

Major Program Problem Management: An Analytical Framework for Second-Order Major Program Risk Management

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Summary - 124 words

This paper examines the limitations of traditional risk management in major programs, where first-order approaches address immediate risks but overlook systemic issues, and second-order methods struggle with implementation. The proposed Major Program Problem Management (MPPM) framework integrates ITIL v4 Problem Management with Lean Six Sigma tools, including Failure Modes and Effects Analysis and Pareto charts, to enhance program performance.

MPPM is applied to data from a major datacenter program's Risk and Issue Register, identifying key sources of schedule delays. Interviews with program professionals inform a high-level implementation approach, emphasizing the relationship between benefits, required resources, and limitations. The study discusses how MPPM improves risk visibility, aligning findings with existing literature. By addressing systemic risks effectively, MPPM offers a structured method to enhance program outcomes.

Track: Performance Management

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1 Introduction

Over 99% of major programs (MPs) experience poor performance in terms of cost overruns, schedule delays, or failure to deliver promised benefits (Flyvbjerg et al., 2023). The UK's High Speed Rail (HS2) megaproject, for example, was plagued by issues such as unexpected ground conditions, underestimated land values, poor governance, and inflation, which ultimately led to the cancellation of a large portion of the project in 2023 (Reuters, 2023). Similarly, the Berlin Brandenburg Airport project experienced significant delays and budget overruns due to design flaws, planning errors, inadequate management, and an overly complex fire safety system, which resulted in a nine-year delay and €4.17 billion in additional costs (Nicola, 2020).

These examples underscore the importance of effective risk management in MPs. Despite evidence that even moderate risk management practices can improve project success (Bakker et al., 2010; Zwikael and Ahn, 2010), only 0.5% of projects are completed on time, within budget, and with the promised benefits (Flyvbjerg et al., 2023). This disparity suggests a gap between inputs into risk management efforts and the outputs on actual impact on project outcomes.

Prevailing risk management frameworks, such as those in the Project Management Institute's Project Management Professional handbook, can be considered first-order practices as they focus on the most immediate and direct risks to project success on an individual risk basis (Pergler and Lamarre, 2009). For example, a project manager in a construction project identifies and tracks potential risks—such as delayed steel deliveries—within a risk register, then creates mitigation strategies (e.g., by arranging an alternative supplier) to avoid immediate disruptions to the project's schedule and/or budget. By focusing on mitigating individual direct risks as they arise, the PMI's risk management framework exemplifies a first-order practice. However, these approaches are limited as they do not prevent the recurrence of risks or address systemic issues (IRGC, 2023). First-order practices often focus on addressing the immediate symptoms of a problem rather than the deeper, underlying factors that allow it to persist. As a result, they may only provide temporary fixes, leaving the system vulnerable to similar risks in the future.

Second-order practices, which involve more in depth measures, aim to address these limitations by tackling root causes (Tucker et al., 2001). By identifying and addressing the fundamental drivers of risks, second-order practices not only resolve the specific issue at hand but also mitigate systemic weaknesses that contribute to recurring problems. Examples of second-order frameworks include Total Quality Management (TQM), Agile, Lean Six Sigma (LSS), and Reference Class Forecasting (RCF). LSS, for example, can be considered second-order due to its structured approach to identifying and addressing the root causes of defects (Yadav and Desai, 2016). However, implementing these frameworks in MPs is challenged by the latter's complex structures and flexibility needed to respond to unforeseen challenges (Arena and Molloy, 2013). Moreover, RCF, while tailored to MP management, is constrained when a specific reference class cannot be identified (Zani et al., 2024) nor does it identify and address the root causes of inaccuracies (Lovallo and Kahneman, 2003).

These limitations lead to the research question: how can a second-order risk management framework be structured to the needs of major program management and improve upon the fundamental root causes of issues that lead poor performance?

This paper proposes one answer to this question by means of a framework called Major Program Problem Management (MPPM). By tracking risks and issues, identifying a categorization method, and leveraging the six sigma techniques, MPPM will provide for a means to identify and address the complex and/or systemic issues that major programs encounter.

This topic is worth addressing because of the potential impact it can have on improving overall program performance. Increased risk management effectiveness has been shown to reduce costs by up to 20% (Bevan et al., 2019). The aim of this paper is to provide a method for how to structure the various components of the framework and introduce a high-level process for managing it in a MP.

This paper is organized as follows. Section 2 reviews relevant literature, addresses the research gap, and identifies the Problem Management conceptual framework. Section 3 outlines the framework's methodology, and the structure of interviews conducted to analyze the efficacy of implementing the framework in a major program. Section 4 demonstrates the use of the framework with data from a real major program and presents findings from the aforementioned interviews. Section 5 links these findings to the research question and evaluates the extent to which it was answered. Finally, section 6 discusses the implications of this research for risk management, addresses limitations, and provides recommendations for future areas of research.

2 Literature review

Several second-order frameworks for Major Program Risk Management (MPRM) have been identified, but their effectiveness is largely confined to specific practices in which they were established.

2.1 Major Program Risk Management

MPRM is a framework for mitigating the effects of uncertainty on objectives (Tranchard, 2018). MPs are inherently risky due to their long lead times, complexity, and unique characteristics (Garemao et al., 2015). An effective risk management framework as a function of a MP can improve the outcomes of common measures of success such as delivering projects on time, within budget, and at a committed quality (Kardes et al., 2017).

At a high-level, MPRM can be generalized into a high level process:

- 1) Planning: selecting which risk management methodologies to use.
- 2) Risk Identification: formal recognition of potential risks (Kardes et al., 2017).
- 3) Risk Assessment: Analysing the severity and likelihood of the impact of a risk (Irimia-Diéguez et al., 2014).
- 4) Risk Response Planning: Developing and choosing appropriate strategies to address assessed risks (Dey, 2012; PMI, 2008).
- 5) Risk Monitoring and Control: Regular reviews of active risks to include updating response planning if needed and closing out risks that are no longer relevant. (Kardes et al., 2017).

The benefits of a structured risk management approach in MPs are significant. Identifying and addressing risks improves schedule and budget adherence (Raz et al., 2002) and enhances the ability to meet technical requirements in uncertain projects (Raz et al., 2002). Aligning a risk management framework with program objectives further strengthens overall outcomes and project success (Kardes et al., 2017).

However, implementing an MPRM framework presents challenges. US public sector programs have historically lacked proactive risk management (Mitra et al., 2023), and senior leaders often have limited knowledge of risk practices (Braig et al., 2011). Many techniques, such as statistical methods and phase-gate processes, struggle with unknown, complex risks (Thamhain, 2013). Additionally, professionals across industries often do not see risk

management as part of their role (Thamhain, 2013), highlighting the need for adaptable frameworks to address both known and unknown risks.

Risk perception also varies across career levels in MPs. Program managers focus on operational risks affecting project performance, such as task monitoring and resource management, while senior managers prioritize strategic concerns like organizational alignment, stakeholder impact, and ROI (Thamhain, 2013). These differing views can create misalignments in risk management strategies within an organization (Thamhain, 2013).

2.2 Review of First and Second-Order Risk Management

MPRM practices can be approached on a first and second-order basis. These concepts have roots in quality management and organizational development and are concerned with the different amounts of changes required within processes (Bartunek and Moch, 1987). They represent distinct approaches to enhancing efficiency and effectiveness within organizational systems.

First-Order Risk Management Practices

First-order risk management practices are tied to both the concepts of first-order effects and first-order improvements. These practices focus on addressing the most immediate and direct risks to a project's objectives on an individual basis (Pergler and Lamarre, 2009). Addressing these risks involves incremental changes by means of introducing rework or working harder to mitigate impact (Bartunek and Moch, 1987). Such changes reinforce the existing structures within an organization and support established patterns and interests (Bartunek & Moch, 1987). Repenning and Sterman (2002) note that such risk management practices can provide short-term gains, but often at the expense of long-term improvements when organisations dedicate their resources to these efforts.

Second-Order Risk Management Practices

Second-order risk management addresses indirect, long-term consequences of systemic risks. These effects can ripple across projects, as seen in global supply chain disruptions from varied COVID-19 policies (McGillivray, 2021), delaying material deliveries (Pergler & Lamarre, 2009). Though not always immediate, such impacts can significantly affect program outcomes.

Second-order improvements involve transformative process changes that yield greater performance gains than incremental improvements (Bartunek & Moch, 1987). Examples include streamlining electrical equipment testing in construction or standardizing risk management across projects.

First-order risk management enhances efficiency within existing frameworks, addressing immediate risks, while second-order practices focus on structural improvements to mitigate hidden risks. Both are essential for continuous improvement, with first-order delivering quick gains and second-order driving long-term program success (Bartunek & Moch, 1987; Repenning & Sterman, 2002).

2.3 Existing models of second-order risk management

Many frameworks for implementing second order improvements in the context of MPRM have been created. This section highlights some of the most prevalent used across business sectors.

Total Quality Management

Total Quality Management (TQM) fosters a culture of continuous improvement, requiring organization-wide participation to meet customer demands (Ciampa, 1996). It enhances financial performance and efficiency by increasing market share, reducing costs, and improving product reliability (Chaudary et al., 2014). It also boosts key performance metrics like net income and sales per employee, particularly in manufacturing (Easton & Jarrell, 1998).

Implementing TQM in MPs is challenging due to their temporary, flexible nature, unlike manufacturing and service industries, which emphasize precision and routine communication (Arena & Molloy, 2013). MPs, focused on innovation, may lack the stability needed for firm-wide TQM adoption and may not last long enough to see its benefits.

Agile

Agile is a flexible project delivery approach that iterates progress and integrates continuous customer feedback to deliver value efficiently (Wafa et al., 2022). Based on four core values and twelve principles, it fosters adaptability and customer focus, making it widely used in software engineering for its speed and flexibility (Wafa et al., 2022). Instead of fixed schedules, Agile uses “sprints” lasting one to four weeks, with deliverables planned one sprint ahead (Carmichael, 2023).

Agile offers key advantages, enabling rapid strategy shifts based on customer feedback (Laoyan, 2024) and fostering collaboration through face-to-face communication. It is particularly effective in software projects (Wafa et al., 2022).

Applying Agile to non-software MPs faces challenges. Large-scale infrastructure projects struggle with Agile’s emphasis on rapid feedback due to their scale, distributed teams, and complexity (Gregory et al., 2016). Agile’s adaptability contrasts with the structured planning required for traditional MP management (Ciric et al., 2019). Scaling Agile across decentralized teams is also difficult, though certain principles, like modularity, can be adapted to MPs (Flyvbjerg, 2021). While a pure Agile approach may not fit MPs, its concepts can still inform large-scale project management.

Lean Six Sigma (LSS)

LSS combines Lean and Six Sigma to improve performance by eliminating waste and reducing process variation, enhancing quality, schedule, and costs (Yadav & Desai, 2016). It uses statistical methods to minimize variation and align processes with targets (Yadav & Desai, 2016).

LSS has proven effective in manufacturing and service sectors (Raja et al., 2018), with large companies implementing it more successfully than smaller ones (Alkhoraif et al., 2019). Its success depends on substantial capital and expertise, which many small businesses lack despite their interest (Thomas et al., 2014). While LSS boosts performance, its effectiveness relies on an organization’s resources and execution capacity.

Reference Class Forecasting (RCF)

RCF is a second-order risk management framework designed for MP management, improving forecasting accuracy by taking an "outside view" and analyzing similar completed projects (Flyvbjerg, 2006). It provides a data-driven approach to managing cost and schedule

while reducing cognitive biases like optimism bias and strategic misrepresentation (Batselier & Vanhoucke, 2017; Park, 2021).

While RCF is widely used for cost prediction, it has faced criticism, with some studies suggesting it does not improve forecast accuracy (Themsen, 2021). Its effectiveness is limited in new or rare projects lacking sufficient precedent data (Garbuio & Gheno, 2021; Zani et al., 2024). In such cases, practitioners must estimate a reference class by comparing project complexity to existing data. The quality of this reference class is crucial, as research shows RCF performs worst when the class is too broad, leading to inaccurate estimates (Zani et al., 2024).

2.4 Information Technology Infrastructure Library (ITIL) and Research Gap

ITIL, originating in the 1980s from the British government's Central Computer and Telecommunications Agency, is a framework widely adopted by leading IT companies to align services with business objectives (IBM, 2021). The latest version, ITIL v4 (2019), comprises 34 processes emphasizing value creation, risk and cost management, and flexibility. It addresses criticisms of v3 by providing guiding principles for decision-making, stronger alignment with business strategies, and compatibility with Agile and Lean (ITIL).

ITIL Problem Management

Problem management is one of the processes in the ITIL v4 framework, the goal of which is to identify and address the root causes of recurring and/or complex issues (Axelos, 2022). ITIL v4 distinguishes this from "incident management," a related process that focuses on addressing unexpected individual events that can disrupt services for customers (Axelos, 2022). Figure 1 below highlights the relationship between the two:

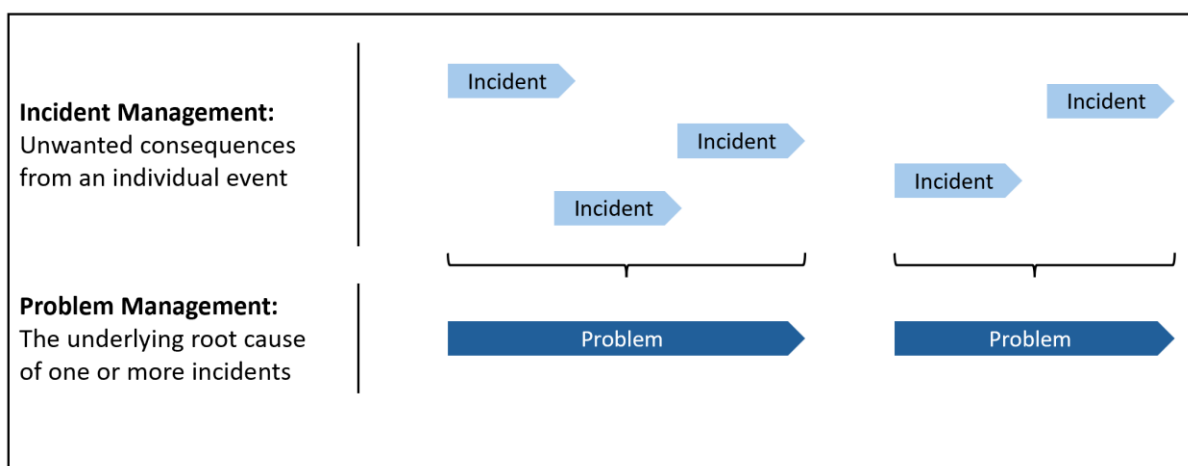


Figure 1. ITIL v4 Incident and Problem Management

For example, if an e-commerce site goes down due to a database failure, Incident Management restores service by restarting the database, while Problem Management investigates the failure, applies a permanent fix, and improves monitoring to prevent future outages.

Incident management is conceptually similar to risk management in MPs. Both are structured to respond to events that negatively impact goals: in ITIL, the goals are to meet service-level agreements (SLAs) for IT services, while in MPs, the goals are to stay within budget, on schedule, and maintain quality.

However, ITIL problem management does not have an equivalent for addressing recurring and/or complex issues that occur within a MP itself. Agile retrospectives focus on second-order process improvement efforts for the upcoming cycle, but these methods are often based on the intuition and perceptions of team members (Matthies, 2019). While root cause analysis (RCA) is useful, it typically focuses on identifying the root cause of individual issues, rather than addressing larger systemic and/or complex issues (Peerally et al., 2016). Additionally, although RCF addresses recurring issues by allocating a buffer for budget and time, it does not tackle the root causes that lead to these issues.

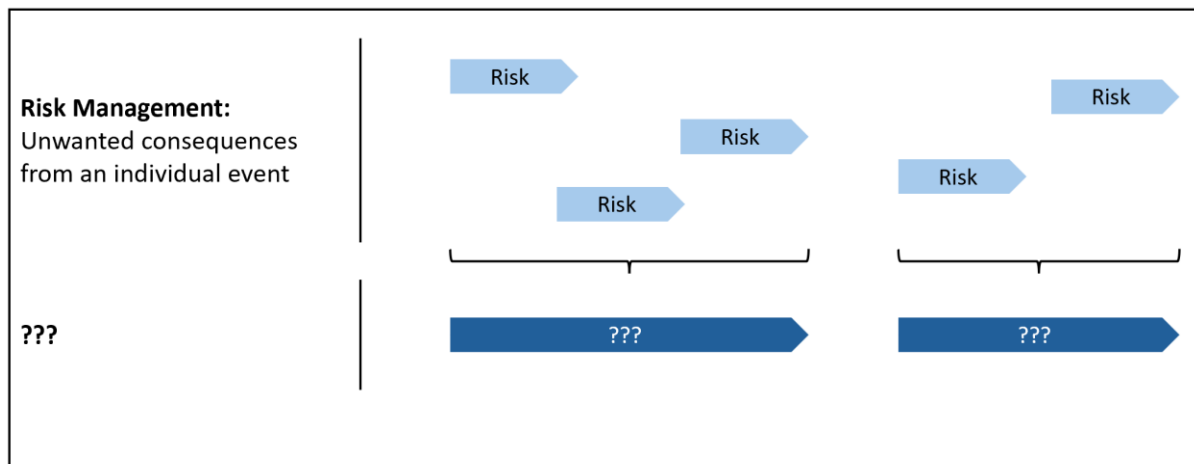


Figure 2. Major Program Risk Management and Framework Gap

2.5 Major Program Problem Management Conceptual Framework

MPPM builds upon ITIL v4 Problem Management and LSS in order to address the needs of MPs. The framework is comprised of four steps:

Step 1 – Separate Issues from Risks

ISO 31000:2009 defines risk as “the effect of uncertainty on objectives as measured by their potential impact.” The uncertainty around risk is based on incomplete knowledge of future events as it relates to an organization’s decision making” (Tranchard, 2018). The “effect” a risk has is related to what could be changed to a project and can be measured in terms of impact such as days lost/gained to a schedule, cost adjustments, and/or quality variance (Piney, 2012). An issue is defined as a specific type of risk that “has been realized” after it actually starts to impact a project (Piney, 2012). In other words, a risk is a forward-looking perspective on what could impact a project, whereas an issue is either a present-time perspective when an event is actively impacting a project, or backwards-looking perspective when an event has caused impact but is no longer. Ciervo et al. (2019) leverage this distinction between risks and issues as the basis for developing a software system that can improve productivity, quality, and compliance in medical clinical trials.

Step 2 – Risk and Issue Categorization

Categorization involves grouping risks and issues together based on common features (Krane et al., 2009) such as shared sources and relationships. In terms of MP management, a comprehensive categorization should consider that risks and issues can manifest from both sides of the programme's system boundary (Kardes et. al 2013):

1. Exogenous sources: arising from events external to the system boundary such as political, legal, economic, social, or environmental conditions.
2. Endogenous: arising from events internal to the system boundary and can be both project (e.g., construction) or party (stakeholder relationships) related.

STEER is one of many frameworks for categorizing exogenous sources of risk and issues. Boateng et. al (2015) use this framework to model prioritizing exogenous sources of risk that transportation megaprojects experience at the construction stage. A categorization for endogenous sources should consider that risks and issues are relevant in all phases and stages of a MP's life cycle (Rothengatter, 2017). Therefore, in this paper, I have adopted the framework by Mahdi et al. (2024) who categorize both sources across the four major project phases (see table 1):

Table 1. Risk and Issue Categorization Across Project Lifecycle Phases (Mahdi et al., 2014)

ID	Category
R1	Market risk and production competition
R2	Planning
R3	Government
R4	Management risks
R5	Stakeholder
R6	Financial and economical
R7	Tendering and contractual
R8	Design
R9	Time and cost
R10	Construction and technical
R11	Quality
R12	Operation and maintenance
R13	Health, Safety, and Environment
R14	Other Risks
R15	Organization

Project Phase	Category
Inception and feasibility	R1, R4, R5, R6, R14, R15
Planning and design	R2, R3, R4, R5, R6, R8, R9, R12, R14, R15
Execution	R5, R6, R10, R11, R12, R14, R15
Performance and monitoring	R5, R6, R12, R13, R14, R15

Step 3 – Risks and Issues Register based on LSS Methodologies

Failure Modes and Effects Analysis (FMEA) is a LSS tool for analyzing potential failures in process, product, or service in order to minimize or eliminate their effects (Tague, 2023). "Failure modes" refers to the various ways in which that process might fail and "effects analysis" refers to studying a process failure's consequences (Tague, 2023).

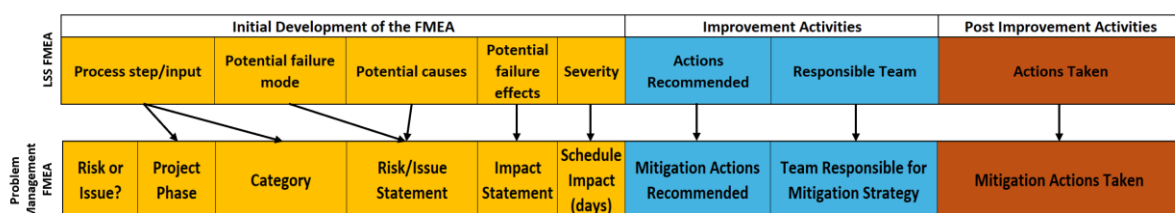


Figure 3. Problem Management FMEA Mapping from LSS FMEA framework

Figure 3 illustrates the phases in the traditional LSS FMEA and the amended FMEA for the MPPM conceptual framework. FMEA supports the conceptual framework as the foundation for a Risk and Issue Register with adaptations as follow:

- 1) “Project Phase” and “Category” are combined and replace the “Process Step” input of LSS FMEA, as each Category includes multiple processes (Mahdi et al., 2024; Project Management Institute, 2017).
- 2) The Risk or Issue Statement merges the “Potential Failure Mode” and “Potential Failure Effect” to connect the event to a root cause, e.g., “construction completion delayed (root cause) due to late arrival of equipment (event).”
- 3) The risk's potential impact or issue's actual impact (e.g., schedule impact in Figure 3) serves as the “severity” entry in LSS FMEA.
- 4) The adapted FMEA includes “actions recommended” for planned mitigations and “actions taken” to track actual measures, highlighting variance when mitigation strategies change.

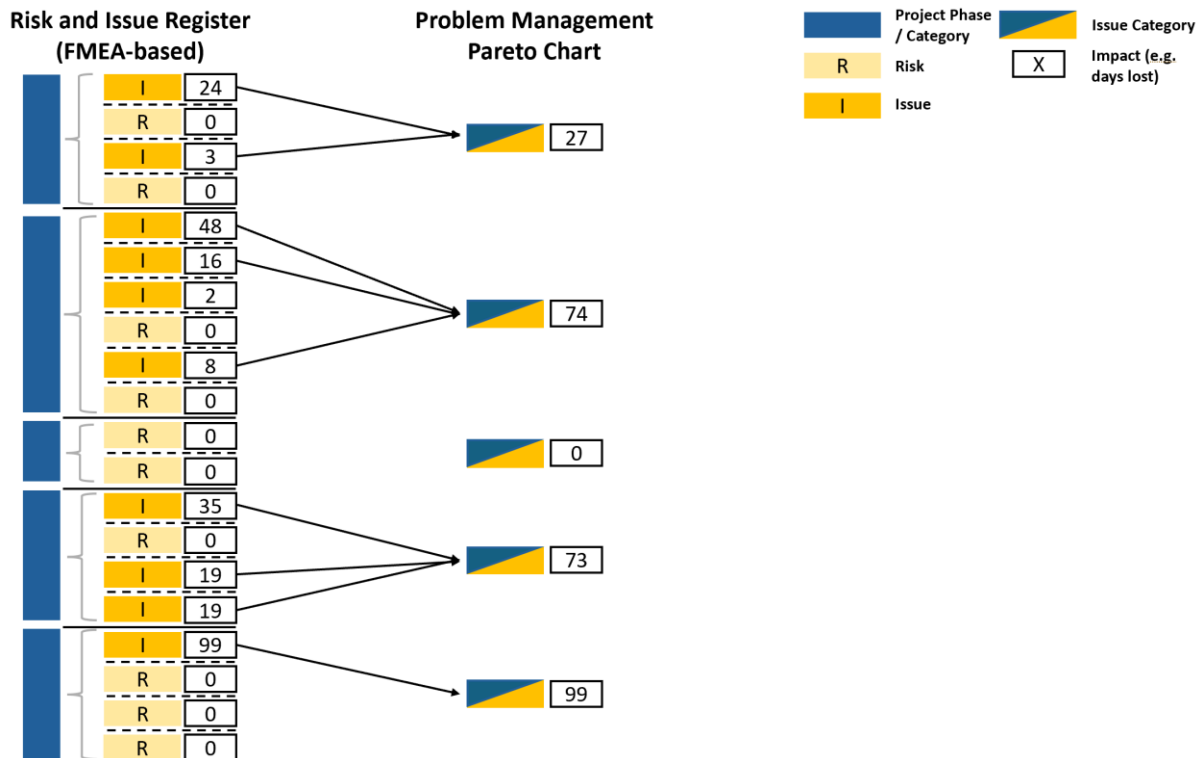


Figure 4. Problem Management Conceptual Framework

Step 4 – Generate Pareto Chart from Issues in Register

With a FMEA-based Risk and Issue Register in place, one can create a Pareto chart using data from *issues only* entered into the register (see Figure 4). For purposes of creating the pareto chart to analyze overall impact by issue category, the Project Phase and Category associated with each individual issue are concatenated into one field. For example:

Project Phase	Category
Execution	Operation and maintenance
Planning and design	Operation and maintenance

becomes

Project Phase - Category
Execution - Operation and maintenance
Planning and design - Operation and maintenance

Without this, the pareto chart would combine issue categories across project phases which would lead to overall impacts being summed up incorrectly.

Issues are combined together based on their individual Project Phase and Issue Category and have their individual impacts summed up into one overall total impact for the Phase/Category (see Figure 5).

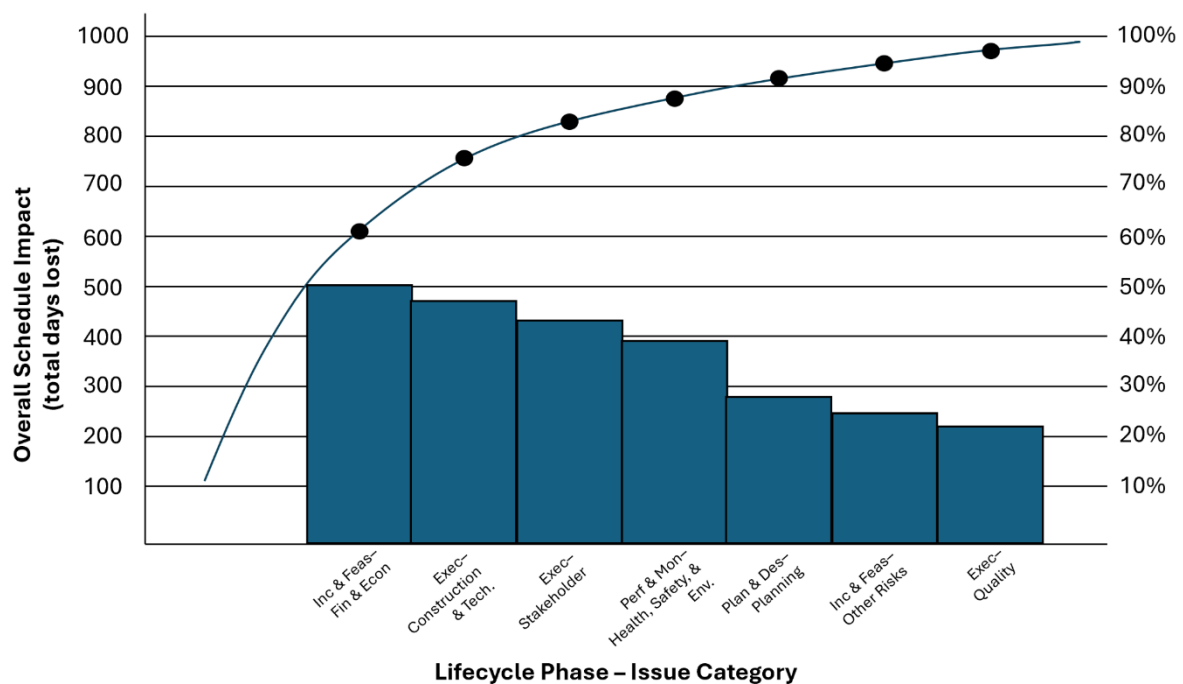


Figure 5. Problem Management Pareto Chart

A Pareto chart is useful because it adheres to the Pareto principle, which holds that a small number of causes often lead to a large proportion of the problems or defects (Harvey and Sotardi, 2018). Ranking Issue Categories by their total impact to a program enables one to identify and develop methods to address what is most impactful to a MP. By prioritizing action into these key problems, a MP is enabled to achieve significant improvements in performance.

3 Methodology

3.1 Research Design

The design of MPPM addresses objective issues related to the quantitative risk and issue data and subjective issues related social dynamics of implementation within an MP. A mixed methods sequential explanatory approach is used, making this framework a new tool for MPRM. The quantitative research is descriptive and analyzes archival data from April 2020 to July 2025 in an MP's Risk and Issue Register, systematically examining prevalence and characteristics of a particular concept without manipulating the data itself (Jackson et al., 2023).

Results of the quantitative analysis are used to familiarize interview participants with the framework in order to identify a high-level approach for implementing it in MPs. Interviews follow a grounded theory design to flexibly explore implementation strategies, allowing interview data to shape the final approach. This design is well-suited for developing new theories based on real-world data (Jackson et al., 2023).

3.2 Data Collection and Analysis Techniques

The quantitative data used to demonstrate MPPM and analyze a MP's problem set comes from an existing dataset. This dataset consists of entries captured in the Risk and Issue Register of a MP dedicated to executing datacenter projects based in the USA. It was collected over four and a half years across 33 individual projects and is comprised of 239 risks and 86 issues. The data was analyzed using Pareto charts, a LSS process, in order to identify the largest areas of impact to the program.

Semi-structured interviews were used to develop an approach for implementing the framework in a MP, from which qualitative data was extracted. A series of ten questions were developed to provide a baseline structure for the interviews, focusing on its implementation, its benefits to an MP, required resources, limitations, and potential improvements (see Appendix 1 for the interview questions). Participants were selected based on a convenience non-probability strategy with the goals of minimizing the researcher bias associated with this strategy (Jackson et al., 2023) based on their career experience, discipline and gender as shown in Table 2 below:

Table 2. Selection Criteria for Research Participants

Career Experience	Discipline	Gender
Program manager-level 5-10 years' experience	Construction	Male
Director-level 10-15 years' experience	Supply chain	Female
Partner-level 15-25 years' experience	Operations	
	Scheduling	
	Senior leadership	

A thematic analysis method was then employed to extract key concepts and patterns, informing the initial stages of developing the high-level approach to implementation. The coding structure used for the thematic analysis aligns with the framework from Maylor et al. (2017):

Table 3. Thematic analysis coding structure with examples

Category: <i>group of concepts</i>	Property: <i>attributes of a category</i>	Dimensions: <i>range of values that each property can take on</i>
Work-Life Balance	Time Flexibility	High / Medium / Low
	Boundary Management	Clear / Blurred
	Work Overload	None / Moderate / High

4 Findings

Section 4.1 illustrates how MPPM can be used to analyze quantitative data from a MP's Risk and Issue Register. Section 4.2 presents the findings of the interviews with MP managers, and a deeper analysis of a specific issue category by incorporating feedback from the interviews to understand the source of problems in the category.

4.1 MPPM Framework in Practice

Data used for this section came from the Risk and Issue Register of a MP dedicated to execution of datacenter builds in the United States. Table 4 is a sample of individual entries in the datacenter program's risks and issue register¹:

Table 4. Sample Data from Datacenter Major Program Risk and Issue Register

Initial Development of the FMEA						Improvement Activities		Post-Improvement Activities
Risk or Issue?	Project Phase	Category	Risk/Issue Statement	Impact Statement	Schedule Impact (days)	Mitigation Actions Recommended	Team Responsible for Mitigation Strategy	Mitigation Actions Taken
Issue	Execution	Quality	Electrical systems testing needs to be redone due to errors in factory fitness test documentation	Delay to L4 commissioning	266	Correct documentation and retest electrical systems	Construction	Electrical system required to be replaced due to degradation while documentation was being corrected. Retesting complete
Issue	Planning and design	Government	Permitting delays due to change in county resourcing availability	Delay to design completion	238	Escalate to county leadership for increased resources	Design	Escalation did not mitigate issue; schedule delay accepted
Issue	Planning and design	Supply Chain	Project schedule at risk due to equipment lead times	Delay to construction completion	546	Review options for substitute equipment with lower lead time to delivery	Supply Chain	Design change approved for substitute equipment
Issue	Planning and design	Financial and economical	Schedule delayed due to change in project need by date per Finance org	Delay to project completion	366	Accept delay and work with project team to analyze impact of delay	E2E	Accept delay and work with project team to analyze impact
Issue	Performance and Monitoring	Health, Safety, and Environmental	COVID-19 site restrictions impacting construction schedule due to social distancing requirements	Delay to construction completion	7	Accept delay and update schedule to reflect COVID-19 restrictions	Construction	Accept delay and update schedule to reflect COVID-19 restrictions
Issue	Planning and design	Other Risks	Potential utility energy constraints blocker to delivering datacenter	Delay to project completion	61	Coordinate with Utility Company to confirm availability of required MW	Energy	Required power for datacenter confirmed available by utility company
Risk	Execution	Network	Network device cable map delayed due to tooling issue	Delay to WAN network go-live	0	Teams reviewing errors in completed cable maps, corrections to be made in tooling systems	Network Engineering	Escalation to networking leadership to complete corrections in tooling systems
Risk	Execution	Construction and Technical	Security systems design change outstanding; risk to construction schedule	Delay to security systems installation	0	Escalate to third-party vendor blocking design change requirements	Construction	Substitute security system approved in design change

¹ Due to word count limitations and sensitivity of confidential business data, a small subset of the 325 total entries in the register were randomly chosen.

Given the specific scope that goes into building a datacenter, two additional risk and issue categories were added to those shown in Table 1, e.g., R16 Network and R17 Supply chain (applicable to all phases except for the Inception and Feasibility phase).

Table 5. Supplemental Categories tied to Datacenter Major Program

ID	Category
R16	Network
R17	Supply Chain

Project Phase	Category
Planning and design	R16, R17
Execution	R16, R17
Performance and monitoring	R16, R17

Overall Issue Impact by Project Lifecycle Phase

Using Microsoft Excel, the dataset from the Risk and Issue Register was further filtered to highlight only issues and their associated data fields. A Pareto Chart was created using this data against Project Lifecycle Phase only using Excel's built in statistical graphing capabilities:

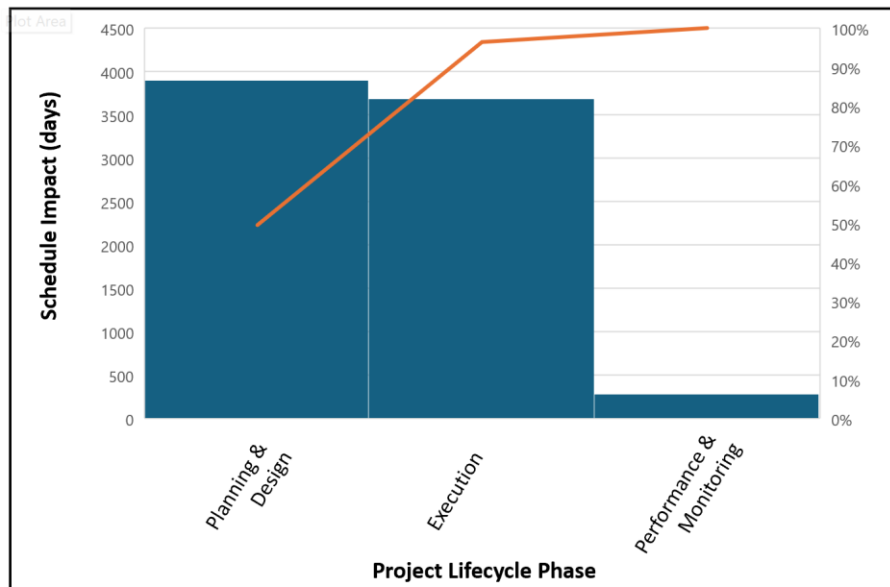


Figure 6. Total Days Schedule Impact by Project Lifecycle Phase

In this lens, roughly 50% of issues occur during the Planning and Design phase with the Execution phase representing 46% of issues.

Overall Issue Impact by Issue Category

In accordance with Step 4 of the MPPM Conceptual Framework, we generate a pareto chart by issue category with the same Excel dataset:

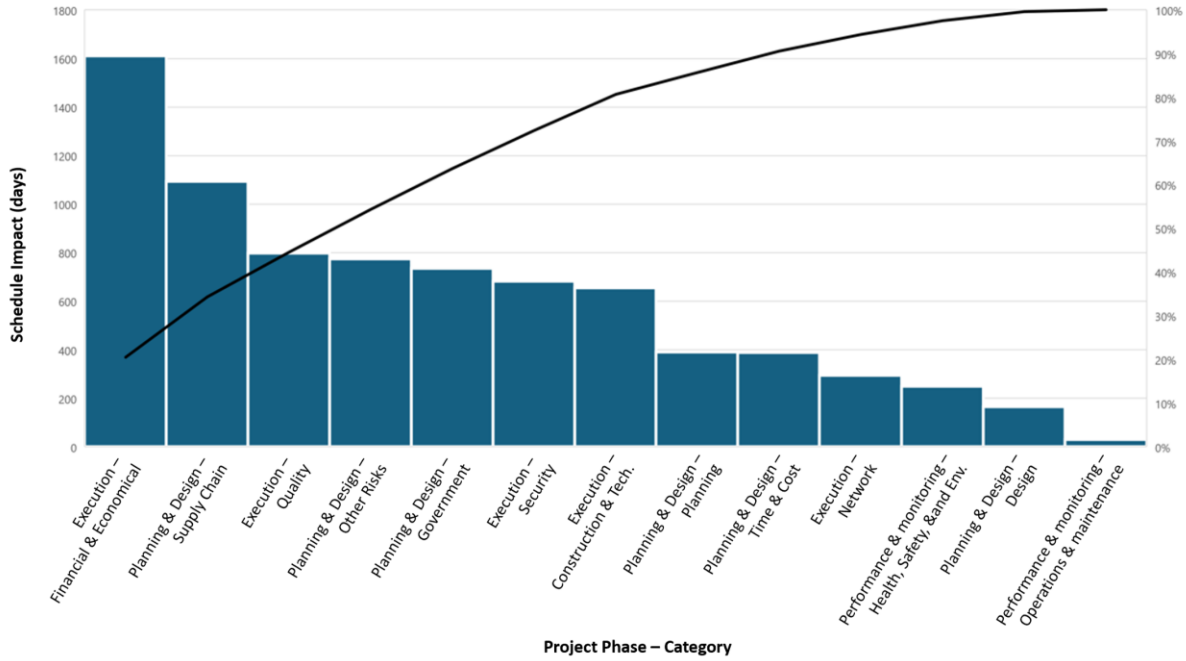


Figure 7. Total Days Schedule Impact by Issue Category

The pareto chart demonstrates that the 33 individual projects experienced a total of roughly 1600 days, or 48.5 days per project, schedule delays due to Financial and Economical issues encountered during the Execution phase. These issues alone represent roughly 20% of total schedule delays in the entire dataset. Continuing, Supply Chain issues encountered in the Planning and Design phase caused 1093 days of impact, or roughly 33.1 days per project. Of note, some categories shown in Figure 7 were not shown in the pareto chart because there were no impact causing issues logged in the Risk and Issue Register.

4.2 Themes from Interviews

To illustrate MPPM, the previous empirical example was used in interviews. This section explores the emerging themes.

Theme 1- Approaches to Implementation

Interviewees supported implementing the framework in an MP by prioritizing the highest-impact issue category, such as Financial and Economic issues as shown in Figure 7. While the Pareto chart served as a starting point, they recommended deeper analysis of the Risk and Issue Register to identify trends and root causes. Techniques like RCAs or Five-Whys could further refine insights, guiding efforts to minimize future project impacts.

Some interviewees acknowledged the first approach but noted that the highest-impact category might be uncontrollable, such as delays from government permit approvals. In such

cases, they recommended focusing on manageable issues, like improving Quality during the Execution phase.

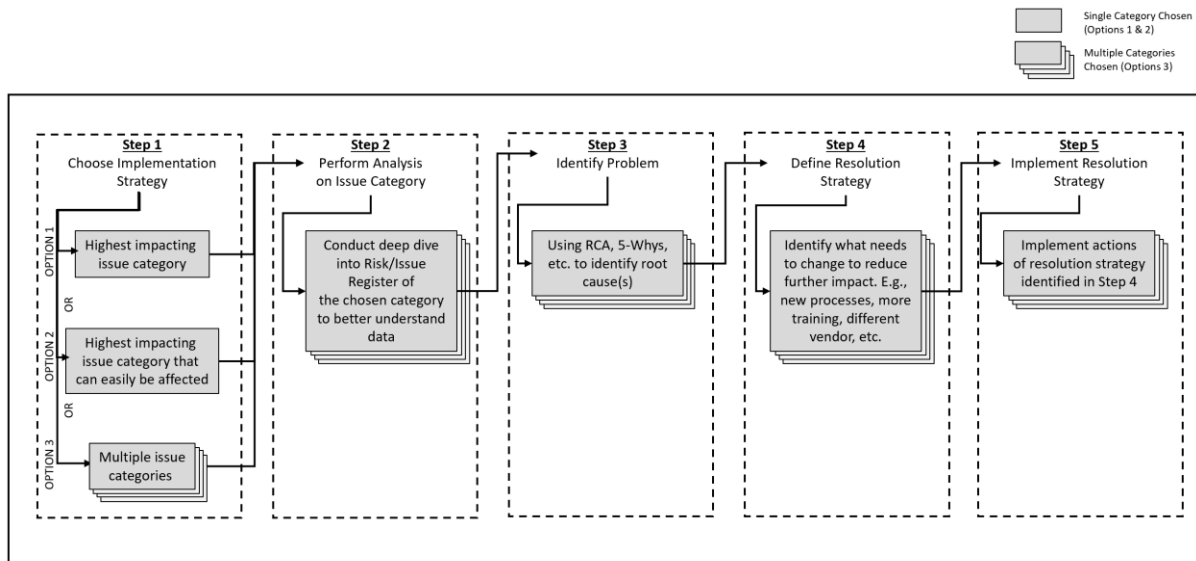


Figure 8. Proposed Problem Management Process Framework

A third approach, recommended by senior career-level participants, was to address multiple issues across different categories rather than focusing on a single problem. They believed that reducing delays in several categories by smaller amounts could be as impactful as a significant reduction in a single category. As quoted from one interviewee, P10: *“I’m always looking for efficiency. My daily focus is on ensuring the teams are accountable for their responsibilities to meet or exceed the business’s need-by dates for projects.”*

Theme 2- Benefits to a Major Program

All interviewees agreed that implementing this framework in an MP offers benefits, primarily by enabling early risk identification. This proactive approach helps prevent issues from escalating, which is especially crucial in complex environments like datacenters, where schedule and cost control are critical. In the words of one interviewee, P1 (2024): *“you pivot out of a reactive mode and move into a proactive mode. One of the biggest challenges for organizations is understanding risk profiles. When you [have a framework] that shows that certain risks become issues 90% of the time, it changes things around a bit and moves to a more proactive approach and eliminates the day to day firefighting.”*

Additionally, this framework can help standardize risk management practices across teams in a MP, ensuring that all project teams and stakeholders share a common understanding of processes and expectations. In the words of one interviewee, P2 (2024): *“but for the wider project teams and stakeholders, a standardized approach would mean they know what to expect from PM to PM. This would facilitate better coordination and information sharing. Without standardization, working relationships could differ, leading to communication issues and delays.”* Interviewees noted though that enabling these aspects requires a thoughtful approach to organizational change management to ensure all stakeholders are bought in to using the framework.

Interviewees noted that the framework’s quantitative data aids decision-making by helping leaders prioritize high-impact issues, improving resource allocation. It also integrates

well with planning efforts, such as setting OKRs to reduce impact in a specific issue category over the next semester.

Finally, implementing this framework improves problem resolution by helping practitioners identify systemic or complex issues that may not be apparent when reviewing individual cases. This deeper understanding enables more effective resolution strategies by addressing root causes.

Theme 3- Resources Required for Successful Implementation

Interviewees noted that a comprehensive approach would be required in order to successfully implement MPPM. This is inclusive of people resource, tooling, training, and buy-in from program leadership and stakeholders.

1) People Resources:

Interviewees differed on resource needs for implementation: six of ten favored dedicated resources, while four believed existing staff sufficed. Notably, the latter were Program Managers (less experienced), while those advocating dedicated resources were at the Partner and Director levels. One interviewee linked implementation strategy to resourcing. Using existing resources favors targeting easily affected issues, yielding some benefits. However, addressing the highest-impact category requires dedicated resources to manage its complexities and root causes.

2) Tooling

Some interviewees emphasized the need for advanced tooling to capture, analyze, and visualize risk register data. More complex risk models, like MPPM, may also require additional dedicated resources. As Interviewee P5 (2024) stated: *“as you get more sophisticated, tooling can become more sophisticated as well to help you predict how risky your project is at any point in time. Tooling is important but can be leveled based on where the organization is.”* Others highlighted the importance of selecting appropriate tooling early, given the FMEA Risk Register’s nuanced structure.

3) Training

Most interviewees agreed that training is essential, regardless of resource allocation. It ensures understanding of MPPM, including its intent, processes, problem identification, and resolution strategies, to maintain standards and maximize benefits.

4) Leadership and stakeholder buy-in

Some interviewees emphasized the need for leadership and stakeholder buy-in for successful implementation. Strong endorsement ensures prioritization, while stakeholder engagement is crucial for understanding and supporting the framework.

Theme 4- Limits to Implementation

Interviewees noted that the implementation of MPPM in a MP can be limited by data quality, organizational politics, culture, and resource allocation:

1) Data Quality

Interviewees agreed that ensuring the integrity and quality of data is crucial. Examples of low quality data include double-counting issues and overlapping data points,

which can affect the accuracy of the pareto chart. Proper tooling and training can help enable the capture of high quality data.

2) Organizational Politics

One interviewee warned that the framework could “challenge fiefdoms,” as teams causing significant impact might question data integrity to deflect scrutiny. Others noted that siloed leadership might resist documenting their team’s issues in the risk register.

3) Organizational Culture

Most interviewees noted that the organization's culture can significantly impact the adoption of the framework. If an organization is not familiar with rudimentary risk management practices or believe it is their responsibility, the framework can be hard to implement.

4) Resource Allocation

Some interviewees noted that implementation could be limited if resources from Theme #3 are not secured. For example, without funding for dedicated staff, teams might be forced to pursue the more manageable issue categories instead.

Theme 5- Improvements to Framework

1) Different metrics

Interviewees noted that creating multiple pareto charts by using multiple metrics to measure impact, such as cost and/or quality, can provide for a more comprehensive assessment of impact beyond schedule delays. For example, while schedule delays are important, understanding the cost implications can help prioritize issues that have a significant financial impact. Leaders are enabled to make more informed and balanced decisions by considering multiple dimensions of impact, such as cost, schedule, and quality.

Moreover, some interviewees noted that different stakeholders may be interested in different metrics. For example, financial stakeholders may prioritize cost metrics, while project managers may focus on schedule metrics. Creating multiple pareto charts with different measurements of impact ensures that the concerns of all stakeholders can be addressed.

2) Subcategories

Along with the improvements of deeper data and multiple measurements of impact, most interviewees also felt that the framework could be improved by including subcategories. Similar to deeper data, having a view of subcategories can enable a better understanding of issues and thus a more detailed understanding of the problems and their root causes. They can also accelerate the analysis on an issue category by narrowing the focus of attention at the forefront.

3) Historic view of pareto chart

Lastly, one interviewee noted that creating a historic view of the pareto chart can improve the framework. A historic view enables the ability to do trend analysis, which can identify if certain issues occur at certain times of the year and if they are becoming more or less frequent. Moreover, a historic view can improve decision-making for future projects by providing a comprehensive view if issues arise at certain points of the year.

4.3 Analysis of Issue Category

This section is an expansion on Section 4.1 that incorporates data from interviews regarding how the framework could be improved. In the previous section interviewees noted four ways in which MPPM could be improved. Of them, using deeper data is the one approach that is easily leverageable with the sample data at hand from the MP of datacenter infrastructure execution. This section will synthesize the use of deeper data analyze the “Financial and Economical” category during the “Execution” phase that was identified in Section 4.1 as having the largest aggregate days lost to schedule.

To use deeper data, I look for common themes in the Issue Statements and Mitigations Actions Recommended/Taken. A full breakdown of the issues in this category can be found in Appendix A. The total 1611 days lost to schedule caused by Financial and Economical issues had three fundamental themes:

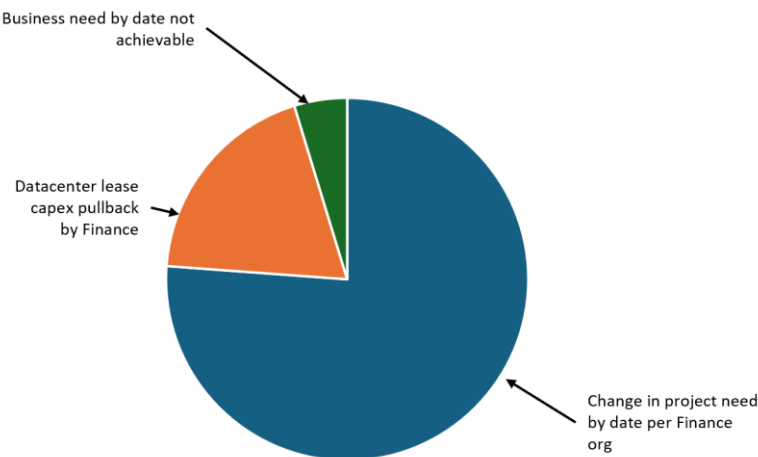


Figure 9. Financial and Economical Category Schedule Delays (days)

1. 1,227 days lost due to delays from Finance by changing the business need-by date,
2. 308 days lost to schedule due to cancellation of capex funding altogether, and
3. 76 days lost due to a business need by date for a specific activity being unachievable.

In conclusion, MPPM can potentially aid in identifying and addressing root causes of systemic and/or more complex issues in a way that traditional risk management frameworks cannot. The framework can be implemented in multiple ways that can each benefit a MP, although there are potential limitations to be considered.

5 Discussion

Analysis of MP risk and issue register data highlights challenges in both the Planning & Design and Execution phases. Typically, the Execution phase is the most problematic, leading to time, cost, and quality shortfalls (Denicol et al., 2020; Eweje et al., 2012). However, the datacenter program experienced more issues in the Planning & Design phase, deviating from the literature. This may be due to unprecedented global supply chain disruptions over the past four and a half years (McGillivray, 2021). As supply chains stabilize, the Execution phase may once again become the primary source of project issues.

The interdependent nature of Problem Management framework implementation in an MP affects its benefits. Using existing resources or securing dedicated ones impacts outcomes, but without business support for additional headcount, MPs may be forced to rely

on existing staff. This could create a doom loop, where limited benefits lead leadership to withdraw resources, ultimately making the framework ineffective.

MPPM aligns with second-order risk management theory by extending FMEA and Pareto charts to a new context. Interview data suggests compatibility with other tools like RCAs, which typically address individual issues (Peerally et al., 2016), while the framework applies them to systemic issues through categorized analysis. The five-step process from interviews (Figure 8) parallels the MPRM high-level process identified in the literature. Although no direct equivalent for "monitoring and controlling risk" emerged, a sixth step, "Monitoring and Control Resolution Strategy," could be proposed (see Figure 10).

As discussed in Section 2, the Monitoring and Control stage in risk management involves reviewing active risks, updating response plans, and closing resolved risks (Kardes et al., 2017). A similar stage in MPPM could track resolution progress, adjust strategies as needed, and close resolutions once implemented or reprioritized.

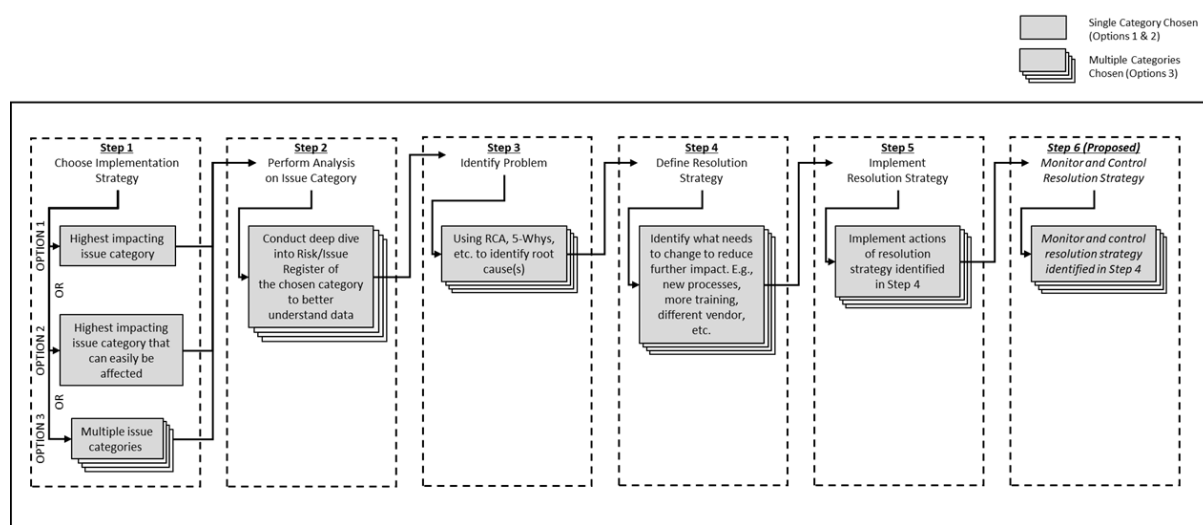


Figure 10. Proposed Sixth Step for Problem Management Process Framework

The findings insinuates that implementing MPPM could face the similar challenges that plague existing practices in MPRM (Braig et al., 2011; Mitra et al., 2023; Thamhain, 2013). Attempting to implement the framework in industries that lack knowledge of fundamental risk management practices could be challenging because it requires training on even more complex practices and quantitative analyses. Similarly, implementation in industries that have a large number of practitioners that do not view risk management as a part of their job (Thamhain, 2013) would be limited as well.

As previously discussed, implementation of the framework would require careful change management practices in order to obtain stakeholder buy-in. Part of this transformation might be a shift in the mindsets of program managers insofar as how they view risk/issues. The literature review identified that such practitioners are more focused on the tactical level of risks and issues (Thamhain, 2013), but MPPM enables a systemic view of these items and requires broader resolution strategies to mitigate impact. Contrastingly, the broader lens that senior managers apply to risks and issues (Thamhain, 2013) seems as if it could be transferred more easily to implementing MPPM.

The framework might be viewed as running counter to notion on viewing risks and issues as extensions of larger uncertainty in a MP (Perminova et al., 2008; Ward and Chapman, 2003). The framework is predicated upon the ability to quantify an issue's impact on objectives; however, in many cases practitioners might lack the data necessary to do this

(Sanderson, 2012). Moreover, quantifying the impact of external sources of issues can be challenging as well (NASA, 2011). For example, while geopolitical instability in a foreign market can affect the ability to obtain natural resources to produce equipment, it might not be easy to discern what the actual impact in a project is. Ultimately, implementing MPPM has the ability to render substantial benefits to a MP but requires a thoughtful approach to getting the buy-in needed from program leadership, stakeholders, and the larger business.

6 Conclusions, Recommendations, and Further Work

This paper develops an analytical framework for second-order risk management in MPs to address systemic and complex risks. Existing frameworks either cater to specific industries (e.g., Agile in software development) or lack direct data integration from MPs (e.g., RCF). While concepts like RCA can be applied to MPs, they typically focus on isolated issues with limited program-wide impact.

MPPM extends ITIL V4's Problem Management to MPRM, integrating FMEA and Pareto charts from LSS. Using four and a half years of data from a datacenter MP's Risk and Issue Register, the study demonstrates how changes in project need-by dates negatively impact performance. Findings show that the Planning or Execution phase has the greatest impact, depending on Pareto chart structuring.

Interviews with MP practitioners informed an implementation approach, highlighting how MPPM fits within broader risk management. Effective adoption depends on robust first-order risk management, including people, processes, and structures. When these are in place, the framework can significantly reduce cost overruns, schedule delays, and quality defects. However, its success may depend on resource allocation and funding from the larger business.

The research has some limitations that need to be acknowledged. Data used to analyze the datacenter MP's problem areas was collected by a team dedicated to the execution lifecycle phase. With this, the collection of data related to the Inception & Feasibility and Performance & Monitoring lifecycle phases was underrepresented. A future area of research might be to perform a comparative analysis of issues across lifecycle phases with MPPM with a dataset that includes data captured equitably across all phases.

This research opens new avenues for MPRM, enabling deeper insights into systemic MP risks across industries. With sufficient cross-industry data, Problem Management could complement RCF by providing an "inside-view" of risk, enhancing time, cost, and quality forecasting. While every major program will continue to face uncertainty in the form of risks and issues, Problem Management can make them substantially less major.

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