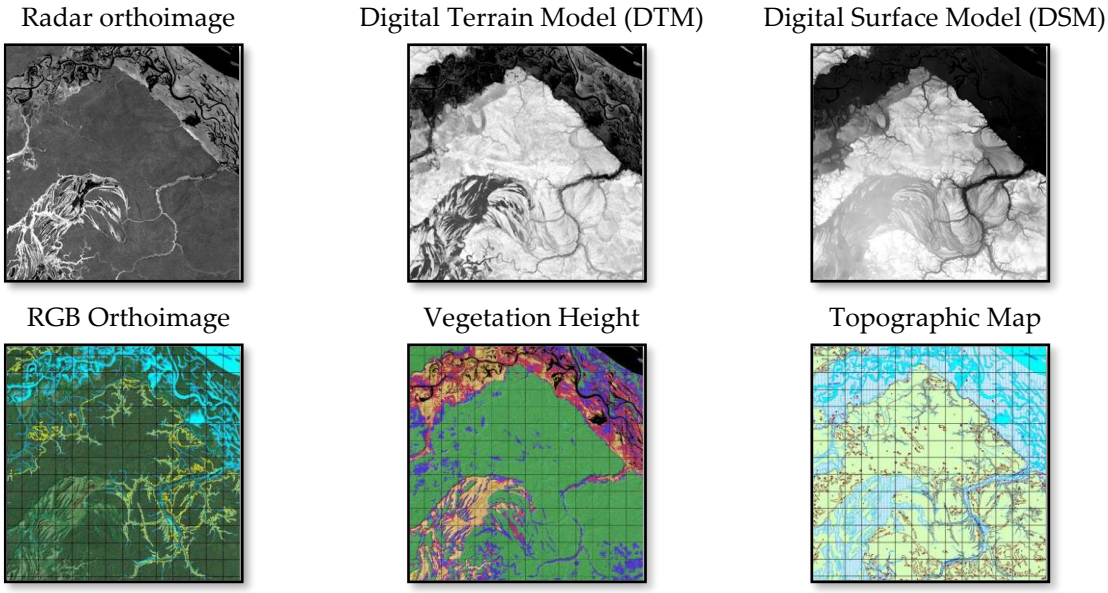

Figure 7.16 - Project products. Source: DSG.

[1] Reambulation is a technical process in topography, cartography and survey that involves the verification or redefinition of information in the field.

These include orthoimages captured in multiple radar bands (X-HH, P-HH-HV-VH-VV), Digital Terrain and Surface Models (DTM/DSM), topographic maps, geospatial databases, and vegetation stratification layers. Figure 7.16, as provided by the Directorate of the Geographical Service of the Brazilian Army (Diretoria de Serviço Geográfico - DSG), showcases examples of these project outputs. This assortment of products, as reported in sources from Brazil (2008) and Castro-Filho and Rosa (2017), represents the project's approach to generating geospatial data and mapping resources for distribution to the broader community.

7.5.2. Risk Identification, Analysis, and Classification

This subsection presents an analysis of risks across project management stages, identifying threats, opportunities, impacts, and causes, and offering insights into technical, project, strategic, and operational perspectives within the project environment.

As shown below, several risks and opportunities could be identified and grouped from the interviews with the project managers, coordinators, and technicians. According to the interviewees' perspective, the risks considered most relevant were detailed in a narrative way for each phase of the project's life cycle and separated into threats and opportunities.

Next, the results are presented in narrative form, based on the initial framework presented in item 7.3 across different project phases. It includes an analysis of the project perspectives encountered during project design, planning, execution, and closure.

7.5.2.1. Risks in Project Design

This section identifies and analyzes risks in project design, focusing on the challenges associated with technological novelty and the lack of consolidated project information. Table 7.30 (Appendix 7B) provides detailed information about project design risks, consequences, and causes.

7.5.2.1.1. Technical Perspective

Technological risks arise primarily from the novelty of the technology involved. The institution's desire to remain technologically advanced poses a risk because of the lack of comprehensive knowledge about using radar technology in large-scale projects. This lack of understanding often leads to incorrectly estimating the technical team's training requirements and underestimating the project's technical needs.

The limited availability of parameters regarding the new technology also hinders decision-making during the project's design phase. Moreover, the lack of practical testing of radar imaging technology in large projects contributes to uncertainty in estimating the project's technical requirements.

7.5.2.1.2. Strategic Perspective

Strategic risks stem from decision-making at the top management level. Unrealistic expectations from senior management and decision-making without considering cumulative risks lead to inaccurate project timelines. Moreover, a culture that accepts and encourages risk, generally willing to take on challenges, which seems to imply the absence of a culture that promotes risk analysis within the project, which ends up amplifying these risks.

7.5.2.1.3. Summary

The primary threats in this context include *technological novelty*, a *lack of parameters*, *unrealistic expectations*, and a *deficient risk analysis culture*. However, opportunities exist, such as *accurately assessing technology potential*, *establishing clear production parameters*, *planning projects with realistic expectations*, and *fostering a robust risk analysis culture*. The impacted dimensions encompass *time*, *cost*, *human resources*, and the *organization's image*.

7.5.2.2. Risks in Project Planning

This subsection addresses identifying and analyzing strategic and operational risks in project planning. It presents the role of process design, human resources, and technology in shaping project outcomes. It highlights the interconnected challenges stemming from organizational culture and technological novelty. Table 7.31 categorizes strategic and operational risks, highlighting the interconnectedness of process design, human resources, and technology.

7.5.2.2.1. Strategic Perspective

Strategic risks include failing to identify or map the worst project risks, leading to missed schedules and financial targets due to a risk-prone organizational culture and lack of risk mapping. These risks are exacerbated by inadequate planning, unknown or catastrophic risk events, and technological underestimations, all rooted in organizational culture, information deficiencies, and technological novelty.

7.5.2.2.2. Operational Perspective

Operational risks involve imprecise definitions of technological steps and processes. It leads to excessive flexibility in technological management, product inconsistencies, and decision-making that ignores project risks. These challenges stem from a lack of standardized production processes, underestimation of technology's potential and limitations, and a risk-prone organizational culture, highlighting the critical impact of organizational culture, process design, and technological understanding on project planning.

7.5.2.2.3. Summary

The main threats identified include challenges in *process design and capacity*, *HR-related security and decision-making issues*, and *technological hurdles such as novelty and the lack of processed information*. Opportunities lie in *improving risk identification*, *enhancing adherence to project timelines*, *effectively leveraging technology*, *implementing reliable planning*, and *standardizing production processes*. The dimensions most impacted by these threats and opportunities encompass *time*, *cost*, *risks*, *innovation*, and *quality*.

7.5.2.3. Risks in Project Execution

This subsection explores the execution phase, detailing strategic, project, technological, and operational risks, their impacts, and origins (Table 7.32, Appendix 7D). Strategic risks encompass international politics, and human resources (HR) issues such as succession planning, decision-making, and process design, impacting political stance, process efficiency, and employee capability. These risks are mainly due to legal issues, process execution flaws, HR limitations, and technological innovations. Communication risks involve HR communication and employee capability, affecting process capacity and employee performance, rooted in HR and communication issues. Technological risks are related to data/system availability and technological disruptions, impacting process and employee performance, with causes spanning environmental, legal, process, and technical issues. Operational risks include environmental, infrastructure, and process execution challenges, affecting process quality and efficiency, employee training, and system development. The table also identifies opportunities for financial savings, HR development, improved political image, decision-making, and system development.

7.5.2.3.1. Technical Perspective

Inadequate management of thematic quality of products. A risk is perceived as being unable to deliver reliable thematic terrestrial information to society in some areas. This perception is due to the lack of validation of thematic data in the field through the phase known as reambulation. Another risk perception is converting radar images, obtained in grayscale, to color images (RGB), compatible with human visual interpretation. Although

it allows for the most pleasing visual analysis for human interpretation, the lack of validation of this data conversion could lead to an incorrect interpretation. Incorrect information in an official document could lead to future legal problems, as many legal definitions are based on geographical issues measured and modeled by the products generated and distributed from these mapping projects. For example, distributing a (true) flood area data in the image with visual characteristics of a deforested area can have very serious legal consequences for the environment area. This perception occurs in case of lack of validation, or incorrect validation or sample validation, of the reambulation phase. Design decision tree techniques are not for legal purposes. The novelty of radar imaging technology meets several needs of the Amazon Forest environment. However, it generates other problems hitherto unknown, or that will only be modeled and corrected from each impact received years later.

Inadequate technology management. Another risk issue is the flexibility of the type of technology used in mapping projects. The flexibility of technological management is seen with caution since the possibility of being too flexible technologically, with more than one macro technology (radar, optical, or laser sensors) or production processes, can generate more errors in the final production process. When making flexible technology, many new technological possibilities are inserted, demanding, therefore, according to the view of the interviewees, a maximum and minimum limit of technological flexibility for each technology. Neither management is too rigid, which prevents technological novelty, nor management too liberal, which brings catastrophic consequences for the project.

Exchange of work software. During the production process, there are eventually some software changes to reduce costs, such as from proprietary software to free software. For example, the move from Microsoft Windows to Linux forced technicians to learn a more complex platform from a computer programming point of view (at that time). A similar aspect occurred with the switch from ArcGIS software to QGIS software. As a result, there is resistance from employees who spend more time in the company and a cost to the project until the new systems generate a new standard.

Lack of adequate physical infrastructure. Insufficient electrical infrastructure can impact irreversible data loss and diverse reworks, seriously impacting production. In addition, inadequate information technology infrastructure, such as computers, data networks, processing, and data servers, can cause significant damage to the project. There is an associated risk when the project depends on changing the institution's old physical infrastructure. For example, a simple misplaced air conditioner can burn out a processor in the data processing room.

7.5.2.3.2. Strategic Perspective

Damage to the institution's image. Failure to deliver what was contracted for the project can damage the institution's image and entail political threats, such as governors and mayors complaining about the products or going to the media for the same purpose.

Political risks. Political decisions to increase the scope of the project, therefore increasing the volume of work simultaneously, can impact the decrease of the quality of the products since metric, thematic, and structural errors can be inserted.

International incident risk. International risks in border areas can also occur periodically, as aircraft with mapping sensors could cross borders between countries. As a result, unforeseen international diplomatic incidents with incalculable impacts may occur.

7.5.2.3.3. Project Perspective

Risk of inadequate management of acquisitions (purchases). Projects of this magnitude involve large sums of money to purchase investment and consumer goods, such as high-generation computers, radar data processing towers, high-performance four-wheel drive vehicles, naval vessels, and aircraft equipment and parts, which can pose a significant risk

to the project. The incorrect purchase of essential high-tech material for the activities can significantly impact the partial project schedule, resulting in a significant delay.

Risk of lack of supply of defense technological inputs. Projects like this involve the few defense technology industries in the radar imaging niche market. In this context, if a national advanced technology company loses a major contract, the possibility of going bankrupt is perceived due to a bilateral monopoly issue (hold-up problem) characteristic of this domestic technology market. In this case, there is a dilemma for the demanders of mapping and defense inputs in trying to maintain a contract for a more extended period to not lose the national technology due to the bankruptcy of a Brazilian private company. From the project's point of view, maintaining the contract with new physical execution goals directly impacts the increase in the volume of work in the same period defined in the project.

Inadequate management of contractual change. There is a perception of risk due to the possibility of changing the rules of the contract or project during the execution. It is perceived that there may be an intention of the change on the contractor's part, for example, to increase the number of products delivered in the project. The inadequate management of a contractual change can negatively impact the project, with an increase in the volume of work in the same original period, which can impact quality, although initially being perceived positively by the contracting party. However, with the inadequate increase in work, metric, thematic, and structural errors can be inserted, among others. The main issue is perceived when the contracting agency suggests an additive term, as the initial investment structure was not modeled and made feasible for the new demands. Although it seems evident that, if there is an additive term, the physical and human resources' structure must be adapted and increased to the new demand, due to the top management already considering the high initial investment, the adequacy may not occur, which would bring catastrophic impacts to the project. In summary, while aiming to take advantage of the initial quality of the project and increase the volume of work, it can end up harming the work and quality by increasing the scope and not considering the constraints.

Inadequate management of contracts with third parties. A perceived risk in contract management is related to failure to hire temporary labor caused by poorly written contracts. Inadequate hiring of external personnel can impact future legal issues, resulting in lawsuits for commanders of military engineering organizations, who are legally responsible for third-party hiring processes.

Changing an experienced project manager. The departure of an experienced and specialized project manager is perceived with reservations. It is because, with the change, there is the possibility of entering new managers without technical knowledge of the project or being "forced" to manage projects or phases without know-how. Relying on managers to make things work can lead to severe problems if the manager leaves the project, such as losing continuity.

Excessive activities outside the Project. Activities outside the project are seen as threats to project phases. Administrative issues, military activities, or emergency external support unrelated to the production environment can sometimes delay production steps and processes.

Unexpected departure from Human Resources. The restriction of human resources specialized in geoprocessing tools occurs in any large project. As a result, the risk related to the unexpected departure of good technicians through public tender, dismissal, or unexpected transfer causes a significant impact on the project. The question remains: "Who will continue the work with the same quality?" Allied to the risk of leaving is the risk of training a professional who will probably not stay in the project because they are studying for a public contest, for example.

Inadequate knowledge management. It is challenging to manage knowledge, as people are heterogeneous, and the volume of human capital varies from place to place in Brazil, even from city to city within the same region. For example, in Brasília, the capital of Brazil, intellectual capital is considered high, while human capital is low. For example, in Porto

Alegre, the southernmost state capital, human capital is high, and intellectual capital is lower than in Brasília.

Lack of vertical communication. The risk related to the possibility of lack of communication between the different spheres of management and with the shop floor is perceived. The risk lies in the possibility that managers only see the shop floor as manual workers, not specialists in the execution phase. When a manager does not consult the shop floor, these professionals fail to contribute insights to important technical project decisions. Communication failure can also be evidenced by the excessive centralization of some managers at the intermediate level, who may not share the importance of tasks with employees. As a result, the shop floor team may not be aware of the purpose of each activity that needs to be carried out. They may not know, for example, how important it is to the project and the final product that they are doing precise work at intermediate phases.

Incorrect management of communication between work shifts. With the adoption of 3 (three) different working hours, communication between the different periods can be impaired, especially between work shifts. As a result, it cannot be easy to control/monitor each professional in the work shift.

7.5.2.3.4. Operational Perspective

Meteorological uncertainties. One of the perceived risks in this regard is related to storms, which generated significant instability in the electrical network and directly interfered with the radar processing tower.

7.5.2.3.5. Summary

The primary threats include *political* (international), *process-related* (design, capacity, execution, and quality), *human resources* (employee capability, recruitment, decision-making, training, organizational culture, communication, succession planning, redundancies), and *technology-related* issues (technological novelty, interruptions, and availability of systems and data). Opportunities, however, emerge in the form of *financial savings* through capital resource management, *enhancements in HR* through improved training, development, and decision-making, as well as *advancements in technology* via system development. The most impacted dimensions include *legal considerations*, *time*, *cost*, *quality*, *risks*, *innovation*, and *organizational culture*.

7.5.2.4. Risks in Project Closure

This subsection presents compliance with legal, contractual, and regulatory standards, detailing the potential consequences on project timelines, costs, human resources, and the broader impacts on institutional reputation and stakeholder trust. The main risk category related to corporate objectives is compliance with the laws, contracts, and regulations applicable to the project. Table 7.33 (Appendix 7E) provides the main risks, consequences, and causes at the end of the project execution.

7.5.2.4.1. Summary

Threats encompass *capacity and quality-related* issues within *processes*, *design and execution* challenges in *HR*, *political risks* affecting the *institution's image*, *budgetary constraints*, *potential legal actions*, *loss of societal trust*, and *technological interruptions*. Opportunities lie in *improving project planning and execution*, *enhancing quality assurance*, *bolstering institutional trust*, and *leveraging technology to minimize interruptions*. These factors impact dimensions such as *time*, *cost*, *HR*, *institutional image*, *legal exposure*, *trust*, and *quality*.

7.5.2.5. Perception of Opportunities

This section explores the perception of opportunities, emphasizing how technological innovations, specifically in radar imaging, offer unique capabilities and data

acquisition that are not possible with traditional methods while highlighting training and development to leverage these new technologies. Table 7.34 (Appendix 7F) provides internal opportunities for project management.

Technological Novelty. The novelty of radar imaging technology allowed obtaining data and information that was not possible with traditional optical remote sensing equipment. Radar technology allows for obtaining different data from the same target in the field. The novelty and originality also bring uncertainties regarding the new technology.

Training and development. The conception of a project with radar technology allows the training of all human resources involved due to the complexity of radar technology. It forces the institution to prepare itself with practical and theoretical training on radar technology. It also allows training to be applied to the production, planning, processing, and storage of these data.

7.5.2.5.1. Summary

Early implementation of new technology brings significant opportunities, such as *specialized training and development*, *leveraging technological novelty*, and *establishing precise production control*. These opportunities result in *improved HR capabilities*, *refined production quality*, and *knowledge for future projects*. The dimensions impacted by these developments include *HR*, *time*, and *quality*, as well as *project definitions based on new technology*.

7.5.2.6. Risks-related to Performance

Participants highlighted 5 (five) macro-risks that could impact the performance of mapping projects, significantly impacting the non-delivery of projects or delays: (i) Poor sizing of the project, directly impacting its execution since it is impossible to know precisely how many people will be part of the megaproject over time; (ii) Problems involving stakeholders, such as input or technology suppliers, resulting in delays in the project due to non-compliance with the contract; (iii) Technological factors in general; (iv) Government budget limitations (public institution, not always fulfilled or well planned); and (v) Lack of testing of prototypes (pilot projects) to test the technology and production deadlines.

7.5.2.7. Data Analysis

Based on Table 7.35, which provides the risks, associated threats, and impacted dimensions, we explored the frequency of each dimension's occurrence.

The most frequent *threats* impacting the projects are: Process (design) - 14, Process (capacity) – 11, Political (image) - 11, Process (execution) - 7, Process (quality) – 6, HR (decision making) – 5, Legal (future legal action) – 5, and Social (lack of trust) – 4. Therefore, the analysis indicates that *Process (design)*, *Process (capacity)*, and *Political (image)* are the most frequently mentioned associated threats.

The most commonly *impacted dimensions* are: Time (55), Cost (49), HR (26), Quality (24), Trust (20), and Image (19). Thus, *time* and *cost* are the most frequently impacted dimensions. Some dimensions, such as Political and Social, are mentioned only once, indicating that they seem to be less commonly impacted.

7.6. TEMPORAL RISKS AND URGENCY

From the above narrative framework, we described how the identified risks could impact the timeline of this type of megaproject. As presented in the initial framework (Figure 7.15), we provide the analysis in the following order: (i) threats related to time; (ii) impacted dimensions related to time; (iii) causes related to time; and (iv) time-related opportunities. Then, we analyze the project risks affecting time based on Table 7.35. Finally, we end this analysis by summarizing temporal risks and how they can potentially increase the project's urgency.

Regarding the *threats related to time*, notice that the "Radiography of the Amazon" Megaproject faced significant risks due to the extensive timeline required for completion. These threats include, for example, inadequate project planning, resulting in timeline exceedances and difficulties meeting project deadlines. Risks, such as expanding the project's scope without adequate resource allocation, further threaten the project's ability to remain on schedule. Moreover, introducing new technology brings uncertainties that may delay projects. Insufficient management knowledge can lead to losing essential staff members whose replacements may lack the necessary technical skills to maintain project progress.

Regarding the *impacted dimensions related to time*, delays can have ripple effects on various areas, such as cost, quality, and staff use. For example, prolonged timelines can inflate project budgets due to the extended use of resources and personnel. Quality can suffer as delays may prompt a hurried approach to meeting revised deadlines, compromising the integrity of the project's outcomes. Moreover, extended timelines can demoralize the workforce and increase turnover, resulting in the loss of specialized skills to maintain project momentum.

Regarding the *vulnerabilities or causes related to time*, notice that many timeline-related risks stem from project design, strategic planning, and risk management. A weak project design can lead to underestimated resource needs, creating bottlenecks that extend the timeline. Strategic decisions that fail to anticipate cumulative risks or include realistic expectations can lead to delays. Lastly, a deficient risk analysis culture, lacking comprehensive risk mapping and mitigation strategies, leaves projects vulnerable to unforeseen delays and interruptions that can impact their timelines.

Regarding *time-related opportunities*, there are several ways to enhance time management in large-scale projects. Implementing project planning and scheduling processes can ensure that timelines are realistic and achievable, reducing the likelihood of unexpected delays. Project management software can improve monitoring, control, and coordination, providing real-time perceptions of progress. It allows rapid adjustments to keep projects on schedule. Additionally, cross-functional training and development programs can increase workforce flexibility and ensure tasks are not delayed due to personnel changes. Creating a culture prioritizing timely delivery through practical risk assessment and contingency planning can reduce the impact of unforeseen events on project timelines.

According to Table 7.35, project risks affecting timelines generally stem from technology, management, external factors, and processes.

In the technology context, not fully understanding its potential and limitations can lead to unrealistic planning and delays. For instance, reliance on untested radar imaging technology may lead to unexpected issues, forcing teams to halt work to resolve them. Frequent technological interruptions, particularly those arising from new, untested technologies, introduce unforeseen challenges that can derail project timelines. A lack of processed technological information can also hinder timely decision-making.

Management issues present a significant risk to project timelines. A lack of clear production parameters and project necessity estimates can lead to inefficiency and resource misallocation, resulting in delays. Decision-making without a proper understanding of impacts and a lack of risk consideration exacerbates this problem by causing missteps and extending the timeline. Poorly designed projects inherently face inefficiencies that prolong timelines. At the same time, inadequate workload division and inaccurate assessments contribute to bottlenecks and misjudged schedules.

External factors add another layer of complexity. Legal complications from project failures can divert resources from project execution, delaying progress. Environmental challenges, such as natural disasters, can potentially halt project activities altogether, leading to significant setbacks. Inconsistent project goals, often influenced by external stakeholder demands, can also introduce delays as project teams adjust to evolving requirements.

Lastly, process-related risks, such as a lack of a risk mapping culture, mean that projects can encounter unexpected challenges that extend timelines. Technological interruptions can disrupt daily operations, causing cascading delays. Issues with infrastructure, such as inadequate power or internet, can also slow progress. Unrealistic workload estimations often lead to tasks overrunning, impacting the project schedule. Over-reliance on under-tested technologies and poor risk management can add further delays.

Time was the dimension that participants perceived as most impacted by project risks, appearing 55 times in the list of risks. These temporal risks are inherent in megaprojects due to their complexity. They can directly impact the endogenous urgency of the project, whether in intermediate stages or in the completion of the project itself, and can create cascading effects in several aspects (e.g.): (i) Timeline exceedances lead to inflated budgets due to extended use of resources and personnel, thus affecting the project's financial health and urgency to meet its deadlines; (ii) Delays often result in rushed work to meet revised deadlines. This haste compromises the quality of project outputs, which can diminish the project's overall impact; (iii) Prolonged timelines can demoralize staff, increase turnover rates, and erode the quality of specialized skills.

Notice that the temporal risks outlined in this paper can potentially increase urgency, often leading to attempts to increase speed to compensate for lost time. For example, without a clear understanding of technology and potential risks, projects might face delays because of unrealistic planning, resulting in extended durations due to unexpected issues. The urgency increases as delays pile up, which could lead to hasty decisions, ultimately escalating costs. Moreover, incorrect estimations can lead to delays and increased urgency due to underestimating the scope and size of the project. This results in unplanned changes in duration and speed, likely increasing both time and costs. Also, poor decisions made without comprehensive analysis can significantly affect project timelines by causing unforeseen complications, increasing the project's urgency, and increasing costs as the team scrambles to adjust the project plan. Analogously, failures during project execution due to inadequate risk planning can cause delays. It increases urgency and may force the project to operate faster to meet deadlines, which typically raises costs due to expedited work. Finally, technical failures and over-reliance on novel technologies may result in extended project durations due to the inability to resolve technical issues quickly. It directly impacts the speed and urgency, often leading to increased costs.

7.7. RISK MITIGATION STRATEGIES WITHIN THE CONTEXT OF MAPPING MEGAPROJECTS

By studying the identified risks and their respective categories, threats, and opportunities, researchers present suggestions that aim to assist managers in developing and implementing risk mitigation strategies in similar contexts.

Table 7.28 - Risk mitigation strategies within the context of land mapping megaprojects.

Theme	Suggestions for Risk Management in Similar Projects
Software and Technology Selection	Choosing the right software and technology at the project's inception is crucial. Changing these during the project's lifecycle should be avoided unless improvements are clear and proven.
Portfolio Management	The Radiography of the Amazon Project is part of a subproject involving different institutions and different megaprojects with the need for synchronism of fieldwork (e.g.): reambulation for the terrestrial cartography project and geological mapping in the geological cartography project (Brazil, 2008). All with the aim of sharing logistics and reducing operating costs (Brazil, 2008). Coordinating these subprojects, including synchronization of fieldwork, is relevant to share logistics and reduce costs. Standardized quality control, improved communication, and increased training can enhance portfolio management.
Knowledge Management	The Brazilian Army has been standardizing knowledge and guiding personnel through manuals to improve the quality of geoinformation personnel. For example, the Army has been working to level the

Theme	Suggestions for Risk Management in Similar Projects
	knowledge of geoinformation personnel and adequately guide their employment (Netto, 2018) with Field Manual EB20-MC-10.209 (Exército Brasileiro - Brazilian Army, 2014).
Schedule of Technical Training	A training schedule for project management and ensuring project managers have the right managerial profile are essential for successful project delivery.
Processes	Pilot projects are critical in defining production processes and phases, enabling smoother execution.
Risk Management	Enhancing risk management maturity across all management levels and hierarchies is essential to handle project risks better.
Production and Management Maturity	Relying on production metrics from previous projects and providing specific engineering management courses can develop managers' maturity. Choosing managers with a managerial profile, enhancing communication, and providing training are all crucial.
Thematic Quality Control	To ensure the reliability of thematic data, it is essential to perform field data validation and find cost-effective ways to validate it.
Organizational Issues	Minimizing or eliminating activities outside the project scope will help maintain focus and efficiency.
Human Resource Management	Preventing project managers from leaving, retaining project management talent, and aligning project deadlines with changes in the public sector are all important strategies. Single working hours, knowledge management, continuous personnel training, and hiring specialized technicians can improve resource management.
Production Planning and Control	Implementing or acquiring production control software can enhance efficiency in production planning.
Contract Management	Having a dedicated sector for engineering contracts specific to terrestrial mapping can improve contractual adherence.
Managing Scope Creep	Scope creep should be handled as a new project to maintain control over project deliverables and timelines.
Procurement Management	Ensuring that procurement processes include adequate technical details can improve the quality and relevance of acquisitions.
Project Planning	Implementing thorough planning and rigorous scheduling ensures realistic timelines, thus mitigating the risk of unforeseen delays.
Technological Readiness	Teams should be well-versed in new technologies to avoid delays due to uncertainty. Practical pilot projects could help test the technology and validate timelines.
Cross-Functional Training	Regular training and development programs can ensure that personnel changes do not hinder project progress.

7.8. PARTIAL CONCLUSIONS

The introduction of radar imaging technology represents an advancement in data acquisition capabilities, offering unique opportunities for obtaining information not possible with traditional optical remote sensing methods. However, the novelty of this technology introduces uncertainties and necessitates project teams' understanding and adaptation to manage associated risks. The complexity of radar technology underscores the need for comprehensive training and development programs to enhance human resource capabilities. Ensuring team members are knowledgeable about radar imaging technology's technical and operational aspects is vital to maximizing its potential and minimizing project risks.

Organizational culture influences risk perception and management strategies. In the Amazon Radiography Megaproject context, an appetite for risk within the organizational culture contributed to the challenges encountered in project execution, especially in risk mapping and decision-making. The interplay among organizational culture, human resources, and technological adoption is evident throughout the project's lifecycle, affecting its ability to manage challenges and capitalize on opportunities.

Across all project phases, several strategic, technological, and operational risks were identified. These risks, categorized by their nature and potential impact on project outcomes, underscore the importance of a risk management strategy that encompasses risk identification, analysis, classification, and mitigation in such projects. In the Amazon Radiography Megaproject, the initiation phase involved project design where technological novelty and strategic alignment were critical. The planning phase

demanded the estimation of technological requirements and workload division. The execution phase highlighted the importance of maintaining quality control, adherence to timelines, and managing external influences such as environmental disruptions and political risks. Closure, the final phase, focused on delivering contracted outputs, ensuring quality standards, and safeguarding institutional trust.

The research outlined the challenges encountered in managing large-scale projects with innovative technologies, including project size, stakeholder management, technological adaptation, budget constraints, and the need for pilot testing. Risks associated with technological novelty, stakeholder engagement, and strategic decision-making are particularly significant in this domain. The project's adoption of novel radar imaging technology posed uncertainties due to limited experience with the data, emphasizing the importance of accurately estimating technological potential and limitations. Furthermore, stakeholder engagement is paramount to ensure project continuity, given the coordination required across multiple government agencies and teams.

The research identified significant opportunities for enhancing project management practices despite the risks. These include leveraging technological innovations for better data acquisition, improving internal processes through training and development, and adopting new project management strategies that are responsive to the complexities introduced by new technologies.

Communication and knowledge management were recognized as components of new technology projects. Managing knowledge transfer across project phases and ensuring clear communication within the project team and with external stakeholders are relevant for addressing the risks and leveraging the opportunities presented by technological innovations.

This research suggests that future projects employing radar imaging technology or other innovative technologies should prioritize comprehensive risk management, invest in extensive training and development, and foster a culture of open communication and knowledge sharing. Additionally, pilot projects are recommended to test and refine technological and management approaches before full-scale implementation.

Risk appetite allows for avant-garde thinking, such as adopting new technologies, even if they are new to the mapping market and without knowledge of the potential and limitations arising from the project's scale gain. It allows the technological impetus of the geoprocessing area, either with the standardization of complex technical specifications, with the adoption of modern technologies on a large scale, or even by the development of innovative systems for the planning and control of the production of geographic data.

Finally, the framework combining risk management and project management provides a structured approach to understanding and managing the complexities of large-scale projects such as the “Amazon Radiography” Megaproject. The framework guides the design of risk mitigation strategies and project management practices tailored to the unique demands of mapping megaprojects.

7.9. APPENDIX 7A: Risk Framework for Corporate Objectives

Table 7.29 shows risks regarding corporate objectives, external and internal risk categories, complemented with the categories identified by the authors.

Table 7.29 - Risks regarding corporate objectives, external and internal risk categories, complemented with the categories identified by the authors.

Sources	Structure for Corporate Objectives	External Risk Categories	Types of Internal Risks
Other authors	Strategic: General goals, aligned with your mission. Operations: Effective and efficient use of resources. Communication:	Economic; Capital Availability; Unemployment; Competition; Environment; Energy; Natural disasters; Politicians; Change of	Infrastructure; Availability of goods; Capacity of goods; Access to capital; Complexity; Human Resources; Employee

Sources	Structure for Corporate Objectives	External Risk Categories	Types of Internal Risks
(COSO, 2018; BOATENG et al., 2015)	Reliability of reports. Compliance: Compliance with applicable laws and regulations. (COSO, 2018)	government; Legislation; Public Policy; Regulations; Social; Demographic characteristics; Technological; Technological disruptions; Emerging technologies. (Boateng et al., 2015)	capacity; Fraudulent activity; Health and safety.
Complemented by the authors	Technological; Technological novelty.	Social; Lack of confidence; Technological; Technological novelty; Other technology projects; Economic; Budget; Environment; Meteorological; Political; International; Image; Legal; Future processes.	Infrastructure; Electric; People (HR); Decision-making; Organizational Culture; Training and development; Safety; Succession planning; Working day; Communication; Firing; Recruitment and Selection.

7.10. APPENDIX 7B: Analysis of Risks, Consequences, and Causes in Project Design

Table 7.30 provides risks, consequences, and causes in project design.

Table 7.30 - Risks, consequences, and causes in project design.

Risks		Consequences	Causes
Cat*	**Threats**	**Impacts and Effects**	
TEC	Not knowing technology's potential and limitations. Threat: Technological (Technological Novelty).	Mistakenly estimate quantity and type of training necessary for the production technical team. Threat: Process (design). Impacted dimensions: time, cost, HR.	Technology.
		Absence of production parameters regarding the new technology for decision-making. Threat: Process (design). Impacted dimensions: time, cost, HR.	Radar imaging technology has not been used and tested in large projects. Source: Technology, HR.
		Mistakenly estimate the technical necessities of the project. Threat: Process (design). Impacted dimensions: time, cost, HR.	Adoption of innovative technology, therefore, not consolidated in the market. Source: Technology.
STR	Making decisions without knowing their potential impacts on the project. Threat: HR (High management decision-making).	Not following total and partial project timelines. Threat: Process (capacity). Impacted dimensions: time, cost.	Strategy.
		Executing actions without considering cumulative risks in the project. Threat: Process (execution). Impacted dimensions: time, cost, Risk.	Unrealistic expectations from senior management about the project. Threat: HR (decision making). Source: HR (organizational culture).
		Catastrophic risks in the project. Threat: Process (capacity). Impacted dimensions: time, cost, HR, Image.	Lack of project risk analysis culture. Threat: HR (organizational culture). Source: HR (organizational culture).
		Mistakenly estimating project size. Threat: Process (capacity). Impacted dimensions: time, cost, HR.	Not knowing precisely the project bottlenecks. Threats: Process (execution). Source: Technology (availability of data and systems, lack of processed information).

* "Cat" – Category; TEC – Technology; STR – Strategy.

7.11. APPENDIX 7C: Risks, Consequences, and Causes in Project Planning

Table 7.31 provides the project planning's main risks, consequences, and causes.

Table 7.31 - Main risks, consequences, and causes in the project planning.

Risks		**Consequences**	
Cat*	**Threats**	**Impacts or Effects**	**Causes**
STR	Not identifying the highest risks for the project/Lack of risk mapping. Threat: Process (design).	Not following the timeline and financial goals. Threat: Process (capacity). Impacted dimensions: Time, Cost.	Organizational culture with appetite for risks. Threat: HR (Organizational culture). Source: Organizational culture.
			Absence of culture of/not carrying risk mapping. Threat: Process (design). Source: Lack of information.
		Going through risky events with unknown or catastrophic impacts. Threat: HR (security). Impacted dimensions: Risk management.	Organizational culture with appetite for risks. Threat: HR (Organizational culture). Source: Organizational culture.
			Absence of culture of/not carrying risk mapping. Threat: Process (design).
	Imprecise/unreliable planning. Threat: Process (design).	Not following the timeline and financial goals. Threat: Process (capacity). Impacted dimensions: Time, Cost.	Absence of a production control database from previous projects. Threat: Technology (lack of processed information). Source: System.
			Not knowing technology's potential and limitations. Threat: Technology (technological novelty).
		Imprecise workload division (under or overestimation of stages). Threat: Process (execution). Impacted dimensions: Time, Cost.	Inexistence of a production control database from previous projects. Threat: Technology (lack of processed information). Source: System.
OPE	Not precisely defining technological process stages at the beginning of the project. Threat: Technology (lack of processed information).	Excess technological management flexibility. Threat: Process (design). Impacted dimensions: Innovation management.	Not knowing technology's potential and limitations. Threat: Technology (technological novelty). Source: Technology.
		Increasing inconsistencies among products. Threat: Process (design). Impacted dimensions: Quality.	Lack of standardization of production processes. Threat: Process (design). Source: Technology.
	Absence of risk consideration in decision-making. Threat: HR (decision-making).	Not following the timeline and financial goals. Threat: Process (capacity) Impacted dimensions: Time, Cost.	Organizational culture with appetite for risks. Threat: HR (Organizational culture). Source: Organizational culture.
			Absence of culture of/not carrying risk mapping. Threat: Process (design). Source: Lack of information.

* "Cat" – Category; STR – Strategy; OPE - Operation.

7.12. APPENDIX 7D: Risks, Consequences, and Causes During Project Execution

Table 7.32 provides the main risks, consequences, and causes during the project execution.

Table 7.32 - Main risks, consequences, and causes in the project execution.

Risks	**Consequences**		
Cat*	**Threats**	**Impacts or Effects**	**Causes**
STR	Political (international). HR (succession planning, decision-making, training, and development). Process (design).	Political (international). Process (capacity, execution). HR (employee capability, recruitment, and selection).	Legal (contracts). Process (design and execution). HR (employee capability, organizational culture, redundancies, succession planning, decision-making, training, and development). Technological (Technological novelty).
COM	HR (communication). HR (employee capability).	Process (capacity). HR (employee capability).	HR (Communication, organizational culture, succession planning).
TEC	Technology (availability of systems and data, technological interruptions).	Process (capacity, execution). HR (employee capability) Technical (technological interruptions).	Environmental (meteorological). Legal (contracts). Process (design). HR (employee capability). Technical (technological interruptions). Technological (Technological novelty). Personnel (employee capability).
OPE	Environmental (meteorological). Infrastructure (electric). Process (capacity, execution). HR (employee capability, organizational culture, workday, training, and development). Technology (system selection, availability of systems and data, technological interruption).	Process (capacity, execution, quality). HR (employee capability, training, and development). Technology (system development, availability of systems and data, data integrity). Opportunity: Financial (capital resources savings). Opportunity: HR (training and development).	Environmental (meteorological). Infrastructure (electric). Personnel (employee capability). Political (image). Process (capacity, design, quality). HR (employee capability, communication, organizational culture, redundancies, succession planning, decision-making, training, and development). Technology (lack of processed information). Opportunity: Political (image). Opportunity: HR (decision-making) Opportunity: Technology (system development).

* "Cat" – Category; STR – Strategy; COM – Communication; TEC – Technology; OPE - Operation.

7.13. APPENDIX 7E: Risks, Consequences, and Causes at the End of Project Execution

Table 7.33 provides the main risks, consequences, and causes at the end of the project execution.

Table 7.33 - Risks, consequences, and causes at the end of the project.

Risks	**Consequences**		
Cat	**Threats**	**Impacts or Effects**	**Causes**
CON	Timeline-exceeding project closing. Threat: Process (capacity).	Continuity of work after contract closure date. Threat: Economic (budgetary). Impacted dimensions: Time, Cost, HR.	Poor project design. Threat: Process (capacity). Poor project design. Threat: HR (design). Flaws in project execution. Threat: HR (execution).

Risks		Consequences	
Cat	**Threats**	**Impacts or Effects**	**Causes**
		Affects institution image. Threat: Political(image) Impacted dimensions: Trust, Image.	Disclosure of project unsuccess. Threat: Political (image).
		Future legal action. Threat: Legal (Future legal action) Impacted dimensions: Legal.	Juridical insecurity. Threat: Legal (Future legal action).
		Lack of partnership trust. Threat: Political (image) Impacted dimensions: Trust, Image.	Not delivering contracted final products. Threat: Legal (Future legal action).
		Decrease of society's trust. Threat: Social (lack of trust) Impacted dimensions: Trust, Image.	Possibility of disclosure of project's unsuccess. Threat: Political (image).
	Delivery of inferior quality/not delivering contracted product Threat: Process (quality)	Difficulty carrying new joint projects. Threat: Political (image). Impacted dimensions: Trust, Image.	Loss of trust in the institution Threat: Political (image).
		Possibility of result disclosure to market and society. Threat: Social (lack of trust). Impacted dimensions: Trust, Image.	Loss of trust in the institution. Threat: Social (lack of trust).
		Institutional image. Threat: Political (image). Impacted dimensions: Trust, Image.	Loss of trust in the institution. Threat: Political (image).
		Product cannot be used for intended purpose. Threat: Technology (Technological interruption). Impacted dimensions: Quality.	Not meeting quality requirements. Threat: Process (quality).

* "Cat" – Category; CON – Conformity.

7.14. APPENDIX 7F: Internal Opportunities

Table 7.34 provides internal opportunities for project management.

Table 7.34 - Internal opportunities in the management of the project.

Cat*	Opportunities	Consequences	Causes
T&D	Training of personnel due to new technology.	Possibility of practical and theoretical training in the new technology. Impacted dimensions: HR, Time, Quality.	Early implementation of new technology.
		Improvement possibility for internal production system phases. Impacted dimensions: HR, Time, Quality.	Early implementation of new technology.
	Training old and new generations to respond to continuous technological change.	Improve knowledge of technicians for future projects. Impacted dimensions: HR.	Training in new technologies.
PM	Possibility of creating new internal separations by ability/capability after training and development of technicians.	Specific specialization of human capital. Impacted dimensions: HR, Quality.	Technology complexity.
TN	Originality of the radar technology.	Technological possibility of obtaining terrestrial information that optical equipment cannot. Impacted dimensions: HR, Quality.	Project definitions based on new technology.
	Possibility of obtaining different data from a single target.	Uncertainties regarding the new technology. Impacted dimensions: HR, Quality.	New radar mapping technology.
		Possibility of obtaining more information about each target. Impacted dimensions: Quality.	Type of technology.

Cat*	Opportunities	Consequences	Causes
PPC	Development of a production control system.	Possibility of controlling production in a more precise manner. Impacted dimensions: HR, Time, Quality.	Lack of adequate production control.

* "Cat" – Category; T&D – Training and Development; PM – Project Management; TN – Technological Novelty; PPC – Planning and Production Control.

7.1. APPENDIX 7G: Risk Assessment in the Mapping Megaproject

Table 7.35 provides the risks, associated threats, and impacted dimensions.

Table 7.35 – Data matrix: risks, associated threats, and impacted dimensions.

Specific Risk	Associated Threat	Impacted Dimensions
Not knowing technology's potential and limitations.	Technological novelty	Time, Cost, HR, Risks
Absence of production parameters.	Process (design)	Time, Cost, HR
Radar imaging technology not tested.	Process (design)	Time, Cost, HR
Mistaken estimate of project necessities.	Process (design)	Time, Cost, HR
Making decisions without understanding impacts.	HR (High management decision-making)	Time, Cost
Executing actions without considering risks.	Process (execution)	Time, Cost, Risks
Unrealistic expectations from senior management.	HR (decision making)	HR (Organizational culture)
Catastrophic risks in the project.	Process (capacity)	Time, Cost, HR, Image
Mistaken estimate of project size.	Process (capacity)	Time, Cost, HR
Not precisely knowing project bottlenecks.	Process (execution)	Technology
Lack of risk mapping.	Process (design)	Time, Cost
Risk events with unknown impacts.	HR (security)	Risks
Imprecise planning.	Process (design)	Time, Cost
Imprecise workload division.	Process (execution)	Time, Cost
Not defining technological processes.	Process (design)	Innovation
Increasing inconsistencies among products.	Process (design)	Quality
Absence of risk consideration.	HR (decision-making)	Time, Cost
International incident risk.	Political (international)	Legal, Process, HR, Technology
Technological interruptions.	Technical	Process, HR, Technology
Meteorological issues.	Environmental	Process, HR, Technology
Infrastructure issues.	Infrastructure	Process, HR, Technology
Flaws in project execution.	Process (capacity)	Legal, Political, Social, Quality
Project unsuccess.	Political (image)	Trust, Image, Quality
Product not meeting requirements.	Process (quality)	Quality
Not meeting project timelines.	Process (capacity)	Time, Cost, HR
Not delivering contracted final products.	Legal (Future legal action)	Legal
Poor project design.	Process (capacity)	Time, Cost, HR
Continuity of work after contract closure.	Economic (budgetary)	Time, Cost, HR
Project impacting institutional image.	Political (image)	Trust, Image
Lack of partnership trust.	Political (image)	Trust, Image
Decrease of society's trust.	Social (lack of trust)	Trust, Image
Delivery of inferior quality product.	Process (quality)	Quality
Difficulties in carrying out new projects.	Political (image)	Trust, Image
Loss of trust in the institution.	Political (image), Social (lack of trust)	Trust, Image
Product cannot be used for its intended purpose.	Technology (Technological interruption)	Quality
Not delivering contracted products.	Legal (Future legal action)	Trust, Image
Not following financial goals.	Process (capacity)	Time, Cost
Excessive technological management flexibility.	Process (design)	Innovation
Inadequate workload division.	Process (execution)	Time, Cost
Lack of technological process standards.	Process (design)	Quality

Specific Risk	Associated Threat	Impacted Dimensions
Flaws in risk management.	HR (organizational culture)	Time, Cost, Risks
Legal action due to poor execution.	Legal (Future legal action)	Legal
Lack of processed technological information.	Technology (availability of data)	Time, Cost, Innovation
Absence of a database from previous projects.	Technology (lack of processed information)	Time, Cost
Lack of effective communication.	HR (communication)	Trust, Image
Technological interruptions.	Technology (Technological novelty)	Process, Time, Quality
Unrealistic expectations from management.	HR (decision making)	HR (Organizational culture)
Environmental challenges.	Environmental (meteorological)	Process, Time, HR
Product fails to meet intended quality.	Process (quality)	Quality
Timeline-exceeding project closing.	Process (capacity)	Time, Cost, HR
Juridical insecurity.	Legal (Future legal action)	Trust, Image, Legal
Lack of a risk mapping culture.	HR (organizational culture)	Risks, Time, Cost
Going through risk events with unknown impact.	HR (security)	Risks
Poor employee capability.	HR (training and development)	HR
Political issues impacting project execution.	Political (international)	Legal, Process, HR, Technology
Technological interruptions affecting operations.	Technology (availability of systems)	Process, Time, Quality
Infrastructure issues causing delays.	Infrastructure	Process, Time
Insufficient technological process standards.	Process (design)	Quality
Flawed project execution, impacting reputation.	Political (image)	Trust, Image
Delivery of inferior quality products.	Process (quality)	Quality
Poor partnership relations.	Political (image)	Trust, Image
Loss of trust in the institution.	Social (lack of trust)	Trust, Image
Loss of institutional credibility.	Political (image)	Trust, Image
Product not meeting intended purpose.	Technology (Technological interruption)	Quality
Excessive reliance on novelty technology.	Technological novelty	Process, Time
Failure to deliver contracted final products.	Legal (Future legal action)	Trust, Legal, Image
Unrealistic workload estimation.	Process (execution)	Time, Cost
Ineffective decision-making due to poor training.	HR (decision making)	Time, Cost
Absence of risk consideration in decision-making.	HR (decision making)	Time, Cost
Not adhering to financial and timeline goals.	Process (capacity)	Time, Cost
Errors in project capacity estimation.	Process (capacity)	Time, Cost, HR
Unrealistic expectations due to lack of risk mapping.	HR (organizational culture)	Time, Cost
Process management risks.	Process (design)	Time, Cost, Quality
Flaws in the design process.	Process (design)	Time, Cost, HR
Lack of coordination and communication.	HR (communication)	Time, Cost, Trust
Environmental factors impacting the project.	Environmental (meteorological)	Process, Quality, HR
Technological interruption.	Technology (availability of data)	Time, Cost, Quality
Inadequate HR management.	HR (succession planning)	Time, Cost
Failure in employee training and development.	HR (training and development)	Time, Cost, HR
Lack of succession planning.	HR (succession planning)	HR
Issues in recruitment and selection.	HR (recruitment and selection)	HR
Political instability impacting projects.	Political (international)	Legal, Process, Technology, HR
Technological issues affecting project operations.	Technology (technological interruptions)	Process, Quality, Time
Inaccurate workload assessment.	Process (execution)	Time, Cost
Misestimation of project size.	Process (capacity)	Time, Cost, HR
Unrealistic financial and timeline expectations.	Process (capacity)	Time, Cost
Absence of data integrity and availability.	Technology (system development)	Time, Cost, Quality
Excessive flexibility in technological management.	Process (design)	Innovation
Flawed project execution, harming the institution's image.	Political (image)	Trust, Image
Misaligned product standards.	Process (quality)	Quality
Failure to assess technological potential.	Technology (technological novelty)	Time, Cost, Quality

Specific Risk	Associated Threat	Impacted Dimensions
Unclear decision-making processes.	HR (decision making)	Time, Cost
Technological risks from novelty technology.	Technology (technological novelty)	Time, Cost, Quality, Risks
Ineffective project governance.	HR (organizational culture, decision-making)	Time, Cost, Risks
Legal complications due to project failures.	Legal (future legal action)	Time, Cost, Image, Trust
Lack of coordination among team members.	HR (communication)	Time, Cost, Trust
Failure to adequately plan for risks.	HR (organizational culture)	Time, Cost, Risks
Environmental disruptions to project timelines.	Environmental (meteorological)	Time, Cost
Lack of process standardization.	Process (design)	Quality
Political image risks from project failure.	Political (image)	Trust, Image
Over-reliance on under-tested technologies.	Technology (technological interruptions)	Time, Cost, Quality
Difficulty in workforce planning.	HR (succession planning, training)	HR
Inconsistent project goals.	Process (execution)	Time, Cost
Challenges in infrastructure.	Infrastructure	Time, Cost, Process
Flawed risk management.	HR (organizational culture)	Risks
Not delivering products with intended purpose.	Process (quality)	Quality
Lack of trust from stakeholders.	Political (image), Social (lack of trust)	Trust, Image

8. ARTICLE 7: WHAT DID WE LEARN FROM RESEARCHING URGENT PROJECTS? A GUIDE TO ASSIST PROJECT MANAGERS IN TIME-SENSITIVE PROJECTS

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Abstract:

The project management literature features “conventional” methods such as Waterfall and Agile (e.g., Scrum). There is a dearth of research on projects that require rapid and immediate action, high-intensity teamwork, high project velocity, and extremely urgent deadlines. This article addresses this problem based on the database obtained from the Systematic Literature Review of Chapter 3 (Article 2), from which the main scientific documents on urgent project management were gathered and synthesized. From what we learned from this research, we developed a more pragmatic framework to guide the implementation and management of highly urgent projects. To do this, we present 140 principles and practical implications categorized into 18 themes. They include financial aspects, stakeholder involvement and communication, time, resources, risks, uncertainty, knowledge management, adaptability, leadership, and organizational change, among others. This document gives managers a guide to increase their ability to deliver highly time-critical projects.

Keywords: Urgent Projects; Time-Sensitive Projects; Agile Projects; Agile Mindset; Emergency Project; Project Management; Time Management

Article 7

What did we learn from researching urgent projects? A guide to assist project managers in time-sensitive projects

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Abstract: The project management literature features "conventional" methods such as Waterfall and Agile (e.g., Scrum). There is a dearth of research on projects that require rapid and immediate action, high-intensity teamwork, high project velocity, and extremely urgent deadlines. This article addresses this problem based on the database obtained from the Systematic Literature Review of Chapter 3 (Article 2), from which the main scientific documents on urgent project management were gathered and synthesized. From what we learned from this research, we developed a more pragmatic framework to guide the implementation and management of highly urgent projects. To do this, we present 140 principles and practical implications categorized into 18 themes. They include financial aspects, stakeholder involvement and communication, time, resources, risks, uncertainty, knowledge management, adaptability, leadership, and organizational change, among others. This document gives managers a guide to increase their ability to deliver highly time-critical projects.

Keywords: Urgent Projects; Time-Sensitive Projects; Agile Projects; Agile Mindset; Emergency Project; Project Management; Time Management

8.1. INTRODUCTION

Conventional project management strategies have limitations when applied to projects necessitating urgent completion (Nachbagauer, 2022; Zidane et al., 2018). Time-sensitive projects, such as emergency responses or infrastructure restoration (Mojtahedi and Oo, 2017; Sun and Xu, 2011), demand distinctive management approaches. Highly urgent projects often require superfast decision-making (da Penha et al., 2024; Geraldi et al., 2010; Yan et al., 2009; Zidane et al., 2018), accelerated execution and delivery (da Penha et al., 2024; Yan et al., 2009; Zidane et al., 2018), and adaptive and flexible approaches (Lechler and Grace, 2007; Mojtahedi and Oo, 2017; Nachbagauer, 2022; Zidane et al., 2018), which Waterfall and Agile methods, may not fully support.

Some urgent projects need to manage external time pressures and demands (da Penha et al., 2024; Lechler and Grace, 2007; Zidane et al., 2018), where events and tasks are defined autonomously within the project, allowing greater flexibility and coordination in uncertain and fast-paced environments (Nachbagauer, 2022). For example, there are challenges in managing innovative and urgent projects (da Penha et al., 2024), where the need for quick completion may conflict with the creative and innovative processes typically encouraged in less time-sensitive projects (Lechler and Grace, 2007). Moreover, conventional frameworks typically do not account for the unique challenges presented by projects under extreme time pressure, such as those seen in emergency response (Campbell et al., 2021; da Penha et al., 2024; Sun and Xu, 2011; Yan et al., 2009).

In general, the literature on project management starts from the premise that it is crucial to carry out complete planning. However, it often ignores the need for rapid decision-making with the rapid mobilization of resources, as presented by some authors (Campbell et al., 2021; Lechler and Grace, 2007; Yan et al., 2009; Zidane et al., 2018) in response to emerging and crucial situations. This gap is evident in urgent projects where

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standard procedures might not apply effectively. The urgency and unpredictability that characterizes some of these projects (Wearne, 2006; Wearne and White-Hunt, 2014) require skills that, although addressed in traditional project management structures, have never been combined in a single structure. There is a demand for studies investigating how management principles can be adapted to urgent contexts without sacrificing aspects such as quality control and communication with stakeholders. Such research can provide practical perspectives into the adaptability and applicability of project management approaches in scenarios where time is a crucial factor and conventional methodologies may not be sufficient (da Penha et al., 2024; Lechler and Grace, 2007; Nachbagauer, 2022; Zidane et al., 2018).

From this, the following research question was identified: *What approach would project managers use to handle urgent projects with tight deadlines at project phases?* This article is based on the systematic literature review database (Article 2, Chapter 3) on urgent project management. We aim to develop an approach to managing projects under severe time constraints. Therefore, we compiled, concisely and non-exhaustively, themes, principles, concepts, and practical implications relevant to these projects' management.

The definition of "urgent project" varies across contexts (De Waard and Kalkman, 2022; Wearne and White-Hunt, 2014; Zidane et al., 2018). Therefore, no pre-defined practices or procedures will be recommended. The content presented here is aimed at professionals working in project management. However, this work exists as an approach that can be applied to truly urgent projects. The development of such strategies/tactics contributes to the field of project management by offering project managers a theoretically sound and pragmatic toolkit for handling projects with tight deadlines.

This toolkit can be used when facing a *true sense of urgency* (Kotter, 2008); it is vital for managing a really urgent project because it fosters a collective mindset and behavior that prioritize immediate, focused action on crucial issues (da Penha and ten Caten, 2023b). According to Kotter (2008), this type of urgency involves a deep, emotional commitment to winning and achieving results. It propels individuals and teams to move quickly, look for opportunities, anticipate problems, and work on solutions daily without succumbing to complacency or the distractions of non-essential activities (Kotter, 2008). Therefore, providing practices based on evidence obtained from the literature offers project managers practical guidance that can be applied in project management in sectors and industries where the *real sense of urgency* is a critical factor and have "a gut-level determination to move, and win, now" (Kotter, 2008).

In the next section, we explore the nuanced definitions of "urgent" across different contexts and the definition of "urgent project." In section three, we present the literature review approach to gather the documents and the thematic analysis approach to develop a framework for managing urgent projects. In section four, the paper introduces the Framework for Managing Urgent Projects, incorporating 141 principles covering project management phases. The conclusion section highlights practical applications and areas for future investigation.

8.2. THEORETICAL BACKGROUND

The term "urgent" is described in dictionaries as meaning something important/necessary that requires some immediate attention (Cambridge Dictionary, 2020; Collins Dictionary, 2022; Oxford University Press, 2021c). Although its core understanding is unambiguous, there are differences between British and American English. British usage highlights earnestness and persistence (Collins Dictionary, 2022), while American English features haste and insistence (Collins Dictionary, 2022). The term "urgent" uses the concepts of importance and necessity (Cambridge Dictionary, 2020; Collins Dictionary, 2022; Oxford University Press, 2021c), suggesting that urgent matters are crucial (da Penha and ten Caten, 2023b). Although the strict definition contemplates immediacy in practical use, the term "urgent" can imply an action that needs to be very brief but not necessarily instantaneous (Collins Dictionary, 2022), allowing flexibility of

action based on each context. Furthermore, urgency exists (can be perceived) at different levels, increasing the importance of differentiating and prioritizing tasks/actions based on their degree of real urgency (da Penha and ten Caten, 2023a; De Waard and Kalkman, 2022; Wearne and White-Hunt, 2014). In general, the term "urgent" is characterized by temporal sensitivity, cruciality (importance and necessity), priority, and speed (da Penha and ten Caten, 2023b).

The definition of an "urgent project" encompasses varying interpretations across different contexts and scenarios, such as: (i) *infrastructure failure*, e.g., power supply restoration (Wearne and White-Hunt, 2014, p. 145); (ii) *infectious diseases*, such as a pandemics in the context of construction (Chen et al., 2021; Luo et al., 2020) or healthcare (da Penha et al., 2024; Maleka and Matli, 2022); and (iii) *natural disasters*, e.g., ice disasters (Wang et al., 2019), floods (Wearne and White-Hunt, 2014, p. 115), and forest fires (Laneve et al., 2016). While dictionary definitions associate "urgent" with importance and immediate attention, in the project management context, the term specifically pertains to projects marked by critical importance and high uncertainty.

This conceptual disparity between project management dictionaries and scenarios suggests the need for a more unified understanding, which aligns practical and technical perception in a domain we call urgent project management. Generally, really/highly urgent projects require a super-fast response to achieve goals or deliver results (da Penha et al., 2024; Wearne, 2006; Wearne and White-Hunt, 2014; Zidane et al., 2018). Challenges in managing such projects include improvisation (De Waard and Kalkman, 2022; Geraldi et al., 2010; Nachbagauer, 2022), stakeholder management (Mojtahedi and Oo, 2017; Zidane et al., 2018), and team dynamics (Geraldi et al., 2010; Wearne, 2006; Wearne and White-Hunt, 2014). Therefore, an urgent project's time-sensitive nature demands immediate attention, quick decision-making, and coordinated efforts to meet demands and deliver lightning-fast results (da Penha and ten Caten, 2023b).

Although the term is used without a technical definition (De Waard and Kalkman, 2022; Zidane et al., 2018), some really urgent projects are understood as High-Intensity and Time-Sensitive (da Penha and ten Caten, 2023a). This understanding characterizes projects that require truly immediate action due to their nature, for example, in emergencies, disaster responses, or pandemics. Furthermore, urgency can be used as a management decision in which "maximum" speed and "minimum" duration are (intentionally) prioritized (da Penha and ten Caten, 2023a; Wearne and White-Hunt, 2014). Projects like this are characterized by intensified urgency, complex management of actions, and very specialized approaches. It is possible to note that the level of urgency influences managerial decision-making in these scenarios (da Penha and ten Caten, 2023a; Mojtahedi and Oo, 2017), affecting decisions related to speed (Nachbagauer, 2022; Zidane et al., 2018), project duration (Nachbagauer, 2022; Wearne, 2006), and costs (Wearne and White-Hunt, 2014; Zidane et al., 2018), as described by da Penha and ten Caten (2023a).

Despite having no consensus on the urgent project definition in the management domain (Zidane et al., 2018), and despite some authors (Nachbagauer, 2022; Wearne and White-Hunt, 2014) having discussed the subjective nature and social construction of urgency, there is a relevant documentation on the theme. The term "urgent" can be subject to varying interpretations depending on the individual authors' perspective and the nuances of everyday language (da Penha and ten Caten, 2023b). Quick action is often understood as a defining characteristic of urgent projects (Nachbagauer, 2022; Wearne, 2006; Wearne and White-Hunt, 2014).

8.3. MATERIALS AND METHODS

This article section outlines the methodological approach to developing the framework for managing urgent projects. Obtaining the database from the Systematic Literature Review can be seen in the steps presented in Article 2, Chapter 3. Here, we summarize this process inspired by the synthesis steps provided by De Waard and Kalkman (2022). As far as this article is concerned, data extraction to identify a checklist

of principles involved inductive coding, from which data was systematically identified and extracted to develop descriptions and management principles (Xiao and Watson, 2019). This made it easier to analyze information. This process allowed the categorization into themes and the identification of codified principles. The synthesis of the framework on highly urgent project management is structured around areas of knowledge (themes) that allowed the organization of the codified literature. As the objective of this article is to develop a complete guide to help with the management of urgent projects, we preferred articles that dealt with the topic in more depth or provided valuable interpretations/insights. A simplified theoretical framework was created that offers a scientific perspective for future analysis and research in this field (Xiao and Watson, 2019).

The categories of principles are separated into parts to facilitate understanding of the extensive volume of information in the URGENT Framework, in its 140 principles. Because the principles are relevant at different phases of the project lifecycle, by separating them into parts, the framework can address specific needs and considerations for each phase. This separation makes it easier for project managers to apply the principles in practice, by allowing a more logical, step-by-step approach.

8.4. FRAMEWORK FOR MANAGING URGENT PROJECTS

As a result of the interpretation described previously, the Urgent Project Management Framework, or simply "URGENT Framework," offers a guide for highly urgent project implementation scenarios that are characterized by high temporal sensitivity, cruciality, priority, and speed. The principles listed here address specific aspects of the management of these projects. The structure provides a comprehensive, therefore high-level, vision to guide projects with critical deadlines; however, without delving into the specifics of each principle, it must be analyzed according to the application scenario.

Figure 8.17 presents this simplified structure in graphic form, presenting the guide around the phases of the project life cycle. It highlights specific areas of each phase. The framework clarifies that some principles are relevant at all project phases (e.g., agile decision-making, risk management). On the other hand, other principles are more relevant for fewer phases (e.g., financial assessment in the pre-project phase). This simplified image, combined with the principle names in checklist form, was designed as a faster, easier way to help managers consider the essential aspects of a high-velocity project.

To develop a framework that was illustratively easy to use, the themes were grouped into 7 (seven) main categories: (i) Urgent Project Essentials; (ii) Resource and Financial Management; (iii) Time and Speed Management; (iv) Agility, Risk, and Adaptability; (v) Leadership and Team Management; (vi) Knowledge, Information, and Organizational Management; and (vii) Performance Management and Organizational Learning.

Table 8.65 (Appendix 8B) provides these categories in more detail, presenting themes and abbreviations with detailed descriptions and some dilemmas that may be relevant.

The URGENT Framework was created to be flexible and adaptable to the needs and constraints of different urgent project contexts. A list of 140 principles is presented, each aligned with the phases of project management, from conceptualization to post-project analysis. Each principle is presented with its brief description. Each table presents publications of the main articles and books that inspired each concept. Practical implications accompany each principle. Results are presented in phases of the project life cycle to meet the need for rapid progression through these stages.

URGENT PROJECT MANAGEMENT FRAMEWORK

	PRE-PROJECT	INITIATION AND PLANNING	EXECUTION AND M&C	ALL PHASES	CLOSING AND POST-PROJECT
01 URGENT PROJECT ESSENTIALS **Context and Urgency Analysis** **Project Foundations** **Stakeholder, Comm., and Collab.**	**Context and Urgency Analysis** - Categorize context for response - Prioritize rapid actions - Enacting Urgency	**Context and Urgency Analysis** - Defining Urgency - Balanced Urgency and Schedule **Project Foundations** - Clear Project Definition - Scope by priority - Leadership-Guided Authoriz. - Objectives early with stakehol. - Implied Commitment - Scope Selective Fulfillment **Stakeholder, Comm., and Collab.** - Early Engagement - Trust and Relationship Build. - Rapid Consensus Building - Network Connections - Stak. Consensus, Participation, and Perceptions	**Stakeholder, Comm., and Collab.** - Stakeholder Involvement and Outcome Focus - Diverse Stakeholder Perspectives Evaluation	**Stakeholder, Comm., and Collab.** - Clarity in Communication - Transparent Communication - Comm. of Urg. and Timelines - Communication And Collab. - Stakeholder and Leadership Collaboration - Active Stakeholder Involvement and Feedback - Building Trust - Continuous Stak. Engagement	
02 RESOURCE AND FINANCIAL **Financial Assessment** **Resource Management and Allocation**	**Financial Assessment** - Feasibility Analysis - ROI-Focused Analysis - Urgency and Profitab. Assess. - Strategic Objective Definition through Financial Planning - Strategic Financial Prioritization	**Resource Management and Allocation** - Reallocation and Justification - Flexibility and Optimization - Real-Time Management - Profitability and Technical Success-Focused Resource Alloc.	**Resource Management and Allocation** - Resource Optimization for Time Efficiency - Resour. Reall. for Priority Teams. - Integ. Stak. and Resour. Manag. - Sustaining Urg. Amidst Competing Demands - Judicious Resource Reallocation		
03 TIME AND SPEED **Time and Speed Manag.** **Delivery Selection and Acceleration**		**Time and Speed Manag.** - Modularization - Temporal Opportunity Ident. - Schedule Compression - Contextual Urgency - Managing Project Rhythm **Delivery Selection and Acceleration** - Delivery Method Selection - Fast Project Delivery - Rapid Subcontractor Onboard. - Data-Driven Decision Making		**Time and Speed Manag.** - Active Timing Control - Adapt. Pace and Timing Interv. - Balancing Time Perspectives - Synchr. and Diachr. Coord. - Temporal Coordination - Temporal Flexibility - Temporal Structures - Temporal Tension Management - Logistics Coordination - Dynamic Urgency - Timing Speed	
04 AGILITY, RISK, AND ADAPTAB. **Agile Decision-Making** **Adaptability, Change, and Flexibility** **Risk and Uncertainty Management**		**Agile Decision-Making** - Proactive Decision-Making - Governmental Support in Process Acceleration - Competitive Acceleration - Time-cost Balance - Speed Management **Adaptability, Change, and Flexibility** - Adaptive Scope Management - Rapid Decis.-Mak. and Flexibil. - Expedited Assess. and prepar. - Preparatory Planning - Competitive Adaptation - Event-Driven Timing - Flexibility - Compet. Market Speed-to-Value **Risk and Uncertainty Management** - Proactive Risk Mitigation - Responsive Adaptation - Complexity Management - Risk Management		**Agile Decision-Making** - Complexity Awareness - Oral Commitments - Time-Constrained Dec. Making - Timing and Urg. Dec.-Making - Speed-Cost Balance Evaluation - Improvisation **Risk and Uncertainty Management** - Complexity Awareness - Agile Risk Management and Responsive Mitigation - Uncertainty Acceptance - Continuous Uncertainty and Risk Review	
05 LEADERSHIP AND TEAM **Team Dynamics** **Coordination** **Leadership** **Employee Engagement and Well-being**		**Team Dynamics** - Focus on Essential Tasks - Agile Temporary Team Form. - Trust - Leadership and Resource Preparedness	**Team Dynamics** - Team Formation - Immediate Evaluation of Temporary Team Effectiveness - Action-Oriented Commitment in Extreme Contexts - Impromptu Team Dynamics - Collab. Strength Integration - Collaborative Decision-Making and Adaptive Problem-Solving - Temporary Team Motivation - Specialized Team Time-Limit. - Time-Limited Focus **Coordination** - Centralized Coordination in Incident Management - Coordinated Multi-Operation Management	**Leadership** - Tech. and Leadership Skills - Experienced Leadership - Team-Centric Leadership - Leadership in Strat. Dec.-Making - Relaxed Management Style **Employee Engagement and Well-being** - Engaging Employ. Strat. Change - Well-being and Safety in Intensive Work Environm. **Coordination** - Flexible Coordination - Controlled Management and Documentation	
06 KNOWLEDGE, INFO., ORGAN. **Organizational Dynam.** **Info. Sys. and Knowledge Manag.**			**Organizational Dynam.** - Impact on the Organization - Perception of Success - Organizational Impact Assess.	**Info. Sys. and Knowledge Manag.** - Enhancing R&D Pers. Particip. - Comm. and IT in Know. Transf. - Reliable Information Systems - Organizational Culture - Knowledge Transfer in Temporary Project Structures - Urgency Impact on Inter-Project Comm. and Knowledge Transfer **Organizational Dynam.** - Continuous Top Manag. and Stak. Involvement - Concentration of Authority and Leadership - Resource Allocation - Adaptability and Flexibility - Continuous Complexity and Strategy Assessment - On-the-Job Learning and Return on Experience (RoE)	
07 PERFORMANCE AND ORGAN. **Performance, Assess., and Cont. Improvement** **Closure and Post-Project Analysis**			**Performance, Assess., and Cont. Improvement** - Benchmark Performance - Aligning Team Perceptions with Project Success Metrics - Monitoring and Controlling - Multi-Dimensional Goal Assess. - Interconnected Performance Criteria - Review and Validation		**Closure and Post-Project Analysis** - Post-Project Review of Comm. and Complexity - Cost Uncertainty Acceptance and Formalization - Document. of Lessons Learned - Post-Project Outcome Assess. - Timing, Pace, and Rhythm Eval. - Stakeholder Satisfaction and Market Impact - Uniform Technical Closure Practices

Figure 8.17 - Framework for Managing Urgent Projects across different phases.

In the subsequent tables, we present the framework for the management of urgent projects in the 18 themes: (i) Context and Urgency Analysis (Table 8.36 and Table 8.38); (ii) Financial Assessment (Table 8.37); (iii) Project Foundations (Table 8.39); (iv) Stakeholder, Communication, and Collaboration (Table 8.40, Table 8.53, and Table 8.60); (v) Time and Speed Management (Table 8.41 and Table 8.52); (vi) Agile Decision-Making (Table 8.42 and Table 8.50); (vii) Team Dynamics (Table 8.43 and Table 8.61); (viii) Delivery Selection and Acceleration (Table 8.44); (ix) Resource Management and Allocation (Table 8.45 and Table 8.57); (x) Risk and Uncertainty Management (Table 8.46 and Table 8.56); (xi) Adaptability, Change, and Flexibility (Table 8.47); (xii) Leadership (Table 8.48); (xiii) Employee Engagement and Well-being (Table 8.49); (xiv) Coordination (Table 8.51 and Table 8.59); (xv) Information Systems and Knowledge Management (Table 8.54); (xvi) Organizational Dynamics (Table 8.55 and Table 8.58); (xvii) Performance Monitoring, Assessment, and Continuous Improvement (Table 8.62); and (xviii) Post-Project Analysis and Closure (Table 8.63).

As the main objective is to help project management professionals, we proposed a second framework at the end of this thesis (Figure 9.19).

8.4.1. Pre-project Phase

This phase involves classifying the project context and identifying urgency factors (De Waard and Kalkman, 2022; Wearne, 2006), along with carrying out feasibility studies to assess demand, benefits, costs, and risks of the project, in addition to ROI and financial viability (Wearne and White-Hunt, 2014; Zidane et al., 2018) in commercial projects. It also involves prioritizing projects based on urgency and profitability (Aram and Javian, 1973; Zidane et al., 2018).

Next, we present the Principles of Context and Urgency Analysis and Financial Assessment. In urgent project management, a foundational phase involves Context and Urgency Analysis (Table 8.36). It focuses on identifying and understanding the context and causes of urgency in the project environment. The principles guide project managers in classifying and analyzing different urgent scenarios, such as emergencies, risks, and disruptions, as presented by De Waard and Kalkman (2022). Financial Assessment (Table 8.37) is a component that evaluates project feasibility and financial viability.

Table 8.36 - Principles of Context and Urgency Analysis.

	Principle	Description	Sources	Practical Implications	Phases
1	Contextual Categorization	Classifies extreme contexts as emergency, risky, or disrupted.	(De Waard and Kalkman, 2022)	Categorize context for response strategies.	Pre-Project
2	Context-Driven Urgency	Prioritize rapid actions for extremely urgent situations such as pandemics.	(da Penha et al., 2024; Yan et al., 2009; Zidane et al., 2018)	Prioritize rapid collaboration in emergent situations.	Pre-Project, Initiation
3	Urgency Causation Analysis	Analyze the causes of urgency, e.g., regulatory limits, environmental threats, or infrastructure failure.	(Sun and Xu, 2011; Wearne, 2006)	Identify and assess urgency factors to plan project response.	Pre-Project
		Identify external factors driving project urgency early.	(McDonough and Pearson, 1993; Wearne, 2006)	Identify urgency causes.	Pre-Project, Initiation, Planning
4	Enacting Urgency	Recognize urgency from the outset and set clear priorities and actions.	(Laneve et al., 2016; Maleka and Matli, 2022; Nachbagauer, 2022; Ren et al., 2018; Zidane et al., 2018)	Create a structure for recognizing and addressing immediate concerns.	Pre-Project, Initiation

Table 8.37 - Principles of Financial Assessment.

	Principle	Description	Sources	Practical Implications	Phases
1	General Feasibility Analysis	Initial assessments of demand, benefits, costs, uncertainties, and risks.	(Sun and Xu, 2011; Wearne and White-Hunt, 2014)	Implement structured evaluation of project aspects; conduct risk analysis.	Pre-project
		Stresses the need for quick and effective feasibility studies in project evaluation.	(Wearne, 2006; Zidane et al., 2018)	Conduct swift feasibility studies to determine project viability.	Pre-project
2	ROI-Focused Analysis	Focuses on financial evaluation, emphasizing ROI and financial viability.	(Xia and Chan, 2012; Zidane et al., 2018)	Conduct ROI analysis and continuous financial monitoring; assess cost-benefit regularly.	Pre-project, Planning
3	Strategic Objective Definition through Financial Planning	Highlights the importance of initial decision-making in defining project objectives and strategies.	(Tishler et al., 1996; Wearne and White-Hunt, 2014)	Allocate time and resources to initial planning; establish clear objectives.	Pre-project, Planning
4	Urgency and Profitability Assessment	Assesses a project's urgency and profitability to guide priority and technical decisions.	(Aram and Javian, 1973; Yan et al., 2009)	Assess urgency and profitability to determine project priority and technical approach.	Pre-project
5	Strategic Financial Prioritization	Categorizes projects based on strategic and financial criteria, impacting resource allocation and attention level.	(Bingham et al., 2018; Zidane et al., 2018)	Develop a framework for project evaluation and prioritization; monitor high-priority projects continuously.	Pre-project

8.4.2. Initiation and Planning Phases

In the initiation and planning phases, the principles of: Context and Urgency Analysis (Part 2); Project Foundations; Stakeholder, Communication, and Collaboration; Time and Speed Management; Agile Decision-Making; Team Dynamics; Delivery Selection and Acceleration; Resource Management and Allocation; Risk and Uncertainty Management; and Adaptability, Change, and Flexibility.

Table 8.38 - Principles of Context and Urgency Analysis (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Defining Urgency	Agree on what constitutes “urgent” in clear terms to guide decisions.	(Geraldi et al., 2010; McDonough and Pearson, 1993; Wearne and White-Hunt, 2014)	Define urgency levels and metrics with stakeholders.	Initiation, Planning
2	Balanced Urgency and Schedule	Balance project urgency with realistic schedules considering complexities.	(Chen et al., 2021; Lechler and Grace, 2007; Nachbagauer, 2022; Wang et al., 2019; Xia and Chan, 2012)	Develop realistic timelines considering project needs.	Planning, Execution

The second part of the "Principles of Context and Urgency Analysis" in Table 8.38 focuses on two core principles: "Defining Urgency" and "Balanced Urgency and Schedule." The balance between urgency and realistic scheduling could be a potential challenge.

The Project Foundations theme (Table 8.39) summarizes the fundamentals for a solid foundation in urgent scenarios. However, the "Implied Commitment" principle, advocating for early resource allocation, could be at odds with the "Clear Project Definition" principle, which focuses on a well-defined project scope. Zidane et al. (2018) suggested an alternative to this dilemma by operationalizing scope fragmentation in a large project. Likewise, accepting a resource commitment before formal authorization, as suggested in “Implicit Commitment,” appears to conflict with traditional planning and authorization processes.

Table 8.39 - Principles of Project Foundations.

	Principle	Description	Sources	Practical Implications	Phases
1	Clear Project Definition	Define project scope and plan unambiguously.	(Geraldi et al., 2010; Wearne and White-Hunt, 2014; Xia and Chan, 2012)	Create project documentation and cross-functional teams.	Initiation, Planning
2	Define the project scope by priority	Define the project scope by priority.	(Zidane et al., 2018)	Prioritize key elements in scope definition.	Initiation, Planning
3	Define project objectives early with stakeholders	Define project objectives early with stakeholders.	(Campbell et al., 2021; Chen et al., 2021; Lechler and Grace, 2007; Maleka and Matli, 2022, 2022; McDonough and Pearson, 1993; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Create a mutual agreement right from the beginning.	Initiation, Planning
4	Leadership-Guided Authorization	Ensure project authorization and maintain performance standards under leadership guidance.	(Laneve et al., 2016; Maleka and Matli, 2022; McDonough and Pearson, 1993; Wearne, 2006)	Secure project authorization; maintain standards.	Initiation
5	Implied Commitment	Allocate resources early, even before formal contracts, to enable early planning.	(Lechler and Grace, 2007; Yan et al., 2009; Zidane et al., 2018)	Identify the risks of early resource allocation.	Initiation, Planning
6	Scope Selective Fulfillment	Prioritize critical aspects of projects to meet key client expectations.	(Chen et al., 2021; Collyer et al., 2010; McDonough and Pearson, 1993; Zidane et al., 2018)	Deliver crucial project aspects, even if the scope is incomplete.	Initiation, Planning, Execution, Monitoring and Controlling

Table 8.40 - Principles of Stakeholder, Communication, and Collaboration.

	Principle	Description	Sources	Practical Implications	Phases
1	Early and Proactive Engagement	Use informal agreements to facilitate swift project progress.	(Mojtahedi and Oo, 2017; Ren et al., 2018; Zidane et al., 2018)	Leverage informal agreements for rapid progress.	Initiation, Planning
		Emphasize immediate action and cooperative efforts among stakeholders.	(da Penha et al., 2024; J. G. Geraldi et al., 2010; Lechler and Grace, 2007; Mojtahedi and Oo, 2017)	Foster rapid response mechanisms and collaboration.	
		Engage with University, Industry, Government, and Civil Society for support and resources.	(da Penha et al., 2024; Lechler and Grace, 2007; Mojtahedi and Oo, 2017)	Build bonds of trust to gain support and resources.	
2	Trust and Relationship Building	Use digital tools for stakeholder partnerships and trust-building.	(da Penha et al., 2024; Laneve et al., 2016; Maleka and Matli, 2022)	Integrate digital strategies for partnerships and execution. Assess the risks of using digital strategies, especially when there is sensitive data. Use transparently to enhance trust-building.	Initiation, Execution
		Evaluate management of unresolved stakeholder objectives in urgent projects.	(Campbell et al., 2021; Chen et al., 2021; Mojtahedi and Oo, 2017; Wearne and White-Hunt, 2014)	Focus on proactive stakeholder management.	Initial phases with a review in the Post-Project phase.

	Principle	Description	Sources	Practical Implications	Phases
3	Stakeholder Consensus, Participation, and Perceptions	Achieve clear, agreed-upon objectives among all stakeholders.	(Campbell et al., 2021; Chen et al., 2021; Laneve et al., 2016; Lechler and Grace, 2007; Mojtahedi and Oo, 2017; Tishler et al., 1996; Wang et al., 2019; Wearne and White-Hunt, 2014; Yan et al., 2009)	Secure consensus on project objectives.	Initiation, Planning
		Communicate to partnerships with stakeholders (e.g., University, Industry, Government, Army, Society).	(Crawford et al., 2013; da Penha et al., 2024; Gonçalves et al., 2023)	Be transparent; share knowledge.	Initiation, Planning, Execution
		Involve local communities and stakeholders.	(Campbell et al., 2021; Crawford et al., 2013; El-Anwar and Aziz, 2014; Laneve et al., 2016; Lechler and Grace, 2007; Mojtahedi and Oo, 2017, 2017)	Address stakeholder needs; maintain open communication.	Planning, Execution
		Consider stakeholder perceptions in project delivery method selection.	(Bingham et al., 2018; Campbell et al., 2021; Laneve et al., 2016; Lechler and Grace, 2007; Mojtahedi and Oo, 2017)	Incorporate stakeholder views in delivery method choices.	Planning, Execution
4	Rapid Consensus Building	Expedite consensus in urgent projects, especially for public safety.	(Laneve et al., 2016; Sun and Xu, 2011; Wang et al., 2019; Wearne and White-Hunt, 2014)	Simplify decision-making processes.	Planning, Execution
5	Network Connections	Strengthen network connections for effective knowledge transfer.	(Maleka and Matli, 2022; Nachbagauer, 2022; Ren et al., 2018; Sun et al., 2019; Wang et al., 2019)	Enhance communication channels and network ties.	Planning, Execution, Monitoring
		Increase communication frequency for stronger network connections.	(Campbell et al., 2021; Geraldi et al., 2010; Laneve et al., 2016; Lechler and Grace, 2007; Mojtahedi and Oo, 2017; Sun et al., 2019)	Prioritize regular, clear communication. Encourage documentation of communication whenever time permits.	Planning, Execution, Monitoring, Closure

The theme of Stakeholder, Communication, and Collaboration (Table 8.40) highlights five principles related to engagement, trust, participation, consensus, and network connections. The principles of "Early and Proactive Engagement" and "Rapid Consensus Building" suggest a rapid approach but may conflict with "Building Trust and Relationships" and "Network Connections."

Table 8.41 - Principles of Time and Speed Management.

	Principle	Description	Sources	Practical Implications	Phases
1	Modularization	Split complex projects into sub-projects for efficiency.	(Chen et al., 2021; de Waard et al., 2014; de Waard and Kramer, 2008; Laneve et al., 2016; Nachbagauer, 2022; Zidane et al., 2018)	Break down projects into manageable parts.	Planning, Execution
2	Temporal Opportunity Identification	Identify opportunities to manage project timelines within constraints.	(de Waard and Kramer, 2008; Laneve et al., 2016; Wang et al., 2019; Yan et al., 2009; Zidane et al., 2018)	Optimize project timelines proactively.	Planning, Execution
3	Contextual Urgency	Address specific urgencies such as time	(Campbell et al., 2021; Lechler and Grace, 2007; Wearne, 2006)	Tailor project plans to specific urgencies.	Planning, Execution

	Principle	Description	Sources	Practical Implications	Phases
		constraints or imminent risks.			
4	Schedule Compression	Prepare to compress project schedules for urgent demands.	(Maleka and Matli, 2022; Wang et al., 2019; Zidane et al., 2018)	Be ready to adjust schedules as needed.	Planning, Execution
5	Managing Project Rhythm	Manage the rhythm and pace of project activities based on urgency.	(Chen et al., 2021; Lechler and Grace, 2007; Nachbagauer, 2022)	Adapt to project pacing and rhythm needs.	Planning, Execution

Time and Speed Management (Table 8.41) addresses issues relevant to project implementation, such as modularization, possible temporal opportunities, understanding the specific urgencies of each context, schedule compression, and project rhythm management. There may be conflict in projects that allow modularization, dividing into smaller projects, and "Schedule Compression," which focuses exclusively on accelerating the project schedule. Although modularization aims for division, an overall accelerated schedule would remain challenging with a modular, multi-project approach.

Table 8.42 - Principles of Agile Decision-Making.

	Principle	Description	Sources	Practical Implications	Phases
1	Proactive Decision-Making	Make proactive decisions for urgent project execution.	(Chen et al., 2021; Geraldi et al., 2010; Maleka and Matli, 2022; Zidane et al., 2018)	Utilize non-traditional execution methods for time savings.	Planning, Execution
2	Governmental Support in Process Acceleration	Expedite processes, such as customs clearance, with governmental support.	(Chen et al., 2021; da Penha et al., 2024; Sun and Xu, 2011; Zidane et al., 2018)	Utilize governmental support for process acceleration.	Planning, Execution
3	Competitive Acceleration	Fast-track projects considering market demands and competitive speed.	(Lechler and Grace, 2007; McDonough and Pearson, 1993; Zidane et al., 2018)	Prioritize activities for Competitive project acceleration.	Planning, Execution, Monitoring and Controlling
4	Time-cost Balance	Balance additional costs with time savings in expedited project delivery.	(Lechler and Grace, 2007, 2007; Zidane et al., 2018)	Evaluate cost-time trade-offs in project decisions.	Planning, Execution
5	Speed Management	Implement strategies to optimize project speed.	(Azeem et al., 2022; De Waard and Kalkman, 2022; Fredberg and Pregmark, 2022; Lu et al., 2022; McDonough and Pearson, 1993; Mohammadi and Tavakolan, 2019; Nachbagauer, 2022; Wang et al., 2016; Wang et al., 2019; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Optimize project delivery speed without compromising outcomes.	Planning, Execution, Monitoring and Controlling

The Agile Decision-Making theme (Table 8.42) diverges conceptually from the Time and Speed Management principles by focusing on aspects more in line with the decision-making structure. One such decision-making example involves balancing the additional costs with the benefits of reduced time. Note that the nature of the agility varies depending on the principle. The "Competitive Acceleration" principle suggests agility in response to market forces; "Government Support in Process Acceleration" suggests external resources and government support to increase agility. There may be another dilemma between the possibility of government support and proactive decision-making, one being external and the other internal to the project.

Table 8.43 - Principles of Team Dynamics.

	Principle	Description	Sources	Practical Implications	Phases
1	Focus on Essential Tasks	Identify urgent work early and focus resources on essential tasks.	(Campbell et al., 2021; Chen et al., 2021; Geraldi et al., 2010; Laneve et al., 2016; Tishler et al., 1996; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Form rapid teams; simplify procedures.	Initial phases and throughout the project lifecycle, with ongoing reassessments.
2	Agile Temporary Team Formation	Form quick response and dedicated temporary teams for urgent needs.	(Lechler and Grace, 2007; Maleka and Matli, 2022; Ren et al., 2018; Wearne, 2006)	Select skilled team members; grant decision-making authority.	Planning, Execution
3	Trust	Establish trust for knowledge sharing in temporary teams.	(Laneve et al., 2016; Lechler and Grace, 2007; Sun et al., 2019)	Develop trust-building strategies.	Initiation, Planning, Execution
4	Leadership and Resource Preparedness	Prepare resources and empower leaders.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Wang et al., 2019; Wearne and White-Hunt, 2014)	Empower competent leaders; prepare resources.	Planning, Execution

"Team Dynamics" (Table 8.43) lists the principles inherent in a work team, revolving around operational issues to initiate, focus, and manage project teams under urgent conditions. Note that there is a challenge that leadership can face between the rapid formation of teams and the need for team members to trust each other. Rapid team formation (in "Agile Formation of Temporary Teams") does not always allow enough time to establish deep trust (as described in "Trust").

The theme "Selection and Delivery Acceleration" (Table 8.44) covers data-based decision-making approaches, evaluating criteria such as urgency, cost, risk, and complexity of the project, seeking rapid subcontracting and delivery. The first three principles emphasize a more systematic and analytical approach. However, "rapid subcontractor onboarding" highlights the speed of operationalizing project initiation, highlighting the need for much faster decision processes, and could conflict with the analytical assessment proposed in first principles.

The theme of "Resource Management and Allocation" involves practicalities of reallocation and justified use of resources, Flexibility and Optimization, Profitability and focus on Technical Success (which is not always aligned with the principle of resource efficiency), and real-time management. "Resource Reallocation and Justification" may conflict with the adaptive approach suggested by the "Resource Flexibility and Optimization principle," perhaps regarding planned and responsive resource management.

"Risk and Uncertainty Management" (Table 8.46) brings together principles ranging from conventional "risk management" to principles focused on proactivity and responsive adaptation, in addition to responsive adaptation to manage complexities in projects. Note that while "Proactive Risk Mitigation" suggests early identification and strategizing against potential risks, "Responsive Adaptation" is a principle that may require a more reactive approach. This combination of proactiveness and responsiveness can potentially conflict with structured risk management approaches, which traditionally involve predefined planning and contingency plans.

The theme "Adaptability, Change and Flexibility" includes principles highlighting rapid decision-making, rapid assessment, flexible planning and competitive adaptation to technological and market changes. Note that the "Accelerated Assessment and Preparation" principle emphasizes determining the project's urgency aimed at rapid decision-making and reducing the preparatory phase, which may be difficult to achieve simultaneously if there is a thorough approach in "Preparatory Planning."

Table 8.44 - Principles of Delivery Selection and Acceleration.

	Principle	Description	Sources	Practical Implications	Phases
1	Delivery Method Selection	Statistically justify the project delivery method selection.	(Bingham et al., 2018; Chen et al., 2021; Wang et al., 2019)	Use data analysis for delivery method decisions.	Planning
		Evaluate multiple criteria for delivery method selection.	(Bingham et al., 2018; Xia and Chan, 2012)	Assess criteria for appropriate delivery method choice.	Planning
		Select delivery methods based on urgency, cost, and risk.	(Bingham et al., 2018; Zidane et al., 2018)	Align delivery method with project demands.	Planning
		Align methods with project urgency and complexity.	(Campbell et al., 2021; Chen et al., 2021; Lechler and Grace, 2007; Xia and Chan, 2012)	Adapt methods and resources for project complexity.	Planning, Execution
2	Data-Driven Decision Making	Base decisions on accurate data analysis and analytics.	(Campbell et al., 2021; Laneve et al., 2016, 2016; Sun and Xu, 2011)	Ensures objective and accurate decision-making and prioritizes efforts based on data.	Planning, Monitoring
3	Fast Project Delivery	Optimize slum upgrading projects for urgent delivery.	(El-Anwar and Aziz, 2014)	Estimate costs; prioritize urgent tasks; communicate with residents.	Planning, Execution
4	Rapid Subcontractor Onboarding	Quickly mobilize subcontractors for urgent project needs.	(Campbell et al., 2021; Lechler and Grace, 2007; Yan et al., 2009; Zidane et al., 2018)	Expedite subcontractor selection and mobilization.	Planning, Execution

Table 8.45 - Principles of Resource Management and Allocation.

	Principle	Description	Sources	Practical Implications	Phases
1	Resource Reallocation and Justification	Plan resource allocation understanding its impact on other areas.	(Campbell et al., 2021; Chen et al., 2021; Geraldi et al., 2010; Wearne, 2006; Yan et al., 2009; Zidane et al., 2018)	Justify resource reallocation at project onset.	Initiation, Planning
2	Resource Flexibility and Optimization	Optimize labor, materials, and financial resources.	(Chen et al., 2021; El-Anwar and Aziz, 2014; Laneve et al., 2016; Zidane et al., 2018)	Implement resource management tools and techniques.	Planning, Execution
		Use resources efficiently and adapt quickly to project needs.	(Lechler and Grace, 2007; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Adapt management style; use resources efficiently.	All phases, with emphasis on initial phases.
3	Profitability and Technical Success-Focused Resource Allocation	Guide resource allocation based on potential profitability and technical success.	(Aram and Javian, 1973; Maleka and Matli, 2022; Tishler et al., 1996; Wang et al., 2019; Zidane et al., 2018)	Prioritize tasks that contribute to technical success and profitability.	Planning, Execution
4	Real-Time Management of Resource Diversion	Manage resource allocation in real time.	(Chen et al., 2021; Laneve et al., 2016; Wearne, 2006; Yan et al., 2009)	Assess and adjust resource allocation dynamically.	Planning, Execution, Monitoring and Controlling

Table 8.46 - Principles of Risk and Uncertainty Management.

	Principle	Description	Sources	Practical Implications	Phases
1	Proactive Risk Mitigation	Identify and strategize to mitigate potential risks early.	(Campbell et al., 2021; El-Anwar and Aziz, 2014; Geraldi et al., 2010; Gonçalves et al., 2023; Mojtahedi and Oo, 2017; Yan et al., 2009)	Conduct risk management and mitigation.	Planning, Execution, Monitoring
2	Risk Management	Integrate rapid and comprehensive risk assessment techniques.	(Chen et al., 2021; Geraldi et al., 2010; Gonçalves et al., 2023; McDonough and Pearson, 1993; Popa et al., 2011; Ren et al., 2018; Wearne and White-Hunt, 2014)	Focus on analyzing known and unknown risks.	Planning, Execution
		Manage and mitigate risks.	(Gonçalves et al., 2023; McDonough and Pearson, 1993; Sun and Xu, 2011)	Implement risk management and contingency plans.	Planning, Execution, Monitoring and Controlling
3	Responsive Adaptation	Adapt to unexpected urgent projects due to new opportunities or threats.	(Gonçalves et al., 2023; A. Nachbagauer, 2022; van den Ende, 2003; Wearne, 2006; Yan et al., 2009; Zidane et al., 2018)	Develop contingency plans; evaluate and accept cost risks.	Planning, Execution, Monitoring and Controlling
4	Complexity Management	Address key complexity factors in projects.	(Lechler and Grace, 2007; Wang et al., 2019; Xia and Chan, 2012)	Conduct risk assessment and response planning.	Planning, Execution

Table 8.47 - Principles of Adaptability, Change, and Flexibility.

	Principle	Description	Sources	Practical Implications	Phases
1	Adaptive Scope Management	Be flexible and responsive to evolving project scopes.	(Lechler and Grace, 2007; Nachbagauer, 2022; Sun and Xu, 2011; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Revise and adapt project plans as needed.	Planning, Execution
2	Rapid Decision-Making and Flexibility	Emphasizes agility and quick decision-making based on an adaptive and autonomous approach.	(Campbell et al., 2021; Chen et al., 2021; De Waard and Kalkman, 2022; de Waard and Kramer, 2008; Mojtahedi and Oo, 2017; Zidane et al., 2018)	Implement rapid mobilization protocols; prioritize key components; establish fast and efficient decision-making.	Initial phases
		Emphasize quick, adaptable decision-making.	(Campbell et al., 2021; Geraldi et al., 2010)	Enables quick adaptation to changing circumstances, efficient use of resources.	Planning, Execution
3	Expedited Assessment and preparation	Quickly determine project urgency for effective decision-making.	(Chen et al., 2021; Laneve et al., 2016; McDonough and Pearson, 1993; Nachbagauer, 2022; Sun and Xu, 2011; Wearne and White-Hunt, 2014)	Adapt and expedite assessment protocols.	Planning
		Shorten the project's preparatory phase for urgent deadlines.	(Geraldi et al., 2010; Maleka and Matli, 2022; McDonough and Pearson, 1993; Sun and Xu, 2011; Wang et al., 2019; Zidane et al., 2018)	Streamline planning; ensure rapid resource mobilization.	Planning
4	Preparatory Planning	Prioritize preparatory planning in temporary organizations post-disasters.	(Campbell et al., 2021; Crawford et al., 2013; De Waard and Kalkman, 2022; de Waard and Kramer, 2008; Laneve et al., 2016; Mojtahedi and Oo, 2017; Ren et al., 2018; van den Ende, 2003)	Develop flexible contingency plans; conduct regular training.	Planning
5	Competitive Adaptation	Adapt projects to Competitive shifts such as market and technological changes.	(Chen et al., 2021; McDonough and Pearson, 1993; van den Ende, 2003; Wang et al., 2019; Yan et al., 2009; Zidane et al., 2018)	Adopt flexible project management frameworks.	Planning, Execution

	Principle	Description	Sources	Practical Implications	Phases
6	Event-Driven Timing	Prioritize flexibility in urgent situations, focusing on event-driven progression.	(Campbell et al., 2021; Maleka and Matli, 2022; Nachbagauer, 2022; Popa et al., 2011; Sun and Xu, 2011)	Design adaptable project plans; train teams for flexibility.	Planning, Execution
7	Flexibility	Implement adaptable strategies for changing project challenges.	(Campbell et al., 2021; Chen et al., 2021; De Waard and Kalkman, 2022; El-Anwar and Aziz, 2014; Geraldi et al., 2010; Laneve et al., 2016; Maleka and Matli, 2022; Zidane et al., 2018)	Develop and adjust contingency plans regularly.	Planning, Execution, Monitoring
8	Competitive Market Speed-to-Value	Deliver projects faster to create value in competitive markets.	(Lechler and Grace, 2007; Zidane et al., 2018)	Use rapid execution as a competitive advantage.	Planning, Execution

8.4.3. All Phases

In urgent project management, leadership, employees, agile decision-making, coordination, time and speed management, stakeholders, knowledge, information systems, organizational dynamics, and risks and uncertainties are highly relevant in all project phases.

Table 8.48 - Principles of Leadership.

	Principle	Description	Sources	Practical Implications	Phases
1	Technical and Leadership Skill Integration	Blend technical skills with leadership abilities.	(Campbell et al., 2021; Chen et al., 2021; De Waard and Kalkman, 2022; McDonough and Pearson, 1993; Mojtahedi and Oo, 2017; Sun and Xu, 2011; Tishler et al., 1996)	Develop technical and soft skills.	All phases
2	Experienced Leadership	Employ experienced leadership for strategic planning and forecasting.	(McDonough and Pearson, 1993; Urrea and Yoo, 2023; van den Ende, 2003; Zidane et al., 2018)	Prioritize experienced leaders.	All phases
3	Team-Centric Leadership	Lead with a dedicated team; focus on teamwork and communication.	(Geraldi et al., 2010; Nachbagauer, 2022; Wearne and White-Hunt, 2014)	Build dedicated teams; enhance team building.	All phases
4	Leadership in Strategic Decision-Making	Guide strategic decisions and change through strong leadership.	(De Waard and Kalkman, 2022; Hensmans, 2015; Zidane et al., 2018)	Lead decisively in change management.	All phases
5	Relaxed Management Style	Balance urgency with patience in managing projects, waiting for the right action moments.	(Kotter, 2008; Nachbagauer, 2022)	Consider taking breaks to gather information.	All phases

Table 8.48 cites possible principles, such as combining leadership skills with technical knowledge, emphasizes the need for experienced leaders to deal with the urgency of the project, team-centered approaches (which aligns with other principles that highlight adaptability and flexibility), strategic decision-making and a balanced management style, which combines real urgency with moments of patience. "Experienced Leadership" and "Leadership in Strategic Decision Making" emphasize competence, experience, and strong leadership, hence a top-down approach to leadership. "Team-Centered Leadership" and the "Relaxed Management Style" suggest a more patient, balanced, and measured approach.

The theme Employee Engagement and Well-being lists the intentional involvement of employees in strategic changes and the prioritization of their well-being in intense work environments. Note that there is a trade-off between the need for rapid changes and employee involvement and the need to ensure their well-being. Sometimes, extremely

rapid strategic or operational changes can ignore employee well-being due to high time pressures, creating an apparent conflict between organizational objectives and employee health and safety.

Table 8.49 - Principles of Employee Engagement and Well-being.

	Principle	Description	Sources	Practical Implications	Phases
1	Engaging Employees in Strategic Change	Foster employee involvement in strategic changes.	(Campbell et al., 2021; Hensmans, 2015; Laneve et al., 2016; Ren et al., 2018; Sun et al., 2019)	Create a collaborative environment for change initiatives.	All Phases
2	Employee Well-being and Safety in Intensive Work Environments	Address workforce issues from intensive schedules and safety concerns.	(Zidane et al., 2018)	Balance cost-cutting with employee well-being and safety.	All Phases

Table 8.50 - Principles of Agile Decision-Making (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Frequent and Immediate Decision-Making	Conduct frequent meetings for instant decision-making in projects such as emergency repairs.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Wearne and White-Hunt, 2014; Yan et al., 2009)	Organize regular meetings for agile decision-making.	All phases
2	Oral Commitments and Decision-Making	Rely on oral commitments for swift decision-making.	(Geraldi et al., 2010; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Make quick decisions through verbal agreements.	All phases
3	Time-Constrained Decision Making	Streamline decision-making under time constraints, such as selecting contractors quickly.	(Maleka and Matli, 2022; Nachbagauer, 2022; Sun and Xu, 2011; Wang et al., 2019; Yan et al., 2009; Zidane et al., 2018)	Make quick decisions under time pressure.	All phases
4	Timing and Urgency Decision-Making	Decide on urgency and importance in alignment with organizational criteria.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Nachbagauer, 2022; Tishler et al., 1996; Zidane et al., 2018)	Align with organizational urgency criteria.	All phases
5	Speed-Cost Balance Evaluation	Assess trade-offs between project speed and costs.	(Laneve et al., 2016; Sun et al., 2019; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Evaluate speed-cost balance post-project.	All phases
6	Improvisation	Use improvisation in fragmented and urgent situations for project momentum.	(Campbell et al., 2021; Mojtahedi and Oo, 2017; Nachbagauer, 2022; Zidane et al., 2018)	Encourage quick decision-making and improvisation.	All phases

The theme "Agile Decision Making" in Table 8.50 covers principles about making decisions more frequently and quickly through regular meetings, oral commitments (without documentation) for speed, time-constrained decision making, under pressure, based on urgency and timing criteria, assessment of trade-offs between project speed and cost, and, finally, improvisation to gain momentum in fragmented projects. The “Oral Commitments” principle suggests informal management, which may contradict a more structured approach suggested in the “Speed-Cost Balance Assessment.”

Table 8.51 - Principles of Coordination.

	Principle	Description	Sources	Practical Implications	Phases
1	Flexible Coordination	Use flexible coordination in projects for fast response.	(de Waard and Kramer, 2008; Lechler and Grace, 2007; Maleka and Matli, 2022; Nachbagauer, 2022; Zidane et al., 2018)	Apply an adaptive approach to execution.	All phases
2	Controlled Management and Documentation	Regulate changes and documents, even in urgent projects.	(Sun et al., 2019; Wearne and White-Hunt, 2014; Yim et al., 2015; Zidane et al., 2018)	Direct and control project management.	All phases

The principles related to project coordination (Table 8.51) illustrate the need to balance flexibility and control, suggesting that, in these cases, projects can adapt to changes while adopting a structured approach to management and documentation.

Table 8.52 - Principles of Time and Speed Management (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Active Timing Control	Proactively manage the timing of tasks and decisions, independent of external time-setting.	(Campbell et al., 2021; Nachbagauer, 2022; Yan et al., 2009; Zidane et al., 2018)	Optimize task scheduling and time management.	All phases
2	Adaptive Pace and Timing Intervention	Monitor project pace and adjust timing as needed to maintain urgency.	(Campbell et al., 2021; Geraldi et al., 2010; Lechler and Grace, 2007; Nachbagauer, 2022; Zidane et al., 2018)	Intervene with timing adjustments when necessary.	All phases
3	Balancing Time Perspectives	Balance immediate actions with strategic patience, considering timing importance.	(Laneve et al., 2016; Nachbagauer, 2022)	Employ strategies for immediate and patient actions.	All phases
4	Synchronous and Diachronic Coordination	Coordinate project activities concurrently and sequentially for effective timing.	(Lechler and Grace, 2007; McDonough and Pearson, 1993; Nachbagauer, 2022)	Ensure effective coordination of project activities.	All phases
5	Temporal Coordination	Manage timing and synchronization of project elements.	(Maleka and Matli, 2022; Nachbagauer, 2022; Zidane et al., 2018)	Handle project timing and synchronization.	All phases
6	Temporal Flexibility	Be flexible in operations, aligning with event time rather than clock time.	(Geraldi et al., 2010; Nachbagauer, 2022; Wang et al., 2019)	Implement flexible and responsive strategies.	All phases
7	Temporal Structures	Maintain consistent rhythms and coordinate activities considering timing aspects.	(Campbell et al., 2021; Nachbagauer, 2022; Xia and Chan, 2012)	Establish consistent project rhythms.	All phases
8	Temporal Tension Management	Address arising temporal tensions without losing project momentum.	(Lechler and Grace, 2007; Nachbagauer, 2022; Sun and Xu, 2011; Zidane et al., 2018)	Develop strategies for managing temporal tensions.	All phases
		Balance long-term planning with the immediacy of urgent tasks, managing temporal challenges.	(Chen et al., 2021; Nachbagauer, 2022; Ren et al., 2018; Zidane et al., 2018)	Balance strategic vision with immediate demands.	All phases
9	Logistics Coordination	Effectively plan and execute logistics to avoid delays.	(da Penha et al., 2024; Maleka and Matli, 2022; Sun and Xu, 2011; Wang et al., 2019)	Focus on efficient logistics and risk management.	All phases
10	Dynamic Urgency	Recognize and adapt to the changing urgency of tasks and objectives.	(De Waard and Kalkman, 2022; Leung et al., 2016; Musca et al., 2014)	Respond dynamically to shifting priorities and urgencies.	All phases
11	Timing Speed	Optimize the speed of decision-making and action-taking within the project scope.	(McDonough and Pearson, 1993; Nachbagauer, 2022)	Enhance the efficiency and responsiveness of project execution.	All phases

This theme (Table 8.52) outlines time and speed management principles in urgent project management, detailing their descriptions, sources, and practical implications. It highlights the importance of proactive, flexible, and dynamic interventions to optimize project outcomes.

Table 8.53 highlights clarity, transparency, and building trust in communications, involving stakeholders in decision-making processes, and maintaining involvement in the project.

Table 8.54 lists the Principles of Information Systems and Knowledge Management. Although some principles focus on human elements and culture in knowledge sharing,

others emphasize information systems, making the balance between human and technological aspects evident. The challenge is to balance the immediacy of the project's urgent demands with the need to transfer knowledge and maintain the information system, depending on the level of urgency.

Table 8.53 - Principles of Stakeholder, Communication, and Collaboration (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Clarity in Communication	Prioritize clarity in communication for technical success.	(Aram and Javian, 1973; Geraldi et al., 2010; Maleka and Matli, 2022; McDonough and Pearson, 1993; Nachbagauer, 2022)	Use clear communication to improve outcomes.	All Phases
		Ensure clear and regular communication within and between teams and stakeholders.	(Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Nachbagauer, 2022; Wearne and White-Hunt, 2014)	Foster transparent team and stakeholder communication.	All Phases
		Start high-complexity projects with clear, direct communication strategies.	(Aram and Javian, 1973; Geraldi et al., 2010; Lechler and Grace, 2007; Maleka and Matli, 2022; Mojtahedi and Oo, 2017)	Initiate with direct communication for clarity.	All Phases
2	Transparent Communication	Maintain transparent communication with all stakeholders.	(da Penha et al., 2024; Geraldi et al., 2010; Maleka and Matli, 2022; McDonough and Pearson, 1993; Yan et al., 2009)	Increase engagement and collaboration.	All Phases
3	Communication of Urgency and Timelines	Communicate project urgency and timelines to stakeholders.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Nachbagauer, 2022; Yan et al., 2009; Zidane et al., 2018)	Update stakeholders on timelines regularly.	All Phases
4	Communication and Collaboration	Ensure effective communication and collaboration among diverse teams and stakeholders.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Nachbagauer, 2022; Sun et al., 2019)	Facilitates understanding, aligns goals, and mobilizes resources.	All Phases
5	Stakeholder and Leadership Collaboration	Establish a system for stakeholder and leadership collaboration.	(Geraldi et al., 2010; Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Wang et al., 2019; Wearne and White-Hunt, 2014)	Improve decision-making and closure processes.	All Phases
6	Active Stakeholder Involvement and Feedback	Understand and involve diverse stakeholders, managing evolving relationships.	(Maleka and Matli, 2022; McDonough and Pearson, 1993; Ren et al., 2018; Wearne and White-Hunt, 2014; Yan et al., 2009)	Involve stakeholders as team members.	All Phases
		Involve stakeholders in decision-making processes for scope, resources, and risks.	(Campbell et al., 2021; Chen et al., 2021; Laneve et al., 2016; Lechler and Grace, 2007; Maleka and Matli, 2022; McDonough and Pearson, 1993; Mojtahedi and Oo, 2017; Wearne and White-Hunt, 2014; Yan et al., 2009; Zidane et al., 2018)	Encourage stakeholder involvement in project decisions.	All Phases
		Involve stakeholders actively and establish quick feedback mechanisms for responsiveness.	(Collyer et al., 2010; da Penha et al., 2024; Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Nachbagauer, 2022; Yan et al., 2009)	Inspire stakeholder buy-in, accelerate problem resolution, and improve project adaptability.	All Phases
7	Building Trust	Build trust with stakeholders through prompt and reliable communication.	(da Penha et al., 2024; Maleka and Matli, 2022; Nachbagauer, 2022; Tishler et al., 1996; Wearne, 2006; Yan et al., 2009)	Foster trust and adaptability in stakeholder engagement.	All Phases
8	Continuous Stakeholder Engagement	Maintain continuous engagement with unchanged stakeholders and sponsors.	(Geraldi et al., 2010; Maleka and Matli, 2022; Wearne and White-Hunt, 2014; Yan et al., 2009)	Safeguard consistent stakeholder and sponsor involvement.	All Phases

Table 8.54 - Principles of Information Systems and Knowledge Management.

	Principle	Description	Sources	Practical Implications	Phases
1	Enhancing R&D Personnel Participation	Encourage active involvement of R&D personnel.	(Aram and Javian, 1973; Laneve et al., 2016; Mojtahedi and Oo, 2017; Tishler et al., 1996; Yan et al., 2009)	Increase engagement of R&D staff.	All phases
2	Communication and IT in Effective Knowledge Transfer	Utilize communication and IT for efficient knowledge transfer.	(Geraldi et al., 2010; Laneve et al., 2016; Ren et al., 2018)	Improve communication and IT for knowledge sharing.	All phases
3	Reliable Information Systems	Implement and maintain robust and secure information systems.	(Laneve et al., 2016; Maleka and Matli, 2022; Nachbagauer, 2022; Sun and Xu, 2011; Sun et al., 2019; Wang et al., 2019; Wearne and White-Hunt, 2014)	Focus on information system maintenance.	All phases
4	Organizational Culture	Promote a culture supportive of knowledge sharing.	(McDonough and Pearson, 1993; Ren et al., 2018)	Cultivate a knowledge-transfer culture.	All phases
5	Knowledge Transfer in Temporary Project Structures	Maintain knowledge-sharing practices in short-term projects.	(Campbell et al., 2021; Laneve et al., 2016; McDonough and Pearson, 1993; Sun et al., 2019; Yan et al., 2009)	Keep robust knowledge-sharing in all projects.	All phases
6	Urgency Impact on Inter-Project Communication and Knowledge Transfer	Use IT to mitigate the negative impact of urgency on communication and knowledge transfer.	(Geraldi et al., 2010; Laneve et al., 2016; Ren et al., 2018; van den Ende, 2003; Zidane et al., 2018)	Leverage IT to support communication in urgent projects.	All phases

Table 8.55 - Principles of Organizational Dynamics.

	Principle	Description	Sources	Practical Implications	Phases
1	Continuous Top Management and Stakeholder Involvement	Involve top management and stakeholders continuously for effective action and cost agreement.	(Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Regularly involve top management and stakeholders.	All phases
2	Concentration of Authority and Leadership	Manage urgent projects with focused authority and leadership.	(Lechler and Grace, 2007; Tishler et al., 1996; Wearne and White-Hunt, 2014)	Employ a distinct approach to leadership and authority.	All phases
3	Resource Allocation	Justify diverting resources to urgent projects considering overall organizational commitments.	(Popa et al., 2011; van den Ende, 2003; Wearne, 2006; Zidane et al., 2018)	Balance urgent project needs with organizational commitments.	All phases
4	Adaptability and Flexibility	Adapt effectively in extreme situations with transparent governance and rapid decision-making.	(De Waard and Kalkman, 2022; Geraldi et al., 2010; Maleka and Matli, 2022; McDonough and Pearson, 1993; Nachbagauer, 2022)	Develop adaptive governance and decision-making approaches.	All phases
		Be adaptable to the dynamic nature of urgent projects.	(Maleka and Matli, 2022; Sun and Xu, 2011; Zidane et al., 2018)	Embrace flexible management styles.	All phases
5	Continuous Complexity and Strategy Assessment	Regularly assess project complexity and adjust strategies accordingly.	(De Waard and Kalkman, 2022; Lechler and Grace, 2007; Xia and Chan, 2012; Zidane et al., 2018)	Respond flexibly to evolving scenarios.	All phases
6	On-the-Job Learning and Return on Experience (RoE)	Emphasize continuous learning from past experiences to inform future operations.	(De Waard and Kalkman, 2022; Geraldi et al., 2010; Ren et al., 2018; Urrea and Yoo, 2023)	Encourage learning and adaptation based on experience.	All phases

The principles presented in Table 8.55 suggest Continuous Top Management and Stakeholder Involvement, Concentration of Authority and Leadership, Resource

Allocation, Adaptability and Flexibility, Continuous Complexity and Strategy Assessment, and On-the-Job Learning and Return on Experience (RoE). There is a potential tension between continually involving top management and stakeholders, which might slow down decision-making.

Table 8.56 - Principles of Risk and Uncertainty Management (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Complexity Awareness	Address complexity factors in risk management for urgent projects.	(De Waard and Kalkman, 2022; Lechler and Grace, 2007; Xia and Chan, 2012)	Identify and mitigate risks related to project complexity.	All phases
2	Agile Risk Management and Responsive Mitigation	Identify risks early and respond with agile approaches for mitigation.	(da Penha et al., 2024; Gonçalves et al., 2023; Maleka and Matli, 2022; Mojtahedi and Oo, 2017)	Prioritize continuous risk assessment and adaptation.	All phases
3	Uncertainty Acceptance	Embrace uncertainty for practical project speed management and time-to-market planning.	(Geraldi et al., 2010; Gonçalves et al., 2023; McDonough and Pearson, 1993; Tishler et al., 1996; Zidane et al., 2018)	Plan for uncertainties with adaptable strategies.	All phases
4	Continuous Uncertainty and Risk Review	Make decisive decisions amidst project uncertainties and risks.	(Gonçalves et al., 2023; Maleka and Matli, 2022; van den Ende, 2003; Wearne and White-Hunt, 2014; Yim et al., 2015; Zidane et al., 2018)	Implement risk management strategies.	All phases

Table 8.56 lists the principles: Complexity Awareness, Agile Risk Management and Responsive Mitigation, Uncertainty Acceptance, and Continuous Uncertainty and Risk Review. "Agile Risk Management and Responsive Mitigation" and "Complexity Awareness" focus on early identification and understanding of risks. "Acceptance of uncertainty" suggests a broader embrace of uncertainty, suggesting a more flexible approach depending on the project's urgency level or context.

8.4.4. Execution and Monitoring and Controlling Phases

These major phases include Principles of Resource Management and Allocation; Organizational Dynamics; Coordination; Stakeholder, Communication, and Collaboration; Team Dynamics; and Performance Monitoring, Assessment, and Continuous Improvement.

Table 8.57 presents the principles: Resource Optimization for Time Efficiency; Resource Reallocation for Priority Teams; Integrated Stakeholder and Resource Management; Sustaining Urgency Amidst Competing Demands; and Judicious Resource Relocation.

The "Principles of Organizational Dynamics" in Table 8.58 focus on evaluating the impact of urgent projects on the organization. These principles record the need to balance the project's urgency with maintaining the integrity and coherence of the organizational structure and culture. Note that “Impact on Organization” shows the possibility of broader organizational impact. At the same time, “Perception of Success” focuses on team management's psychological and perceptual aspects.

Coordination (Table 8.59) focuses on two principles: Centralized Coordination in Incident Management and Coordinated Multi-operational Management. They offer different approaches. One suggests centralized directive control. The other highlights cases in which projects are fragmented into multiple subprojects, with more flexible and adaptive supervision for each operation. Therefore, the theme balances structured command and adaptive multi-operation management applied to urgent projects.

Table 8.57 - Principles of Resource Management and Allocation (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Resource Optimization for Time Efficiency	Optimize resources for time efficiency, such as sourcing equipment from other projects.	(Maleka and Matli, 2022; Popa et al., 2011; Yan et al., 2009; Zidane et al., 2018)	Reallocate resources efficiently for urgent execution.	Execution
2	Resource Reallocation for Priority Teams	Allocate resources to priority teams, even if it means diverting from other commitments.	(Chen et al., 2021; Wearne, 2006; Zidane et al., 2018)	Assess and justify resource reallocation for priority teams.	Execution
3	Integrated Stakeholder and Resource Management	Balance stakeholder concerns with resource management.	(Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Wearne and White-Hunt, 2014)	Integrate stakeholder feedback in resource optimization.	Monitoring and Controlling
4	Sustaining Urgency Amidst Competing Demands	Manage urgency in projects despite competing resource demands.	(Chen et al., 2021; Geraldi et al., 2010; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Strategically allocate resources to maintain urgency.	Monitoring and Controlling
5	Judicious Resource Reallocation	Monitor resource reallocation impact on other projects.	(Laneve et al., 2016; Nachbagauer, 2022; Wearne, 2006)	Evaluate ongoing urgency and adjust resource allocation.	Monitoring and Controlling

Table 8.58 - Principles of Organizational Dynamics (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Impact on the Organization	Assess the effect of urgent projects and team structures on the overall organization.	(Campbell et al., 2021; Geraldi et al., 2010; Maleka and Matli, 2022; Wearne, 2006)	Monitor the organizational impact of temporary team structures.	Execution, Monitoring and Controlling, Post-Project
2	Perception of Success	Align team perceptions with project priorities for time and technical success.	(Aram and Javian, 1973; Maleka and Matli, 2022; Ren et al., 2018)	Manage team views on project priorities and urgency.	Execution, Monitoring and Controlling
3	Organizational Impact Assessment	Consider the immediate impacts of urgent projects and team structures on the organization.	(Campbell et al., 2021; Geraldi et al., 2010; Maleka and Matli, 2022; Wearne, 2006)	Assess and monitor organizational impact during the project.	Execution, Monitoring and Controlling

Table 8.59 - Principles of Coordination (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Centralized Coordination in Incident Management	Use centralized coordination, such as an incident manager.	(Campbell et al., 2021; Sun and Xu, 2011; Wearne and White-Hunt, 2014)	Implement centralized management for complex situations.	Execution, Monitoring and Controlling
2	Coordinated Multi-Operation Management	Manage multiple operations simultaneously with coordination and adaptability.	(Campbell et al., 2021; Wearne and White-Hunt, 2014)	Oversee multiple operations with effective coordination.	Execution, Monitoring and Controlling

Table 8.60 - Principles of Stakeholder, Communication, and Collaboration (Part 3).

	Principle	Description	Sources	Practical Implications	Phases
1	Stakeholder Involvement and Outcome Focus	Involve stakeholders from the project at the start for successful outcomes.	(Maleka and Matli, 2022; Mojtahedi and Oo, 2017; Zidane et al., 2018)	Engage stakeholders early for alignment and support.	Monitoring and Controlling
2	Diverse Stakeholder Perspectives Evaluation	Consider varied stakeholder evaluations of project efficiency.	(Lechler and Grace, 2007; Tishler et al., 1996; Zidane et al., 2018)	Address diverse stakeholder perspectives in evaluations.	Monitoring and Controlling

As described in Table 8.60, the principles focus on stakeholder engagement but differ in their approach. The first prioritizes engagement for alignment and support, while the second suggests that diverse stakeholder points of view should be considered in the evaluation process.

Table 8.61 - Principles of Team Dynamics (Part 2).

	Principle	Description	Sources	Practical Implications	Phases
1	Team Formation	Quickly form specialized teams to address specific project needs in urgent situations.	(Lechler and Grace, 2007; Nachbagauer, 2022; Wearne and White-Hunt, 2014; Zidane et al., 2018)	Mobilize specialized teams rapidly for urgent requirements.	Execution
		Form full-time, dedicated teams to meet urgent needs.	(Lechler and Grace, 2007; Wearne, 2006)	Assemble teams with expertise and decision-making authority.	Execution
2	Immediate Evaluation of Temporary Team Effectiveness	Monitor the effectiveness and motivation of temporary teams during urgent tasks.	(Lechler and Grace, 2007; Urrea and Yoo, 2023; Wearne, 2006; Yan et al., 2009)	Evaluate temporary team performance during the project.	Execution, Monitoring and Controlling
3	Action-Oriented Commitment in Extreme Contexts	Foster deep, action-oriented commitment in teams for effective functioning in extreme contexts.	(De Waard and Kalkman, 2022; Geraldi et al., 2010; Lechler and Grace, 2007)	Encourage strong team commitment in challenging projects.	Execution, Monitoring and Controlling
4	Impromptu Team Dynamics	Support organic team formation and improvisation in response to disruptions.	(De Waard and Kalkman, 2022; Maleka and Matli, 2022; Tishler et al., 1996)	Encourage spontaneous team formation in disruptive contexts.	Execution, Monitoring and Controlling
5	Collaborative Strength Integration	Combine individual team strengths to develop shared objectives and encourage diverse ideas.	(Wearne and White-Hunt, 2014)	Nurture team collaboration and utilize individual strengths.	Execution, Monitoring and Controlling
6	Collaborative Decision-Making and Adaptive Problem-Solving	Involve team members in decision-making and problem-solving, especially in unexpected demands.	(Campbell et al., 2021; Mojtahedi and Oo, 2017; Wearne, 2006)	Adopt cooperative problem-solving and decision-making.	Execution, Monitoring and Controlling
7	Temporary Team Motivation	Monitor the motivation of temporary teams, especially if their task extends beyond initial expectations.	(Wearne, 2006)	Keep temporary teams motivated and focused on urgent tasks.	Execution
8	Specialized Team Time-Limitation	Limit the duration of specialized teams to maintain focus and prevent disruption.	(Wearne, 2006)	Set clear time frames and plan for team reintegration.	Execution
9	Time-Limited Focus	Keep specialized teams' focus sharp and time-limited to maintain effectiveness.	(Wearne, 2006)	Define clear time boundaries for specialized teams.	Execution

The "Principles of Team Dynamics" is presented in Table 8.61. The need to quickly form teams to address urgent situations can conflict with the need for practical, comprehensive team management and thorough evaluation.

Table 8.62 - Principles of Perf. Monitoring, Assessment, and Continuous Improvement.

	Principle	Description	Sources	Practical Implications	Phases
1	Benchmark Performance	Benchmark performance in dynamic, uncertain projects.	(Collyer et al., 2010; Lechler and Grace, 2007; Sun and Xu, 2011; Xia and Chan, 2012)	Use benchmarks flexibly in evolving projects.	Monitoring and Controlling
2	Aligning Team Perceptions with Project Success Metrics	Align team perceptions with project priority and success metrics.	(Aram and Javian, 1973; Geraldi et al., 2010)	Continuously align team views with project goals.	Monitoring and Controlling, but should be considered throughout the project lifecycle.
3	Monitoring and Controlling	Implement stringent monitoring for urgent projects.	(Bingham et al., 2018; Lechler and Grace, 2007; Zidane et al., 2018)	Enhance monitoring and control processes.	Monitoring and Controlling
4	Multi-Dimensional Goal Assessment	Use a balanced scorecard approach for disaster management performance.	(De Waard and Kalkman, 2022; Laneve et al., 2016)	Adopt comprehensive monitoring across sub-goals.	Monitoring and Controlling
5	Interconnected Performance Criteria	Understand how performance in one area affects others.	(De Waard and Kalkman, 2022; Wang et al., 2019)	Use integrated monitoring for interdependent goals.	Monitoring and Controlling
6	Review and Validation	Adapt to feedback for regulatory compliance and technical specifications in production.	(Chen et al., 2021; Collyer et al., 2010; da Penha et al., 2024; Sun et al., 2019)	Align production with market and regulatory requirements.	Execution, Monitoring and Controlling

The "Principles of Performance Monitoring, Assessment, and Continuous Improvement" focus on dynamic and adaptive strategies for project performance. Contradictions arise from the tension between the need for stability (e.g., benchmarking, team perception alignment, monitoring) and adaptability in complex project environments (e.g., continuous improvement, holistic goal assessment).

8.4.5. Closing and Post-Project Phases

The closing phase involves delivering to the client, obtaining stakeholder approval to close the project, and conducting a post-project evaluation. After formal project closure, the post-project phase includes post-implementation reviews, impact assessments to evaluate project results against expected benefits, and the possibility of capturing lessons for future projects.

Table 8.63 - Principles of Closure and Post-Project Analysis.

	Principle	Description	Sources	Practical Implications	Phases
1	Post-Project Review of Communication and Complexity	Analyze the impact of communication and complexity on project success.	(Aram and Javian, 1973; Geraldi et al., 2010; Xia and Chan, 2012)	Review communication strategies and project complexity post-project.	Closing and post-project
2	Cost Uncertainty Acceptance and Formalization	Accept and formalize cost uncertainty in urgent projects.	(Wearne and White-Hunt, 2014; Zidane et al., 2018)	Document and understand cost variations during closure.	Closing and post-project

	Principle	Description	Sources	Practical Implications	Phases
3	Documentation of Lessons Learned	Document critical decisions and lessons from unexpected, urgent projects.	(Geraldi et al., 2010; Lechler and Grace, 2007; Ren et al., 2018; Wearne, 2006)	Create a repository for lessons learned and share insights.	Closing and post-project
4	Post-Project Outcome Assessment	Evaluate both positive and negative outcomes of project delivery.	(Campbell et al., 2021; Mojtahedi and Oo, 2017; Zidane et al., 2018)	Conduct a comprehensive evaluation and analyze the consequences.	Closing and post-project
5	Timing, Pace, and Rhythm Evaluation	Evaluate timing, pace, and rhythm. Reflect on the timing and impact of urgency on outcomes.	(Lechler and Grace, 2007; Nachbagauer, 2022)	Reflect on and document project timing and pace.	Closing and post-project
6	Stakeholder Satisfaction and Market Impact	Assess stakeholder satisfaction and the project's market impact.	(Mojtahedi and Oo, 2017; Ren et al., 2018; Zidane et al., 2018)	Measure and share market penetration and stakeholder satisfaction.	Closing and post-project
7	Uniform Technical Closure Practices	Maintain consistent technical closure practices in urgent projects.	(Sun and Xu, 2011; Wearne and White-Hunt, 2014)	Apply uniform technical review processes during closure.	Closing and post-project

The principles outlined in Table 8.63, relating to Closure and Post-Project Analysis, include the analysis of communication and project complexity (Principle 1), formalization of cost uncertainty (Principle 2), documentation of lessons learned (Principle 3), and the assessment of Stakeholder Satisfaction and Market Impact (Principle 6), for example. Note that although the principles highlight the need for structured, predictable closure practices, there is a need to accept uncertainties in handling project aftermath. This contradiction highlights the tension between a need for order and predictability, and the reality of inherent uncertainties in highly urgent projects.

8.5. PARTIAL CONCLUSIONS

This chapter presents a practical approach for project managers in handling time-sensitive projects. A framework with principles explicitly designed to meet the requirements of these projects is proposed. It lists 140 principles, such as rapid team mobilization, direct and rapid communication, proactive risk management and flexibility in decision-making and resource allocation. These principles are categorized into 18 themes related to managing urgent projects, ranging from urgency identification and response to closure and post-project analysis.

This guide also provides a relevant document for management researchers. This is because it contributes to the body of knowledge in urgent project management, helping to bring together a basis of principles for future research and the curricular development of project professionals, therefore equipping future managers with the knowledge to deal with urgent projects.

Some industries, such as technology, construction, and manufacturing, also benefit from this framework, especially in expected urgent projects. Principles focused on rapid decision-making, rapid risk management and mitigation, and adaptability are particularly relevant in these fast-paced sectors. Therefore, companies can combine these principles in their specific approaches to improve their ability to respond quickly to market demands and technological advances.

The Urgent Project Management Framework can be combined with the real urgency behavior tips presented by Kotter (2008) at an individual level.

Finally, the practical implications of this chapter are very broad, from the short to the long term, offering a structured framework for the management of truly urgent projects. This research contributes to the field of managing urgent projects characterized by high velocity, significant risks, and intense demands on resources and decision-making. The Urgent Project Management Framework introduces an approach that fills a gap in existing

literature focused primarily on traditional project management methods. Furthermore, the framework's thematic organization helps managers quickly identify and apply relevant principles based on the phases of their projects, improving the structure's usability.

8.7.1. Potential Areas for Future Research

Future research could focus on: (i) applying the framework to truly urgent projects, collecting data on results, challenges, and improvements; (ii) exploring how different organizational structures, cultural norms, and management practices affect the implementation of the principles listed in this research; and (iii) investigate how short-term decisions on urgent projects affect short- and long-term success.

This article presents a framework that assumes that various aspects of project management can coexist. However, there may be inconsistencies in how this framework can be adapted to different sizes and types of projects. Urgent projects range from small-scale, localized efforts to large, complex initiatives. The adaptability of the framework to these varied contexts needs to be addressed in future research.

An emphasis on rapid execution and decision-making on urgent projects can conflict with maintaining quality. This balance is critical but can be challenging to achieve. Future research could explore how to manage this balance in specific sectors.

The framework may present inconsistencies when applied to specific scenarios, as each type of urgent project may have unique characteristics and requirements. Therefore, as highlighted by the Contextualization and Urgency Analysis principles, responses must be adapted to each context.

Future research could focus on testing these principles in practice to establish their effectiveness and make necessary adjustments.

8.6. APPENDIX 8A: Principles and Their Alignment with Urgent Project Phases

The table presents the data matrix with 141 principles within 18 themes' and phases' abbreviations.

Table 8.64 - Data matrix relating each principle to their urgent project phases.

#	Theme	Principle	Pre-P	Init	Plan	Exec	M&C	Close	Post-P
1	TSM	Timing Speed	x	x	x	x	x	x	x
2	TSM	Temporal Tension Management	x	x	x	x	x	x	x
3	TSM	Temporal Structures	x	x	x	x	x	x	x
4	TSM	Temporal Flexibility	x	x	x	x	x	x	x
5	TSM	Temporal Coordination	x	x	x	x	x	x	x
6	TSM	Synchronous and Diachronic Coordination	x	x	x	x	x	x	x
7	TSM	Schedule Compression			x	x			
8	TSM	Temporal Opportunity Identification			x	x			
9	TSM	Modularization			x	x			
10	TSM	Managing Project Rhythm			x	x			
11	TSM	Logistics Coordination	x	x	x	x	x	x	x
12	TSM	Dynamic Urgency	x	x	x	x	x	x	x
13	TSM	Contextual Urgency			x	x			
14	TSM	Balancing Time Perspectives	x	x	x	x	x	x	x
15	TSM	Adaptive Pace and Timing Intervention	x	x	x	x	x	x	x
16	TSM	Active Timing Control	x	x	x	x	x	x	x
17	TD	Trust		x	x	x			
18	TD	Time-Limited Focus				x			
19	TD	Temporary Team Motivation				x			
20	TD	Team Formation				x			
21	TD	Specialized Team Time-Limitation				x			

#	Theme	Principle	Pre-P	Init	Plan	Exec	M&C	Close	Post-P
22	TD	Focus on Essential Tasks		x	x	x	x	x	
23	TD	Leadership and Resource Preparedness			x	x			
24	TD	Collaborative Decision-Making and Adaptive Problem-Solving				x	x		
25	TD	Impromptu Team Dynamics				x	x		
26	TD	Immediate Evaluation of Temporary Team Effectiveness				x	x		
27	TD	Collaborative Strength Integration				x	x		
28	TD	Agile Temporary Team Formation			x	x			
29	TD	Action-Oriented Commitment in Extreme Contexts				x	x		
30	S2C	Trust and Relationship Building		x		x			x
31	S2C	Transparent Communication	x	x	x	x	x	x	x
32	S2C	Stakeholder Involvement and Outcome Focus					x		
33	S2C	Stakeholder Consensus, Participation, and Perceptions		x	x	x			
34	S2C	Stakeholder and Leadership Collaboration	x	x	x	x	x	x	x
35	S2C	Robust Network Connections			x	x	x	x	
36	S2C	Rapid Consensus Building			x	x			
37	S2C	Early and Proactive Engagement		x	x				
38	S2C	Diverse Stakeholder Perspectives Evaluation					x		
39	S2C	Continuous Stakeholder Engagement	x	x	x	x	x	x	x
40	S2C	Communication of Urgency and Timelines	x	x	x	x	x	x	x
41	S2C	Communication And Collaboration	x	x	x	x	x	x	x
42	S2C	Clarity in Communication	x	x	x	x	x	x	x
43	S2C	Building Trust	x	x	x	x	x	x	x
44	S2C	Active Stakeholder Involvement and Feedback	x	x	x	x	x	x	x
45	RUM	Uncertainty Acceptance	x	x	x	x	x	x	x
46	RUM	Risk Management			x	x	x		
47	RUM	Responsive Adaptation			x	x	x		
48	RUM	Proactive Risk Mitigation			x	x	x		
49	RUM	Continuous Uncertainty and Risk Review	x	x	x	x	x	x	x
50	RUM	Complexity Management			x	x			
51	RUM	Complexity Awareness	x	x	x	x	x	x	x
52	RUM	Agile Risk Management and Responsive Mitigation	x	x	x	x	x	x	x
53	RMA	Sustaining Urgency Amidst Competing Demands					x		
54	RMA	Resource Reallocation for Priority Teams.				x			
55	RMA	Resource Reallocation and Justification		x	x				
56	RMA	Resource Optimization for Time Efficiency				x			
57	RMA	Resource Flexibility and Optimization		x	x	x	x	x	
58	RMA	Real-Time Management of Resource Diversion			x	x	x		
59	RMA	Profitability and Technical Success-Focused Resource Allocation			x	x			
60	RMA	Judicious Resource Reallocation					x		
61	RMA	Integrated Stakeholder and Resource Management					x		
62	PMACI	Monitoring and Controlling					x		
63	PMACI	Review and Validation				x	x		
64	PMACI	Multi-Dimensional Goal Assessment					x		
65	PMACI	Interconnected Performance Criteria					x		
66	PMACI	Benchmark Performance					x		
67	PMACI	Aligning Team Perceptions with Project Success Metrics		x	x	x	x	x	
68	PF	Scope Selective Fulfillment		x	x	x	x		
69	PF	Leadership-Guided Authorization		x					
70	PF	Implied Commitment		x	x				
71	PF	Define the project scope by priority		x	x				
72	PF	Define project objectives early with stakeholders		x	x				
73	PF	Clear Project Definition		x	x				
74	OD	Resource Allocation	x	x	x	x	x	x	x
75	OD	Perception of Success				x	x		

#	Theme	Principle	Pre-P	Init	Plan	Exec	M&C	Close	Post-P
76	OD	Organizational Impact Assessment				x	x		
77	OD	On-the-Job Learning and Return on Experience (RoE)	x	x	x	x	x	x	x
78	OD	Impact on the Organization				x	x		x
79	OD	Continuous Top Management and Stakeholder Involvement	x	x	x	x	x	x	x
80	OD	Continuous Complexity and Strategy Assessment	x	x	x	x	x	x	x
81	OD	Concentration of Authority and Leadership	x	x	x	x	x	x	x
82	OD	Adaptability and Flexibility	x	x	x	x	x	x	x
83	LD	Technical and Leadership Skill Integration	x	x	x	x	x	x	x
84	LD	Team-Centric Leadership	x	x	x	x	x	x	x
85	LD	Relaxed Management Style	x	x	x	x	x	x	x
86	LD	Leadership in Strategic Decision-Making	x	x	x	x	x	x	x
87	LD	Experienced Leadership	x	x	x	x	x	x	x
88	ISKM	Urgency Impact on Inter-Project Communication and Knowledge Transfer	x	x	x	x	x	x	x
89	ISKM	Organizational Culture	x	x	x	x	x	x	x
90	ISKM	Reliable Information Systems	x	x	x	x	x	x	x
91	ISKM	Knowledge Transfer in Temporary Project Structures	x	x	x	x	x	x	x
92	ISKM	Enhancing R&D Personnel Participation	x	x	x	x	x	x	x
93	ISKM	Communication and IT in Effective Knowledge Transfer	x	x	x	x	x	x	x
94	FA	Urgency and Profitability Assessment	x						
95	FA	Strategic Objective Definition through Financial Planning	x		x				
96	FA	Strategic Financial Prioritization	x						
97	FA	ROI-Focused Analysis	x		x				
98	FA	Feasibility Analysis	x						
99	DSA	Rapid Subcontractor Onboarding			x	x			
100	DSA	Fast Project Delivery			x	x			
101	DSA	Delivery Method Selection			x	x			
102	DSA	Data-Driven Decision Making			x		x		
103	CUA	Urgency Causation Analysis	x	x	x				
104	CUA	Enacting Urgency	x	x					
105	CUA	Defining Urgency		x	x				
106	CUA	Contextual Categorization	x						
107	CUA	Context-Driven Urgency	x	x					
108	CUA	Balanced Urgency and Schedule			x	x			
109	COO	Flexible Coordination	x	x	x	x	x	x	x
110	COO	Coordinated Multi-Operation Management				x	x		
111	COO	Controlled Management and Documentation	x	x	x	x	x	x	x
112	COO	Centralized Coordination in Incident Management				x	x		
113	C2PA	Uniform Technical Closure Practices						x	x
114	C2PA	Timing, Pace, and Rhythm Evaluation						x	x
115	C2PA	Stakeholder Satisfaction and Market Impact						x	x
116	C2PA	Post-Project Review of Communication and Complexity						x	x
117	C2PA	Post-Project Outcome Assessment						x	x
118	C2PA	Documentation of Lessons Learned						x	x
119	C2PA	Cost Uncertainty Acceptance and Formalization						x	x
120	ADM	Timing and Urgency Decision-Making	x	x	x	x	x	x	x
121	ADM	Time-Constrained Decision Making	x	x	x	x	x	x	x
122	ADM	Strategic Acceleration			x	x	x		
123	ADM	Speed-Cost Balance Evaluation	x	x	x	x	x	x	x
124	ADM	Speed Management			x	x	x		
125	ADM	Proactive Decision-Making			x	x			
126	ADM	Oral Commitments and Decision-Making	x	x	x	x	x	x	x
127	ADM	Improvisation	x	x	x	x	x	x	x
128	ADM	Governmental Support in Process Acceleration			x	x			
129	ADM	Frequent and Immediate Decision-Making	x	x	x	x	x	x	x

#	Theme	Principle	Pre-P	Init	Plan	Exec	M&C	Close	Post-P
130	ADM	Time-cost Balance			x	x			
131	ACF	Rapid Decision-Making and Flexibility		x	x	x			
132	ACF	Preparatory Planning			x				
133	ACF	Flexibility			x	x	x		
134	ACF	Expedited Assessment and preparation			x				
135	ACF	Event-Driven Timing			x	x			
136	ACF	Competitive Market Speed-to-Value			x	x			
137	ACF	Competitive Adaptation			x	x			
138	ACF	Adaptive Scope Management			x	x			
139	2EW	Engaging Employees in Strategic Change	x	x	x	x	x	x	x
140	2EW	Employee Well-being and Safety in Intensive Work Environments	x	x	x	x	x	x	x
		TOTAL	**59**	**69**	**99**	**104**	**83**	**61**	**59**

8.7. APPENDIX 8B: Principles and Their Alignment with Urgent Project Phases

The table presents Framework categories, themes and abbreviations, descriptions, and dilemmas of the *URGENT framework*.

Table 8.65 – Framework categories, themes, descriptions, and dilemmas.

#	FC*	Theme and Abbreviation	Description	Dilemmas or Complementarities
1	UPE	Context and Urgency Analysis (CUA)	Principles for identifying, understanding, and responding to urgent scenarios, including classification, causation analysis, and balancing urgency with realistic planning.	While there is a focus on rapid action and prioritization (in principles such as "Context-Driven Urgency"), there is also an emphasis on balanced and realistic planning (as seen in "Balanced Urgency and Schedule").
		Project Foundations (PF)	Principles emphasizing clear scope and objective definitions, early resource allocation, and stakeholder engagement for a unified project vision and planning.	Ranges from detailed documentation and cross-functional team building to flexible approaches toward resource allocation and scope fulfillment.
		Stakeholder, Communication, and Collaboration (S2C)	Highlights the role of proactive stakeholder engagement, clear communication, and collaboration, focusing on building trust, achieving consensus, and leveraging digital tools and network connections.	The principles balance swift, informal engagement strategies and the need for structured, transparent communication for long-term stakeholder relationship management.
			The role of clear, transparent communication and collaborative stakeholder engagement, emphasizing trust-building and consistent engagement throughout the project lifecycle.	There is a tension between agile, direct communication and the need for comprehensive, consistent stakeholder engagement in dynamic project environments.
			The importance of aligning stakeholders with project objectives from the start and the value of considering multiple viewpoints in decision-making.	Balances the need for cohesive stakeholder alignment with embracing and addressing diverse opinions for well-rounded project assessments.
2	RFM	Financial Assessment (FA)	Focuses on evaluating financial aspects of projects, emphasizing feasibility studies, ROI-focused analysis, strategic planning, and profitability assessment to guide resource allocation and prioritization.	The principles balance financial planning with tactical aspects such as ROI analysis and feasibility studies.
		Resource Management and Allocation (RMA)	Addresses allocation and use of resources in urgent project scenarios, focusing on efficient and justified reallocation, adaptability, and real-time management to meet changing project demands.	While the theme leans towards strategic planning and justification for resource allocation, it also highlights the necessity for real-time adjustments and flexibility.

#	FC*	Theme and Abbreviation	Description	Dilemmas or Complementarities
			Focuses on balancing efficiency with broader organizational impacts and stakeholder expectations.	The balance between efficient resource utilization and strategic decision-making.
3	TSM	Time and Speed Management (TSM)	Covers modularization, optimizing timelines, addressing specific urgencies, schedule compression, and managing project rhythm.	The need for schedule compression with the adaptability required in managing project rhythm and the division approach in modularization.
			Addresses strategies for time management, focusing on active control, strategic balance, coordination, and flexibility in timing and scheduling.	Navigating between proactive timing control, strategic patience, and maintaining consistent project rhythms amid flexibility.
		Delivery Selection and Acceleration (DSA)	Pertains to strategies for selecting suitable delivery methods, emphasizing a data-driven approach, aligning with project demands, and rapid execution strategies.	While the theme leans towards detailed data analysis for decision-making, it also highlights the necessity of rapid action in certain aspects, such as subcontractor onboarding.
4	ARA	Agile Decision-Making (ADM)	Centers on proactive decision-making, leveraging governmental support, acceleration, and balancing cost-time trade-offs.	A recurring theme is balancing execution speed with cost implications and strategic considerations.
			Focuses on enhancing the rapidity of decision-making processes in urgent projects, advocating for agility.	Balancing the need for swift, informal decision-making with the requirements for structured, cost-effective, and organizationally aligned decisions.
		Risk and Uncertainty Management (RUM)	Involves structured risk assessment, responsive adaptation to changes, and managing project complexities.	The theme crosses the tension between structured risk management processes and the need for agile responses to unexpected changes and complexities.
			Concentrates on blending agile methodologies with structured risk assessments.	Balancing the need for agile, responsive risk management with structured, quantitative assessments.
		Adaptability, Change, and Flexibility (ACF)	Focuses on adjustment of project scopes, methodologies, and strategies in response to evolving requirements and external changes, emphasizing rapid decision-making, expedited assessment, flexible planning, and competitive adaptation.	The theme navigates the tension between maintaining ongoing flexibility and agility versus focusing on specific areas for rapid execution and competitive advantage.
5	LTM	Team Dynamics (TD)	Addresses forming, focusing, and managing project teams, including prioritizing tasks, agile team formation, trust establishment, and leadership empowerment.	Highlights the balance between rapid action and developing team cohesion and trust.
			Principles include rapid team formation, evaluating team effectiveness, fostering commitment in extreme situations, impromptu team dynamics, collaborative strength integration, inclusive decision-making, maintaining motivation, and time-limited focus.	The need for rapid team formation with maintaining team effectiveness and motivation, and managing the challenges of team dynamics in urgent and often stressful situations.
		Leadership (LD)	Emphasizes the integration of technical and leadership skills, strategic foresight, team collaboration, and adaptability in leadership styles.	Technical expertise with soft skills, experience with adaptability, and directive with adaptable leadership styles.
		Employee Engagement and Well-being (2EW)	Underscores actively involving employees in strategic changes and prioritizing their well-being and safety in intensive work environments.	The need for rapid strategic change with maintaining employee health and safety.

#	FC*	Theme and Abbreviation	Description	Dilemmas or Complementarities
		Coordination (COO)	Explores the dual aspects of project coordination, emphasizing both the need for flexibility in response to changing conditions and controlled management and thorough documentation.	The tension between adapting to rapid changes and maintaining structured, documented control over project activities.
			Focuses on structuring control and oversight mechanisms in project management, incorporating centralized coordination for complex situations and adaptive management of multiple operations.	The need for a singular command structure with the flexibility required in managing multiple operations and adapting to changing project dynamics.
6	KIOM	Information Systems and Knowledge Management (ISKM)	Focuses on leveraging IT and communication for knowledge transfer, maintaining information systems, and embedding knowledge-sharing practices in organizational culture.	The challenges of maintaining consistent knowledge-sharing practices and robust IT systems in the face of urgent project demands.
		Organizational Dynamics (OD)	Focuses on continuous leadership and stakeholder involvement, adaptability, resource allocation, complexity assessment, and learning from experience.	Concentrated authority and leadership with the need for adaptability and responsiveness in dynamic project environments.
			Encompasses principles focusing on the impact of urgent projects and team structures on the broader organization, with an emphasis on alignment of team perceptions and continual impact assessment.	Managing urgent project demands while preserving the stability of organizational structure and culture.
7	PMOL	Performance Monitoring, Assessment, and Continuous Improvement (PMACI)	Principles for adaptive performance evaluation, focusing on flexible benchmarking and holistic goal assessment.	Managing structured evaluation with adaptability to changes.
		Closure and Post-Project Analysis (C2PA)	Principles guiding the comprehensive review of communication, cost management, stakeholder satisfaction, and documentation of lessons learned.	Balancing formal closure processes with ongoing learning and adaptation.

* FC – Framework Categories; UPE - Urgent Project Essentials; RFM - Resource and Financial Management; TSM - Time and Speed Management; ARA - Agility, Risk, and Adaptability; LTM - Leadership and Team Management; KIOM - Knowledge, Information, and Organizational Management; and PMOL - Performance Management and Organizational Learning.

9. CONCLUSION OF THE THESIS

In this last chapter, we present the main results concerning each Research Question stated in the Introduction chapter. We highlight the main contributions of the Thesis to the field of urgent project management, as well as the limitations of the study and possible directions for future research.

9.1. SYNTHESIS AND OVERVIEW

Until the beginning of this study, there were gaps to be addressed in the field of research. The conceptual and theoretical gap was related to: (i) the lack of definition for urgent projects in the management field (Zidane et al., 2018); (ii) the lack of a framework that could characterize urgent projects; and (iii) the possible/diverse interpretations of urgency (Wearne and White-Hunt, 2014, p. 9). In the Introduction, it was highlighted that no studies were found in Latin America regarding the topic, indicating a geographical gap to be explored. In addition, Brazil's vast territory and maritime area present unique challenges in terms of continental dimensions for managing and delivering products, services, or results arising from urgent projects. There was still a gap in how to manage urgent projects themselves in such a way as to serve this vast territory. During the exploratory component of the Thesis, it was found that the literature on project management only addressed urgency as a problem to be solved or as a possible emerging threat. Based on these gaps, this Thesis explored aspects that would contribute to advancing this understanding.

Based on the research problem identified in Chapter 1, the Thesis Research Question aimed to answer *how to manage urgent projects*. This Research Question was answered in the articles that constitute this Thesis. In summary, *the integrated idea of urgent project management was adopted*; *and what urgent projects are and the process of managing them was analyzed*. The relationships between the chapters, objectives, and main contributions of this Thesis are summarized in Table 9.67, while Table 9.66 presents the research steps and synthesis of the main results of this Thesis.

Due to the conceptual and theoretical framework gap, the first articles (Articles 1 to 4) were planned as conceptual and theoretical articles *to help develop the foundations of the field of research in urgent project management*. The following two articles (Articles 5 and 6) were conceived as empirical case study articles, investigated within the Brazilian continental geographic gap, in a total area equivalent to an incredible 14,215,767 km². Article 5 sought to validate the concepts and definitions presented in Article 4, mainly the Theoretical Model; and

Article 6 provided an understanding of the temporal risks within a megaproject, which can, therefore, impact as an increase in the urgency of project activities. All previous articles (from 1 to 6) lead to the proposal, with theoretical and practical components, of Chapter 8 (Article 7) with implications on how an urgent project (or one that becomes urgent after its initiation) can be managed, thus answering the General Research Question of this Thesis.

As a summary of the findings (Table 9.66) of the conceptual and theoretical articles, Chapter Two (Article 1) reveals various interpretations and challenges of urgent project management. This article introduces four core concepts of what is urgent (*Cruciality, Speed, Time-Sensitivity,* and *Priority*), culminating in two definitions, one narrow and one broad, for urgent projects (Figure 9.18). Chapter Three (Article 2) expands on these core concepts by identifying eight characteristics within three concepts (*Expectation*, *Priority*, and *Speed*); compared to Article 1, it adds *Expectation* as a relevant concept and reinforces the concepts of *Priority* and *Speed*. In addition, the second article presents *sixty-nine characteristics that can occur in urgent project management*, categorized into *fourteen themes*, offering a synthesis of the literature on the possibilities of urgent project management. Chapter Four (Article 3) applies text mining to analyze selected academic documents from the previous articles, identifying key terms and twelve themes related to urgency, offering a data-driven analysis of urgent projects. Chapter Five (Article 4) develops the Unified Model for PRoject Urgency and Economic Speed Analysis (or PRUES model) that combines *urgency*, *speed*, *duration,* and *cost*, offering a graphical structure to facilitate interpretation and decision-making when managing high-intensity and time-sensitive projects. In this way, we consolidate the theoretical and conceptual bases of the field of urgent project management.

As a summary of the findings from the case study articles, Chapter Six (Article 5) provides a detailed analysis of the management of a highly urgent Open Innovation project using the Quadruple Helix model, identifying *thirty-two risks* and developing a new framework that presents stakeholder collaboration combined with risk management. It presents the elements observed in the project (*trust*, *immediate necessity*, *collaboration*, *communication*, *agility*, *partnership with stakeholders*, *scale*, and *logistics*), the impact concerns (on *finance*, *time*, *reputation*, and *health*), the thirty-two risks (with *time risk being considered unacceptable*) categorized (by similarity in *partnership*, *institutional image* or *reputation*, *equipment*, *production*, *project*/*design*, *people*, *intellectual property* or *patents*, *logistics*, *regulation* or *Health Surveillance Agency*, and *sanitation* or *cleaning*), and the graphic framework showing an *urgent Open Innovation project in the context of risk management in*

the fast Quadruple Helix formation. Finally, it presents possible *risk mitigation strategies* for such projects.

This empirical component reinforces the concepts of urgency presented in Article 1, which states that an urgent project refers to a project that requires immediate attention and action due to critical or urgent circumstances. Furthermore, it deeply explores the concepts of *priority* and *intensity-consistency relationships* presented in Article 2. Building on the results of Article 3, it also validates the most frequently used words (*unexpected*, *time*, *stakeholder*, *team*, and *event*) and explores the four central topics in current literature (understanding and managing project urgency, the impact of stakeholder relationships and networks, the need for agile and adaptive project management strategies; and the role of leadership in managing urgency). It validates the High-Intensity and Time-Sensitive Projects modeled in Article 4. Moreover, the results of the analysis of the GRU Project (Article 5), an emergency initiative to meet the high Brazilian demand (of continental dimensions) for face shield products during the pandemic, demonstrate the conceptual importance of the High-Intensity Sector presented in the previous article (Article 4).

Chapter Seven (Article 6) explores another case study. This time, it focuses on time-related risks within a megaproject in the Brazilian Amazon region, which *can alter the project's endogenous urgency over time*. The article analyzes and discusses project urgency based on time-related risks, as explored in Article 1 and modeled in Article 4. In doing so, it also clarifies the concept of *dynamic urgency*, introduced in Article 2. It empirically explores a case where the project was not designed to be urgent. However, very tight deadlines become urgent and can give the team the feeling that they are constantly working on urgent (expected) projects.

Article 6 identifies and categorizes risks and opportunities at different stages of the megaproject life cycle, detailing threats and benefits of technological innovation, project management perspectives, and strategic and operational challenges, thus providing findings on risk management in mapping projects over large territorial areas. The main technical and strategic risks identified include the novelty of airborne radar imaging technology and strategic risks related to imaging and institutional decisions. Operational and project risks include inadequate physical infrastructure, difficulty managing contracts, and changing project managers. Technological opportunities were recognized, particularly the ability to obtain unprecedented data through radar technology, marking a significant advance for the field and the institution. The main risks related to performance in the mapping project were inadequate

sizing of the megaproject, issues with stakeholders, government budgetary limitations, and the lack of prototype testing in the Amazon region.

Table 9.66 - Overview of research articles on project urgency: Articles, research steps (methodological approaches), and main findings.

Article	Steps	Main Findings
Article 1: Meanings and Management Challenges	Lexical Semantic Analysis	(i) The understanding that the word *"urgent" refers to something of the highest importance, requiring immediate or as soon as possible attention and action, with a sense of criticality and nonnegotiability.* (ii) The central concepts of what has some *degree of urgency* were identified, namely: *Cruciality*, *Speed*, *Time-Sensitivity*, and *Priority*.
	Systematic Literature Search (SLS)	(i) It revealed that, among the various terms with the word urgent in the literature, the terms "*urgent project*," "*urgent need*," and "*sense of urgency*" are the most common. (ii) The urgency at the individual level ("*sense of urgency*" and "*perceived urgency*") and qualitative aspects of urgency ("*urgent need*" and "*urgent unexpected*") were highlighted. (iii) Key themes: immediate attention and action, high level of uncertainty, rapid decision-making and coordination, complex and risky scenarios. (iv) Common Characteristics: Critical Nature, Management Challenges, and Rapid Response Risk Management. (v) Management Challenges: quick acceptance of cost risks, top management involvement, attention to stakeholders' interests, trust in oral commitments, *the need for completion within significantly shorter durations compared to similar non-urgent projects*, resource allocation, and decision-making under time constraints.
	Definition and Conceptualization	(i) Strict definition (combining LSA and PMI's perspective): An urgent project is "*a temporary effort that needs to happen according to the degree of urgency and be executed as fast as possible to create a product, service, or result*" (da Penha and ten Caten, 2023b). (ii) Broad definition (combining LSA and SLS): "*An urgent project can be conceptualized as a time-bound effort to achieve a specific and critical objective that requires immediate attention and action according to the degree of urgency, rapid decision-making, and coordination due to its high level of cruciality. Urgent projects often arise in complex and risky scenarios, such as disaster management, fast-response organizations, and innovation projects, or unexpectedly, necessitating rapid action to address new business opportunities, sudden threats, or severely damaged assets. The urgency factor in urgent projects outweighs concerns about the cost of working at the maximum possible speed when deciding to initiate them, emphasizing the significance of achieving results promptly. These projects are considered by high level of uncertainty, complexity, and risks. The challenges specific to urgent project management include dealing with improvisation, and fragmentation while maintaining focus on the project's scope and objectives. Stakeholder management is crucial in urgent projects, as their interests and involvement play a vital role in the project's success. It involves relying on oral commitments to achieve accelerated momentum and timely delivery. Success for an urgent project is primarily measured by its timely delivery rather than its post-project evaluation, acknowledging the need for quick action to meet pressing deadlines or capitalize on time-sensitive opportunities*" (da Penha and ten Caten, 2023b).

Article	Steps	Main Findings
Article 2: Review of Literature and Future Challenges	Systematic Literature Review (SLR) and Snowball Approach	(i) Among the 463 potential studies from the main scientific journals, 105 academic documents were selected (combining SLR and Snowball) between the years 1973 to 2024. (ii) 8 (eight) characteristics were identified and grouped into 3 (three) central concepts, described as *Expectation* (characterized by unexpected or expected urgency), *Priority* (characterized by temporal and/or dynamic urgency), and *Speed* (characterized by work intensity, time speed, speed management, and speed-reflection balance). (iii) Identified and synthesized 69 (sixty-nine) Urgent Project Management Characteristics categorized into 14 (fourteen) Urgent Project Management Themes (key knowledge areas), namely: *human resources and teams' management*, *time*, *stakeholders' urgency*, *risks*, *costs*, *suppliers*, *scope*, *quality*, *integration*, *knowledge*, *communications*, *financial*, *health and safety*, and *innovation*. (iv) It described 33 future challenges for the management of urgent projects related to, for example, commitment-innovation relationship, expectation-of-the-unexpected mentality, operational flexibility behaviors, precision-speed management/balancing, management of highly skilled teams, leadership skills and relationship with performance, consistency, short-term urgent mentality, recognition and enactment of urgency, space-time analysis, event forecasting, temporariness, understanding time urgency and partnership risks, study of stakeholder attributes in real urgent projects, understanding stakeholder interests and claims, performance of what is urgent, cost-value relationship and cost-speed dilemma.
Article 3: Computational Text-Mining Approach	Extract., Preproc, Structur.	(i) A list of the 20 documents with the largest number of sentences containing the term urgent. (ii) Outlier: "Managing the Urgent and Unexpected: Twelve Project Cases and a Commentary" (Wearne and White-Hunt, 2014) with 321 sentences.
	Word Frequency Analysis	(i) Most frequent words: *unexpected* (269 times), *time*, *stakeholder*, *team*, and *event* (136 times). (ii) Highlights: role of unpredictability, importance of time management, significance of stakeholder needs, focus on teamwork and coordination, time-sensitive incidents, authority and influence, central practices for urgency, stakeholder legitimacy, essential project resources, and understanding urgent project needs.
	Topic Modeling	Prevalent topics identified on urgent projects: *urgency in disaster management*, *team dynamics and urgency*, *stakeholder network and urgency*, *innovation and urgency*, *power dynamics in urgent projects*, *unexpected projects*, *stakeholder influence on urgency*, *stakeholder urgency*, *unexpected time urgency*, *team and resource management in urgent projects*, *event-driven urgency*, and *managing team differences in urgent projects*.
	Topic' s Interpretation	(i) Final interpretations: management of urgency in projects in the face of disasters; urgency in project teams; the impact of stakeholder networks on emergency management; the urgency of innovation and adaptation in projects; the influence of power and the need for a sense of urgency in project development; management of unexpected and urgent situations in projects; the relationship between urgency, time sensitivity, and power of project stakeholders; how urgency is perceived and acted upon differently by stakeholders; time management in response to urgent and unexpected project developments; operational challenges and strategies for managing teams and resources under urgent conditions; the role of specific events in triggering urgency in projects; and urgency management in different project teams. (ii) Key points: understanding and managing project urgency; impact of stakeholder relationships; need for agile and adaptive management; and leadership role in urgency management.

Article	Steps	Main Findings
Article 4: The Unified Project Urgency and Economic Speed Analysis Model	Model Formulation	(i) From the variables *urgency*, *duration* (time required to complete the project), *speed* (rate of project progress), and *costs*, relationships were identified between variables: urgency and duration (there is a direct relationship between urgency and duration, i.e., increased urgency typically requires a reduced duration), urgency and speed (an increase in urgency generally implies an increase in speed), urgency and costs (greater urgency can cause higher costs), duration and costs (a longer or shorter duration is generally related to increased costs), and speed and costs (greater speed can imply increased costs, due to the need for more resources or decreased costs if the project is completed more efficiently). (ii) A unified model for the analysis of urgent projects is introduced, combining urgency, speed, cost, and duration of projects, called the Unified Model for the Analysis of Urgency and Economic Speed of Projects (PRUES model), which facilitates the understanding and making of necessary management decisions in the management of high-intensity and time-sensitive projects. Within this model, the "High-Intensity Sector" is introduced and defined in managing highly urgent projects. (iii) "High-Intensity Time-Sensitive Projects" or simply "High-Intensity Projects" have been defined as those that require immediate attention due to their critical nature; characterized by tight deadlines and a high level of urgency; therefore, managers opt for maximum speed and minimum duration; which can result in the maximum total cost of the project.
Article 5: Urgent Open Innovation Project from a Quadruple Helix Perspective	Case Study Analysis	(i) The case study reveals the execution/implementation of a highly urgent project characterized by three macro-phases: (i.i) Phase I (Initial Development): the University and Society are the key actors; Data collection, partnership formation, and production study are the main actions. (i.ii) Phase II (Scale-Up): instant digital communication was essential for collaboration between stakeholders and supported key actions; Super-fast open innovation for face shield design; highlighted the role of society in donations and support; Industry was the main actor in this phase; and enabled large-scale production. (i.iii) Phase III (Government Action): military support for assembly and distribution; Armed Forces logistics for distribution across the vast Brazilian territory; government (Armed Forces) is the key actor; assembly, sanitation, and national distribution are the main actions. (ii) The project design and execution allowed for more expressive temporal and geographic results compared to other global initiatives. Project outcomes: 278,137 face shields produced; coverage of 498 institutions across 470 cities in 8 states; and budget over BRL 220,000. (iii) Challenges: *financial*, *time*, *reputation*, and *health* impacts; and importance of *instant digital communication*, *trust*, and *stakeholder relationships*.
	Risk Assessment and Analysis	(i) Internal risks: *Partnership* (PA), *Equipment* (EQ), *Production* (PR), *Project* (PJ), *People* (PE), *Intellectual Property* (IP), *Sanitation* (SA), and *Logistics* (LO). (ii) External risks: *Institutional Image* (IM) and *Regulatory Standards* (AN). (iii) *The logistical (and temporal) risk of delaying and losing the task force's effectiveness appears to be the most critical and, therefore, unacceptable*. (iv) *Sanitation and Logistics are the most critical categories*.
	Framework	(i) Key components: *trust*, *collaboration*, *communication*, *agility*, *stakeholder partnerships*, *scale*, and *logistics*.

Article	Steps	Main Findings
		(ii) Project characteristics: *high degree of urgency*, *extremely short duration*, and *very high speed*.
	Risk Mitigation Strategies	(i) 7 internal risk mitigation strategies related to (e.g.): trust and open communication, equipment management practices, project management plan with agile methodologies, collaborative work environment, and relationships with supply chain and logistics partners. (ii) 2 external risk mitigation strategies, such as proactive communication strategy and open communication with regulatory bodies.
Article 6: Temporal Risk Management in Land Mapping Projects	Temporal Risks Identification	(i) Project Design Risks: technical perspective (risks of technological novelty and lack of knowledge of the technology) and strategic perspective (lack of consolidated information from previous projects and imprecise division of activities). These risks may lead to an underestimation of the time required to complete the intermediate activities of the megaproject. (ii) Project Planning Risks: strategic (failure to identify the worst project risks, inadequate planning, and unknown catastrophic events) and operational (imprecise definition of technological stages and excessive flexibility in technological management). These risks can result in unrealistic schedules, causing delays in execution. (iii) Project Execution Risks: technical perspective (inadequate management of thematic quality and possibility of incorrect information that leads to legal problems), strategic (damage to the institution's image, political and international incidents), project (inadequate management of acquisitions and lack of supply of defense technological inputs) and operational (weather uncertainties). The main temporal risks are technological failures, interruptions in data availability, and communication problems, which prolong the execution time of tasks. (iv) Project Closure Risks: Project closure outside the schedule affects the institution's image and future legal proceedings. At closure, non-compliance with legal and contractual standards may result in additional delays. (v) The perception of temporal opportunities suggests that adopting new technologies and more effective management practices can mitigate delays, helping to keep the project on schedule. (vi) Performance-related risks: poor project sizing, stakeholder issues, technological factors, government budget constraints, and lack of prototype testing. These risks, such as project undersizing and budget constraints, increase urgency and can lead to significant delays. (vii) The main time-related risks identified in the megaproject include technological challenges, such as the introduction of new technologies that may cause unforeseen interruptions and technical difficulties; management failures, including the lack of precise parameters, incorrect estimates and decisions made without adequate analysis of the impacts; and external factors, such as legal complications, as well as a risk-taking organizational culture. These factors can extend the project schedule, increasing the urgency for its completion, which can lead to hasty decisions, increased costs, and a possible decline in the quality of the final results.

Summary of literature and case studies

(i) Context and Urgency Analysis: 6 (six) principles; and the importance of balancing rapid actions with realistic planning.

(ii) Financial Assessment: 5 (five) principles; and balancing financial planning with tactical aspects.

(iii) Project Foundations: 6 (six) principles; and manage cross-functional teams with flexible resource allocation and scope achievement approaches.

(iv) Stakeholders, Communication, and Collaboration: 15 (fifteen) principles; balance the rapid and informal involvement of stakeholders with the need for communication that is as structured and transparent as possible to maintain the long-term relationship; and balance immediate, agile, and direct communication with consistent involvement of stakeholders.

(v) Time and Speed Management: 16 (sixteen) principles; schedule compression and adaptability required in managing project pace with the modularization approach; and proactive time control with moments of patience, maintaining consistent project paces amid operational flexibility.

(vi) Agile Decision-Making: 11 (eleven) principles; and the dilemma of project speed versus costs in its execution.

(vii) Team Dynamics: 13 (thirteen) principles; and the trade-off between rapid action versus team cohesion and developing trust among participants.

(viii) Delivery Selection and Acceleration: 4 (four) principles; and the balance between data-driven decision-making versus speed of execution (therefore, without sufficient data for decision-making).

(ix) Resource Management and Allocation: 9 (nine) principles; strategic planning and its justification for resource allocation, considering the flexibility of the project in real-time; and the balance between efficient use of resources and decision making.

(x) Risk and Uncertainty Management: 8 (eight) principles; and the dilemma in using structured vs. agile approaches in risk management.

(xi) Adaptability, Change, and Flexibility: 8 (eight) principles; and flexibility with focused rapid execution.

(xii) Leadership: 5 (five) principles; and technical expertise with soft skills, experience with adaptability, and directive with adaptable leadership styles.

(xiii) Employee Engagement and Well-being: 2 (two) principles; and balance the need for rapid strategic change with maintaining employee health and safety throughout a highly urgent project.

(xiv) Coordination: 4 (four) principles; and the dilemma of the simultaneous use of flexibility and monitoring and control of project activities.

(xv) Information Systems and Knowledge Management: 6 (six) principles; and the balance between knowledge sharing and information technology systems in urgent projects.

(xvi) Organizational Dynamics: 9 (nine) principles; and the possibility of combining authority and leadership with adaptability and organizational responsiveness.

(xvii) Performance Monitoring, Assessment, and Continuous Improvement: 6 (six) principles; and the balance between monitoring versus flexibility in monitoring and evaluation for continuous performance improvement.

(xviii) Closure and Post-Project Analysis: 7 (seven) principles; and ensure formal closure with continuous post-project learning.

As this Thesis argues, there are levels of urgency (as discussed in Articles 1, 2, and 4), urgency depends on the context (Articles 1 to 6), and the management of extremely urgent projects may require a very different approach compared to conventional approaches such as Waterfall and Agile, as they violate some of the latter's assumptions/definitions. In the traditional approach, extreme urgency (high time constraints) may violate the linear and sequential approach, predictability, time management and delivery, and clear objectives and requirements from the beginning of the project. While in Agile, extreme urgency may violate the approach of constant work intensity, project velocity, much shorter development and iteration cycles, and project prioritization and scope definition.

Based on these premises, the final Thesis article (Article 7, Chapter 8) presents a proposed framework for managing urgent projects, offering 140 principles in 18 themes that cover the entire life cycle of a project (plus what we call pre-project and post-project phases) and that can be used by future managers of these types of projects. The final framework stands out for its structured approach to dealing with the complexities of managing projects under very tight deadlines or in crisis situations. The framework is designed to be adaptable, allowing customization to meet the varying degrees of urgency, contexts, and tactical, operational, and logistical demands of different projects. In addition, each principle in the framework presents possible practical implications, offering project management practitioners suggestions for applying the identified principles to real-world challenges. Table 9.66 presents the main findings of each step of this Thesis.

Table 9.67 describes the relationship between chapters and articles, as well as their objectives and main contributions to this Thesis. It begins with conceptual clarifications on what an urgent project is in Chapter 2, where the aim was to bridge the conceptual gap and establish a definition, and moves on to practical and theoretical advances in subsequent chapters, which include a literature review, computational text mining, and the development of models and frameworks to map, understand characteristics, and facilitate the management of urgency in projects. Each chapter contributes by addressing specific aspects, such as the concept of urgency, the identification of challenges, the application of computational methods for thematic analysis, and the development of a graphical framework for decision-making on urgency, speed, duration, and costs in projects. The exploration covers a variety of scenarios, from super-fast Open Innovation projects during crises, to managing time risk in land mapping megaprojects, and proposing a guide for managing urgent projects, culminating in a body of

knowledge that brings together theory and practice for managing critical and highly time-sensitive projects.

Table 9.67 - Summary of research objectives and contributions in each chapter.

Article, Title	Research Aims	Main Contributions
Article 1: Meanings and Management Challenges.	(i) Investigate the meanings of the word "urgent" and explore semantic nuances and practical considerations. (ii) Minimize the gap between the term "urgent" used in everyday language and scientific articles. (iii) Explore studies relevant to urgent projects. (iv) Define "urgent projects."	(i) Provides an in-depth discussion of the meanings and nuances of "urgent." (ii) Bridges the gap between everyday and academic language and integrates diverse conceptual perspectives on urgency. (iii) Identifies challenges, diverse perspectives, and management approaches to urgent projects. (iv) Formulates two definitions positioning "urgent projects" within the management domain.
Article 2: Review of Literature and Future Challenges.	(i) Conduct a literature review to investigate, identify, and synthesize existing knowledge on urgent project management. (ii) Identify key concepts and characteristics related to urgent projects; and develop a conceptual framework. (iii) Describe the challenges related to urgent project management.	(i) Reviews the literature on urgent project management. (ii) Identifies and describes 8 (eight) characteristics of urgent projects, grouped into 3 (three) central concepts. (iii) Summarizes 69 (sixty-nine) Urgent Project Management Characteristics categorized into 14 Key Knowledge Areas. (iv) Highlights 26 future challenges for research in urgent project management.
Article 3: Text-Mining Approach.	(i) Identify and analyze prevalent themes and patterns related to urgency in projects. (ii) Provide a data-driven perspective on the dimensions and implications of urgency as discussed in academic texts.	(i) Explores urgency in the academic domain, identifying prevalent themes and issues. (ii) Contributes a theoretical framework on urgent projects, providing a data-driven perspective on urgency.
Article 4: The PRUES Model.	(i) Formulate a Theoretical Model that integrates the degree of urgency, project duration, speed, and costs. (ii) Synthesize the existing literature on these variables and offer a framework for decision-making.	(i) Combines urgency, speed, duration, and cost; develops the Unified Project Urgency and Economic Speed Analysis Model (PRUES model). (ii) Introduces and defines "High-Intensity Time-Sensitive Projects."
Article 5: Urgent Open Innovation Project from a Quadruple Helix Perspective.	(i) Validate the Theoretical Model through case study. (ii) Provide insights into managing extremely/highly urgent projects. (iii) Examine how urgent Open Innovation projects can be executed in the context of the Quadruple Helix model, considering stakeholder dynamics and risks involved. (iv) Identify and categorize risks associated with urgent innovation projects, focusing on	(i) Validates the concept of “High-Intensity Time-Sensitive Projects.” (ii) Demonstrates the execution of the agile mindset and the use of instant digital communication tools in the super-fast execution of an extremely urgent project. (iii) Provides an analysis of the rapid formation of partnerships and collaboration among stakeholders in the Quadruple Helix model, highlighting trust and open and transparent communication between them. (iv) Provides a risk assessment and analysis for urgent projects in similar contexts, identifying 32 risks

Article, Title	Research Aims	Main Contributions
	developing PPE in Brazil during COVID-19. (v) Develop a framework for managing urgent Open Innovation projects, emphasizing stakeholder collaboration. (vi) Understand risk management in a crisis with extremely urgent projects.	grouped into ten categories, with their respective suggested mitigation strategies. (v) Develops a unified framework that illustrates the interaction between Quadruple Helix stakeholders and risk management in urgent projects. (vi) Analyzes Brazil's response to the COVID-19 crisis through the development and distribution of PPE, contributing valuable lessons on managing extremely urgent, high-intensity, and large-scale projects in times of national emergency.
Article 6: Temporal Risk Management in Land Mapping Projects.	(i) Validate the theoretical concepts and characteristics through a case study. (ii) Investigate how temporal risks affect territorial mapping megaprojects' endogenous urgency and completion schedules, focusing on strategies to mitigate these impacts. (iii) Explore practical and theoretical aspects of managing megaproject risks, specifically in terrestrial mapping projects such as the "Radiography of the Amazon." (iv) Address the gap in the literature regarding risk management in large land mapping projects. (v) Study the execution and challenges of the "Radiography of the Amazon" megaproject to understand risk management in mapping large areas using radar imaging technology.	(i) Validates the understanding of the temporal risks endogenous to the project, which can impact urgency, therefore, from the theoretical lens of urgent project management. (ii) Identifies the risks in a mega-mapping project in the Amazon region. (iii) Discusses the temporal risks and urgency in a mega-project. (iv) Analyzes risks and opportunities in the Amazon mapping mega-project. (v) Highlights the risks of adopting new radar imaging technologies for large-scale mapping projects. (vi) Presents risk mitigation strategies to manage large-scale mapping mega-projects. (vii) Adds a body of knowledge on risk management in mega-projects, focusing on the specific challenges of large land mapping projects, an area little explored in project management research.
Article 7: A Guide to Assist Project Managers in Time-Sensitive Projects.	(i) Address limitations of conventional project management. (ii) Develop theoretical and practical principles for urgent project management. (iii) Create a framework for managing urgent projects. (iv) Offer a versatile tool for project management practitioners.	(i) Addresses conventional (traditional or agile) project management limitations. (ii) Develops a theoretical and practical framework with an extensive set of principles covering all phases of time-sensitive project management. (iii) Links principles with theoretical foundations and practical applications to facilitate time-sensitive project management. (v) The framework recognizes the varied nature of time-sensitive projects and offers a customizable approach.

It is worth highlighting that this Thesis addresses the gaps identified in the initial stages of the research related to the management of urgent projects in general and in the context of Latin America, especially in the academic, industrial, and governmental sectors. To deepen these contexts, the Thesis used empirical case studies. The first focused on the super-fast

development of Personal Protective Equipment and then on the megaproject of mapping the vast Brazilian territory. Therefore, we offer two empirical analyses on managing urgent projects in the Latin American context, addressing the challenges posed by geographic and sectoral gaps.

9.2. CONCEPTUAL FRAMEWORK FOR URGENT PROJECTS

We consolidate the conceptual findings of the Thesis into a conceptual framework for urgent projects, as presented in Table 9.68. The consolidation of concepts, a fundamental idea described in the context of urgent project management, simplifies the complexity inherent in the conceptualization of such projects, highlighting urgency as a dynamic element that affects several dimensions of the project, such as cost, duration, and speed, for example. With this, we return to the core concepts presented in Articles 1 and 2, describing each one from the perspective of the subsequent chapters in order to ratify each concept. A summary definition at the end of each concept section consolidates the central understanding of the concept derived from its discussion in the articles.

Table 9.68 - Comparative analysis of urgency concepts (Expectation, Cruciality, Priority, Time-Sensitivity, and Speed) across articles (A1, A2, A3, A4, A5, A6).

Concept	Article	Concept Description
Expectation	A1	The concept of *expectation* may manifest itself in the distinction between projects initiated due to unexpected circumstances, or business opportunities, that require immediate action and attention; and those that, although foreseen, require rapid execution and within short and strict deadlines.
	A2	The *expectation* is the possibility of anticipation regarding future events, actions or behaviors, influenced by past experiences, knowledge, and various contextual factors. In this way, the concept of *expectation* signals the possibility of agile project management mindset, adaptable and capable of responding to sudden emergencies or opportunities; or to quickly planned emergencies.
	A3	*Expectation* is manifested through *unexpected urgency*, the most frequent term in the literature. This term highlights the relevance of unpredictability in urgent or emergency projects. It highlights unexpected challenges, changes, situations, and events.
	A5	The *expectation* manifests itself through the agile mindset and super-fast execution of an unexpected and extremely urgent Open Innovation project, which was initiated in response to the crisis during the COVID-19 pandemic.
	Definition/ Consolidation	Therefore, the concept of expectation refers to the possibility of anticipating future events, actions, or behaviors, influenced by past experiences, knowledge, and contextual factors. Manifestations of Expectation: *unexpected/unforeseen urgency* or *expected/foreseen urgency*.

Concept	Article	Concept Description
Cruciality	A1	*Cruciality* is the degree of *importance* or *necessity* that something (e.g., a project) possesses. It is the attribute of being *important*, *necessary*, and *indispensable*, requiring immediate attention or action to ensure the resolution of a specific situation, task, outcome, or objective. Cruciality suggests that failure to address the issue promptly may result in undesirable outcomes or missed opportunities. It encapsulates the concepts of *earnestness*, *persistence*, and *pressing necessity*.
	A2	*Cruciality* manifests itself as the essential and immediate need for action in managing urgent projects. For example, *cruciality* manifests itself clearly in response to disasters, highlighting the non-negotiability of projects to mitigate impacts and achieve results quickly.
	A5	The concept of "*cruciality*" is manifested through the highly urgent and collaborative development of protective equipment during the COVID-19 pandemic. The project's focus on helping to address an immediate health crisis, the indispensable nature of protective equipment for frontline healthcare workers, and the innovative and coordinated approach among stakeholders highlight the importance and extremely relevant need for the project.
	Definition/ Consolidation	Therefore, the concept of *cruciality* refers to the *degree of importance and necessity something has for achieving* specific objectives. It is *characterized by being indispensable*, requiring immediate and prioritized attention or action to resolve a situation, task, result, or objective. Cruciality means that failing to address the issue promptly can lead to undesirable results or missed opportunities. It incorporates the concepts of *earnestness*, *persistence*, and *pressing necessity*.
Priority	A1	*Priority* means before all else or before others. Priority is *the assignment of a level/ordering of importance* to tasks, issues, actions, projects, or goals, guiding the sequence in which they will be addressed. It involves *ranking them based on their potential impact on objectives*, ensuring that the most important activities receive attention and resources first. *Urgent projects are characterized by a high/very high priority status, but not all high-priority projects are urgent*. It is a guiding concept for allocating time and resources, ensuring that the most crucial and urgent matters are addressed first. *Priority* is determined by the "necessity" and "importance" of "requiring or compelling" action or attention "before anything else" due to its "cruciality" and "time-sensitivity."
	A2	The concept of *project priority* is divided into two: *Temporal Urgency*, when the project as a whole is temporally urgent and needs to be completed within a specific time (shorter than if it were non-urgent), and *Dynamic Urgency*, when the urgency varies throughout the project. The concept of "*Priority*" impacts the allocation of resources, the prioritization of tasks, and the rapid mobilization of teams and stakeholders for as immediate or as fast-paced action as possible. *Priority* also appears in the topic of subscope and subproject prioritization.
	A3	The concept of "*Priority*" appears as a design element in prioritizing stakeholder demands, and the urgency attribute helps distinguish between stakeholders who require immediate attention and those whose needs may be less time-sensitive. The word "*priority*" appears among the 30 most relevant in urgent projects.
	A4	The concept of "*Priority*" is closely linked to its level of urgency. *Priority projects*, with high speed, and shorter duration than usual, can imply high costs. The article presents the importance of projects that require immediate attention due to their sensitivity and impact on time, closely aligning with the prioritization of tasks and projects.
	A5	The concept of "*Priority*" is evident in the super-fast execution of the PPE development project in response to the COVID-19 pandemic. This prioritization is characterized by super-agile project execution, rapid collaboration among stakeholders, and allocating necessary resources to serve healthcare workers.

Concept	Article	Concept Description
	Definition/ Consolidation	Therefore, the concept of *priority* assigns a level of importance to tasks, projects, or goals, guiding the order of execution. Priority Dimensions: *Temporal Urgency* (projects need to be completed within a specific timeframe, shorter than would be the case under normal conditions); and *Dynamic Urgency* (the level of urgency varies throughout the project life cycle).
Time-Sensitivity	A1	"Immediate action and attention" or "as soon as possible". "*Immediate*" suggests an extremely high level of urgency, emphasizing the need for immediate action. It encompasses a sense of emergency or criticality. On the other hand, the terms "*as soon as possible*" and "very soon" give a sense/perception of urgency, but allow for a more flexible time frame, recognizing that there may be practical considerations, and the task, activity, or project must be completed as quickly as realistically possible. As such, urgency can encompass different time perceptions, depending on each project's complexity and specific requirements. *Time-sensitivity* denotes the extreme importance of time in actions, decisions, or deliverables. It highlights that specific tasks, activities, or projects require immediate or timely execution within specific deadlines or periods to ensure the best results, avoid negative consequences, or take advantage of time-limited opportunities. Thus, *Time-Sensitivity* is the need for immediate action, haste, and attention, often requiring something to happen or be dealt with as soon as possible, very soon, or before anything else due to its importance.
	A2	"*Time-Sensitivity*" manifests itself in managing projects under strict time constraints, for example, to address or mitigate the effects of unforeseen catastrophic events. *Time-sensitivity* materializes the need for quick action and decision-making and the prioritization of speed in executing some projects.
	A3	The concept of "*Time-Sensitivity*" is evident, since the word "time" is the second most relevant word in the analysis of urgent projects. Time-sensitivity manifests itself in several identified themes, such as disaster management, team dynamics, unexpected projects, and stakeholder influence. "*Time-Sensitivity*" is a fundamental aspect of urgent project management.
	A4	"*Time-Sensitivity*" is highlighted in the Unified Model for Analysis of Urgency and Economic Speed of Projects. Part of the model illustrates the role of time in the analytical analysis of an urgent project, whether in cost management or in the management of high-intensity and highly time-sensitive projects.
	A5	"*Time-Sensitivity*" is very clearly manifested in the extremely fast development and execution of the project during the COVID-19 pandemic, which required super-fast action, rapid partnership formation among stakeholders, and super-fast execution to address the immediate risks to the lives of healthcare workers. At every stage of the project, there is an emphasis on *time-sensitivity*.
	A6	"*Time-Sensitivity*" also manifests itself in megaprojects, through temporal risks that can affect the endogenous urgency of the project and the need for timely interventions in the different phases of the megaproject.
	Definition/ Consolidation	Therefore, "time sensitivity" refers to the importance of time as an essential measure in actions, decisions, or deliveries, evidenced when there is a need for immediate or timely execution. Levels of time-sensitivity: immediate action (requires an instant response, indicative of a high level of urgency or emergency), as soon as possible (urgency with a flexible timeframe, emphasizing quick action within realistic constraints), and very soon (suggests urgency but allows for some degree of flexibility in timing). Key elements of time-sensitivity: quick decision-making (the ability to make effective decisions swiftly to manage time-sensitive situations), speed of execution (prioritizing speed in project tasks to meet urgent deadlines), and adaptability (flexibility to adjust plans and actions in response to time-critical changes).

Concept	Article	Concept Description
Speed	A1	*Speed* means the requirement of rapid action and attention to achieve a specific result. In extreme urgency, working at maximum speed implies increasing costs. Speed is the measure of how quickly tasks are completed, or objectives are achieved. Speed involves balancing rapid action with maintaining accuracy, ensuring that accelerated efforts lead to results without compromising standards. It encapsulates the concepts of *speedy action*, *speedy attention*, and *haste*.
	A2	*Speed* is crucial to accelerate decision-making and support project agility. The concept of *speed* encompasses: *work intensity*, *timing speed*, *speed management*, and *speed-reflection balance*. *Speed* combines time and the result achieved/delivered, appearing as an essential dimension. It appears in rapid decision-making, execution, and management of project speed to meet urgent deadlines.
	A3	"*Speed*" appears in emergency management, characterized by the need for rapid decision-making and adaptability to unforeseen events.
	A4	*Project speed* encompasses the rate at which the scope of a project is delivered within a specified or desired time frame. *Speed* can take precedence over cost, highlighting the importance of selecting the right speed and being intentionally/managerially controlled and deliberate. *Speed* and duration are important, especially in projects characterized by high urgency. Within the High-Intensity Sector, "high intensity" emphasizes intensity, speed, and pressure.
	A5	The concept of "*Speed*" appears in super-fast and extremely agile coordination between stakeholders, rapid decision-making, and extremely fast project execution and delivery.
	Definition/ Consolidation	Therefore, speed measures how quickly tasks are completed, or goals are achieved. Speed involves balancing rapid action and maintaining precision to ensure that accelerated efforts produce results without compromising standards. It is characterized by: *work intensity*, *timing speed*, *speed management*, and *balancing speed and reflection*.

Note that urgency is intrinsically linked to the need for quick action in all articles. Articles 1, 2, 4, and 5 associate urgency with *the need to accelerate actions and decisions to achieve results within a limited time frame*. In particular, Articles 1, 4, and 5 highlight that *in extremely urgent scenarios, minimizing the duration and maximizing speed is important*, therefore highlighting the fusion between speed and project duration as characteristics of urgency. Furthermore, Article 1 emphasizes the need for immediate action or "as quickly as possible," which reflects the nature of urgency in demanding quick attention and action. This notion runs through all articles when discussing the relationship between urgency, time, and speed.

Articles 1 and 4 show that working at maximum speed in urgent contexts implies increasing costs. However, Articles 2 and 4 highlight the possibility of balancing speed with costs, where, in the case of a more urgent project, speed may take precedence over costs, but should/can be controlled and deliberate. *This dilemma highlights the tension between the need for speed and economic considerations, indicating that managing urgency involves making*

decisions – whenever possible – on the trade-off between cost, speed, and duration. Furthermore, Article 2 also mentions how the degree of urgency influences decisions about the project's cost, speed, and duration. This conceptual aspect shows that *urgency is not a static concept, but a dynamic concept, which varies in degree and throughout the project life cycle*. This suggests the possibility of using the Unified Model (Article 4) as a dynamic model.

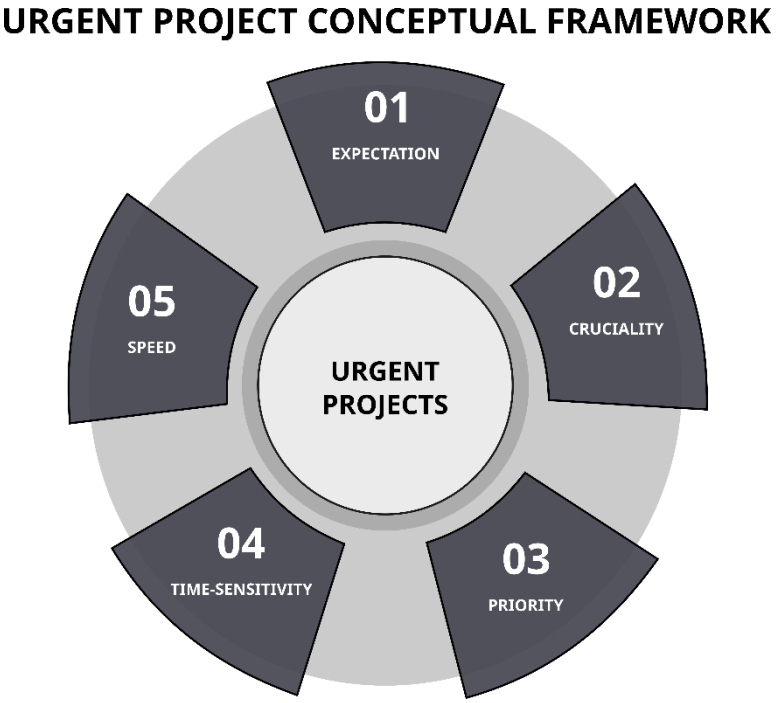

Figure 9.18 - Conceptual framework for urgent projects composed of the concepts of expectation, cruciality, priority, temporal sensitivity, and speed.

As such, the conceptual framework proposed in this Thesis addresses urgent projects, illustrating how urgency influences and is influenced by multiple factors. It can be seen in Figure 9.18. By characterizing the urgency of a project based on the concepts of *expectation*, *cruciality*, *priority*, *time-sensitivity*, and *speed*, this Thesis provides a solid conceptual basis that serves as a foundation for future investigations.

9.3. THE HIGH-INTENSITY TIME-SENSITIVE PROJECTS

In addition to defining what an urgent project is (Article 1), this Thesis introduces the definition of Time-Sensitive and High-Intensity Projects (Article 4). In doing so, it takes the initiative to be more specific and aligned with the conceptual framework already presented. It was necessary to characterize the concepts of "time sensitivity" and "speed" to what is highly urgent.

The rapid life cycle of the GRU Project (Article 5), from conception to delivery in just 11 days, exemplifies the complex trade-offs involved in executing these extremely urgent projects. Decisions had to be made super-quickly by stakeholders across the Quadruple Helix model (Government, Academia, Industry, and Civil Society), *with limited information, balancing high speed with the need for rapid solutions*. This reinforces the characterization of the *High-Intensity Sector* (Article 4) as *an area of maximum complexity and decision-making challenges*. The success of the highly urgent Open Innovation Project was likely due to the strong leadership and trust within the University Engineering Department, the *instant communication* available (via mobile app) between Quadruple Helix stakeholders, and the ability to prioritize tasks and allocate resources super-fast. From what the empirical data suggests, these are essential skills for managing high-intensity projects.

The GRU Project's focus on the rapid production and donation of face shields for healthcare workers during a pandemic shows its crucial nature and the (literally) immediate attention it required. As described in the Unified Model for the Analysis of Urgency and Economic Speed of Projects – PRUES (subsection 5.4.4), the project directly addressed an urgent problem (e.g., disasters, conflicts, or emergencies) as postulated in the definition of High-Intensity Time-Sensitive Projects. With a project life cycle of only 11 days, the GRU initiative empirically demonstrates the essence of extremely tight deadlines and, thus, a very high level of urgency due to the extremely fast response to protect healthcare workers on the frontlines of the pandemic. Additionally, the project analysis demonstrated rapid coordination between stakeholders from different sectors, with rapid decision-making under extremely high pressure to safeguard the lives of healthcare workers, and extremely fast adaptation capacity.

Therefore, projects characterized by extremely accelerated development/execution, high stakeholder collaboration, and extremely rapid results on a large scale exemplify the conceptual framework of High-Intensity and Time-Sensitive Projects. The case study exemplified how highly urgent, complex, and time-sensitive projects require a differentiated approach, highlighted by the speed, agility, and the need for rapid and accurate decision-making in the High-Intensity Sector of the model. This real-world example provides empirical evidence that supports the theoretical conceptualization of high-intensity and Time-Sensitive Projects and the PRUES model, illustrating the practical challenges and strategies that can be used to manage projects under extreme urgency.

9.4. THE GENERAL URGENT PROJECTS ANALYSIS MODEL

Article 2 introduces the concept of "dynamic urgency," in which a project's urgency may change over the course of its life cycle. A project that was initially non-urgent may become time-sensitive due to unexpected events, such as a public health crisis, leading to a continued sense of pressure and tight deadlines for the team. On the other hand, a project that started out with high urgency may lose that characteristic if the circumstances that justified its urgency change or disappear, which may result in the project being reclassified as conventional or even discontinued.

This concept of dynamic urgency is seen in the terrestrial mapping megaproject case study. Projects like this present varying levels of urgency over time, and their risk analysis provides relevant empirical information to expand concepts of the models discussed in the text on (i) General Model for Analysis of Urgent Projects (subsection 5.4.2), (ii) Economic Speed Model (subsection 5.4.3), and (iii) Unified Model for Analysis of Urgency and Economic Speed of Projects (subsection 5.4.4). In the context of megaprojects, the model could be expanded/extrapolated to a dynamic analysis model, with variations in the level of urgency throughout the project life cycle.

The set of identified time risks, including technological innovation, lack of consolidated information, and operational and strategic risks, highlight the challenges of managing the time and speed of a megaproject. These risks can directly impact the ability to meet deadlines and maintain or even minimize the duration and maximize speed in some intermediate stages, exemplifying the possibility of endogenous urgency of a project, varying over time, as described in Quadrant I (from point A to point D) and Quadrant II (from point A' to point D'), of the General Model for Analysis of Urgent Projects (Figure 5.9).

The results highlight the financial implications of operating at full speed in some sub-stages or activities. The potential incremental costs of accelerating parts of the sub-projects, as well as the decision-making criteria for selecting a speed that minimizes costs while mitigating urgency, are practical manifestations of the Economic Speed Model. Risk analysis helps us understand the dynamic trade-off between cost, duration, and speed for these projects that may eventually evolve into urgent internal contexts.

Thusly, the megaproject risk and opportunity list provide empirical evidence supporting the dynamic aspects of the Unified Project Urgency and Economic Speed (PRUES) Analysis Model. The identified risks help to illustrate possible interactions between urgency, duration, velocity, and cost over the course of a project. This complexity is represented in the unified

model, which aims to provide a simple framework for understanding, decision-making, and managing urgent projects and interpreted, by analogy, as a dynamic urgency model.

9.5. THE PRIMACY OF TIME IN MANAGING EXTREME-URGENCY PROJECTS

Theoretical lenses for project management focus on traditional, agile, or hybrid projects. However, these theories do not seem to explain truly/highly urgent projects included in the High-Intensity Sector, as these theoretical lenses offer frameworks with assumptions and constraints on scope, time, costs, resources, and control that do not fully align with the characteristics of such projects. Traditional (waterfall) projects operate with a fixed scope, such as a linear and phased structure, which is violated in extreme contexts (da Penha et al., 2024; De Waard and Kalkman, 2022; Zidane et al., 2018) due to the need for high flexibility, high-speed response capacity, and continuous adjustments to new information and changes in project assumptions and circumstances. Agile, or adaptive, projects assume fixed schedules or cycles, resources, and work intensity, which are also violated due to the imposition of immediate action, meeting extremely urgent deadlines, changing too quickly, or lack of scope definition. Extreme urgency and high risks challenge the ability of agile methodologies to respond as quickly as necessary, although the agile mindset seems to be essential for these projects. On the other hand, hybrid projects adopt a mixed traditional and agile strategy, suggesting the violation of both.

Because the agile mindset is implicit in a genuinely urgent project, such as that presented by da Penha et al. (2024), these exceptionally urgent projects may be misinterpreted as Agile projects. However, in the High Intensity Sector, an urgent project may break the technical perception of an agile project, by not evolving in a constant time, with a constant amount of work between sequential periods, for example. In the context of (indeed) urgent projects, none of the main constraints related to projects (e.g., time, scope, and cost) and resources are not necessarily fixed, for example, as presented by da Penha et al. (2024), Zidane et al. (2018), and De Waard and Kalkman (2022). These latter authors specifically highlight that, at high levels of urgency, “it is practically impossible to bend time to one’s will” and have a planned approach. They also show that in extreme contexts, especially interrupted ones, the relational logic is very different from the PMBOK logic; that is, they do not have much in common. The authors (De Waard and Kalkman, 2022) also present the lack of control over time when approaching an interrupted context. In addition, secondary constraints, such as risks, stakeholder relationships, image and reputation end up becoming as critical as the primary ones,

since urgency is one of the factors of project complexity, as presented in the contextualization of this Thesis.

As presented by De Waard and Kalkman (2022), “the time dimension itself has remained relatively untouched in the academic debate so far” (Hällgren et al., 2022). In general, the urgent project aim is to minimize or shorten the time/schedule compared to a conventional project; hence, a different approach in thinking about time. The more urgent the project, the more the frame/perspective of the project changes from the focus on the scope, or the cost, to *the focus on the speed*, i.e., duration and outcome. Therefore, the project perspective changes because the dimensions of time and scope are mixed to achieve more speed, which is incompatible with agile or traditional mindsets.

As presented in this Thesis (Articles 4 and 5), the project may be reduced to instant initiation, speed, and time outcome in extreme cases. Due to this perspective, some areas of project management knowledge gain relevance, e.g. (De Waard and Kalkman, 2022), time/schedule, human resources, integration, and stakeholders. For example, da Penha et al. (2024) reinforce this proposition due to the finding that the risks of time urgency, partnerships, and team resources seem to be the most relevant in the management of exceptionally urgent projects. Likewise, to accelerate a project exponentially, managers need disruptive thinking to break the rules and explore new possibilities compared to a conventional project. For example, in the management of the organization's portfolio, allocating resources and products from other important projects to eliminate the critical path of a truly urgent project (Zidane et al., 2018), bringing impacts on these other projects. Consequently, in super-fast urgent projects, managers question the assumptions and constraints of project management, imposing a new perspective on the subject.

In a different direction from the general perspective of time in schedule management, focused on execution and control, time in the context of urgent project management can be interpreted as a scarce “resource” (da Penha et al., 2024; Gonçalves et al., 2023; Zidane et al., 2018), a more compatible (and controversial) theoretical lens when studying extremely urgent projects. For example, da Penha et al. (2024) identify that (the time risk of) delaying the delivery of a service, product, or result of a highly urgent project is an unacceptable risk, which reinforces the findings presented by Azeem et al. (2022), that time urgency, specifically schedule delay, was the most critical risk faced in infrastructure projects during the COVID-19 pandemic. Gonçalves et al. (2023) also present that “time to respond is scarce” during emergencies. To change a paradigm of exponential expansion and super-fast delivery (for

example, in an emergency project in a disruptive context), teams, leaders, and stakeholders need to "abandon" project management practices (which professionals already know), which leads us to approach the dimension of time as the most valuable, critical and scarce “resource.”

Note that when the goal of an urgent project is to deliver the result at maximum speed, therefore “independent” of cost, it forces a change in the mindset about time and cost. In this case, time is scarce; and so, cost is the opposite of the traditional way of thinking about project management. Moreover, the literature (Wearne and White-Hunt, 2014, p. 14) highlights that in other urgent projects, cost forecasts were not a criterion for deciding to start work; thus distinguishing them from “conventional” projects (Wearne and White-Hunt, 2014, p. 14). Extreme urgency demands new approaches to time management.

This reassessment of project management principles in extreme urgency reveals inadequacies of existing theories when applied to high-intensity, extremely time-sensitive projects. It suggests the need for a theoretical reorientation toward a *time-centric approach* to project management, with the analogy of a scarce "resource" emphasizing the criticality of time over other project constraints such as cost and scope.

9.6. THE PRACTICAL FRAMEWORK FOR MANAGING URGENT PROJECTS

At the end of this Thesis, it is highlighted that extremely urgent projects generally focus on delivering results as quickly as possible, with variable flexibility, which can be high to adapt quickly, but limited by critical deadlines, and can have their requirements simplified or prioritized to meet the urgency, with high work intensity and extremely fast decisions, documenting only the essential, with risks prioritized based on time, with highly focused teams, with very high adaptability, constant and immediate feedback cycles, flexible budget, with performance based on delivery in the shortest possible time, with changes implemented very quickly.

This Thesis also explored the gap in the study of time in the context of an extremely urgent project compared to a regular project. Most of the academic literature assumes the dimension of time as a constant, stationary, and exogenous variable. In (really or extremely) urgent projects, the analysis of the temporal dimension transfers the relevance of time to an endogenous variable (due to, for example, timing, speed, unacceptable delay, time management capacity) aligned with all levels of analysis, from individuals to organizations. This Thesis emphasizes the understanding of the temporal dimension in urgent projects, specifically when it is necessary to minimize execution time at any cost (da Penha et al., 2024).

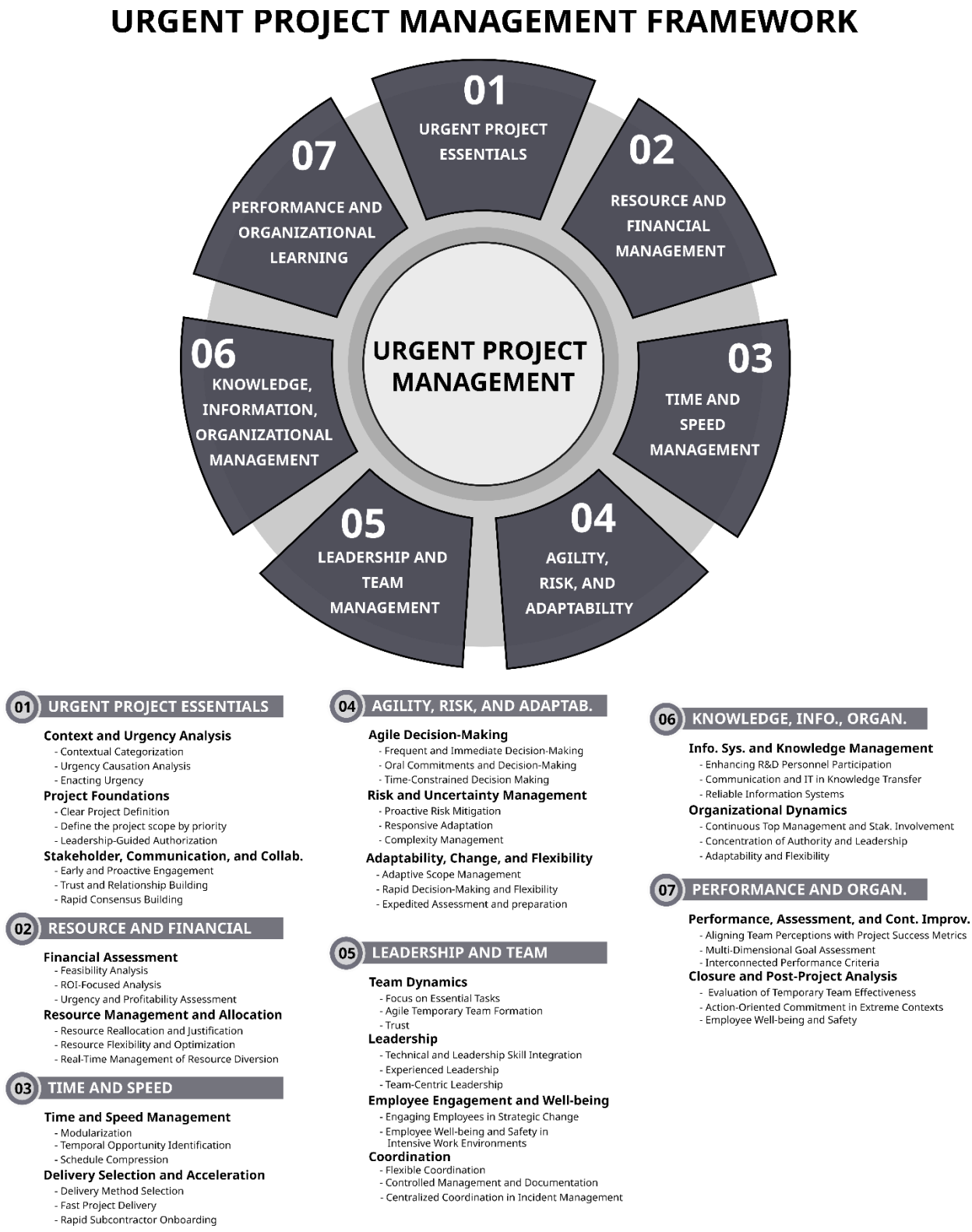

Figure 9.19 - Urgent Project Management Framework focusing on the seven major categories with their respective themes and an overview of some principles.

Finally, this PhD Thesis makes significant contributions to the field of project management by addressing an extremely relevant area from a practical point of view, but little has been explored academically: the management of urgent projects. Through a study that ranged from conceptual development, empirical case studies, and the formulation of practical tools, this research investigated the challenges, complexities, and nuances of urgency in project management. This Thesis identified and filled gaps in the existing literature, offering a refined definition of urgent projects, elucidating their main characteristics, and providing a theoretical model for their management. The empirical studies validated the theoretical propositions and offered relevant material on the practical aspects of managing projects under severe time constraints and in conditions of variable urgency. The final framework, covering the principles in 18 themes, demonstrates the depth and breadth of this thesis, offering managers an adaptable tool to face the challenges of future urgent projects, especially super-fast ones. Ultimately, this Thesis contributes by placing urgency as a notable dimension in the project management domain.

9.7. LIMITATIONS

This research has some limitations.

(i) The empirical component of this Thesis, while providing valuable information, is based on a limited number of case studies. These cases may not fully represent the urgent projects in different sectors and geographic regions. Although they have been combined with findings from the literature, they may have limited generalizability.

(ii) Aspects relating to the complexity of the analyzed projects are not emphasized. Despite its importance and the urgency of being considered a measure of complexity, the decision not to delve deeper into this topic occurred because managing complex projects presents a vast field of study that this research did not intend to explore.

(iii) The research predominantly uses qualitative methodologies to develop its conceptual framework and analyze case studies. While this approach is appropriate for the exploratory and theoretical nature of the Thesis, it limits the ability to quantitatively measure the impact of proposed management principles on the results. Future research could incorporate quantitative methods to validate and refine the framework.

(iv) The research acknowledges human resources and organizational culture(s) when managing urgent projects. However, it does not explore these aspects in depth. The interaction between individual behaviors, team dynamics, and organizational structures in the context of urgency can be explored in future studies.

(v) Although research considers the role of external factors, such as institutional image and reputation conditions and legal regulation, it does not extensively analyze their impact on managing urgent projects. As these factors can influence project urgency and outcomes, further investigation into how external environments shape urgent project management strategies is suggested.

9.8. FUTURE CHALLENGES

Future challenges range from the individual level, through the project level and up to the portfolio level, and may explore aspects such as the sense of urgency, team dynamics, the relationship between commitment and innovation, flexible operational behaviors, management of highly skilled teams, the relationship between speed and accuracy, stakeholder management of urgency, and variables such as quality, cost, and time in contexts of pressure. Therefore, there is a vast avenue for future research.

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