

ABSTRACT

Digital transformation is a strategic priority for firms in the electric utility industry and accounts for billions of investment dollars (USD) across all industries. Leaders of these organizations strive for effective risk management governance systems and adequately prepared workforces to execute their strategic initiatives. Identifying and understanding the key factors that increase the effectiveness of project portfolio risk management in these organizations helps enable their digital transformation goals.

The goal of this research is to identify and understand the key determinants of project portfolio risk management effectiveness (PPRME) relevant to power producers in the United States electric utility industry. A survey of over two hundred workers provided the data informing the investigation. Partial Least Squares - Structural Equation Modelling (PLS-SEM) was used to test a model describing the impact of risk management culture, leadership support, stakeholder engagement, and management processes on project portfolio risk management effectiveness.

The results inform the key roles of organizational risk management culture and the quality of senior management support for improving the effectiveness of an organization's project portfolio management. Effectiveness in project portfolio risk management is driven by informed, and empowered project teams and engaged, risk-aware leadership.

Keywords: Project portfolio risk management, Digital transformation, Electric utilities

INTRODUCTION

Digital transformation (DT) is the process of continuous technological adaptation and adoption that organizations embrace to sustain competitive advantages and strategic ascent (Mican, Fernandes, Araujo, & Ares, 2021). The scale of this transformation is unprecedented, with worldwide investment in DT forecasted to reach four trillion USD by 2027, a 400% increase over the preceding decade (Statista, 2024). This growing investment reflects not only a technological shift, but also a fundamental reimagining of how organizations operate, compete, and create value in an increasingly digital economy. Managing these challenges hinges on understanding the strategic importance of DT for the nation and electric utility providers. These providers are uniquely positioned at an intersection of both pursuing DT and supplying the critical infrastructure that powers DT. This study explores the primary challenges associated with the need to update and sustain the power generation infrastructure required to support DT.

The strategic importance of digital transformation extends beyond individual organizational competitiveness to national priorities. The United States Department of Energy has prioritized becoming world leaders in artificial intelligence (AI) (Energy.gov, 2025). This commitment has implications for the energy sector, where AI and data center growth are projected to be key drivers of future power demand for the next decade (Petersen, 2024). The convergence of national AI goals and energy infrastructure requirements creates a complex landscape of interdependent risks and opportunities.

Emerging technologies serve as catalysts for transformational change and require increasing and substantive computing and electrical power across most industries. The rate of data generation by consumers and producers is expected to quadruple over the next five years, necessitating more power-intensive data center servers and networking equipment to support AI and other advanced technologies (Petersen, 2024). The internet of things (IoT), big data

analytics, cloud computing, augmented reality, cryptocurrency, and blockchain technologies are examples of power-intensive digital transformation initiatives. Data centers, as collocated banks of servers, routers, and network hubs, provide the foundation of IT advancement. The organizational changes enabled by DT, such as technology platform transitions from on-premise to cloud environments and the adoption of internet-hosted services (e.g., Software as a Service, SaaS; Infrastructure as a Service, IaaS; Platform as a Service, PaaS, etc.), require significant data center capacity to execute and maintain (Battisti et al., 2020; Gemino & Reich, 2023).

Risks Associated with Digital Transformation

The technological advancement driving DT introduces multifaceted risks that organizations must actively manage. AI (Busheyev & Ivko, 2024) and cloud computing (Gemino & Reich, 2023) exemplify advanced technologies that compel power producers to enhance their risk management capabilities. Additionally, internet technology faces increasingly sophisticated and adaptive cybersecurity threats that must be contained by both producers and users (Catrina & Ghigiu, 2024; Muntés-Mulero et al., 2019). Data center owners and operators seek long-term, strategic partnerships with power producers to lower costs, improve reliability, and manage operational risks (News, 2025; Panagakou, 2024). These partnerships reflect the recognition that effective risk management requires collaborative approaches across the digital transformation ecosystem.

Digital Transformation Project Management

The challenges and opportunities associated with technological advancement through digital transformation and innovation are expected to represent key risks in project management for the next decade (Farrow & Kezner, 2023). Consequently, project and portfolio managers across organizations are accountable for effectively managing DT initiatives.

Based on the scope and growth of DT and the associated organizational risks, there is an important need for enhanced project and portfolio risk management frameworks specifically designed for digital transformation initiatives, particularly within the context of energy infrastructure development and the complex interdependencies between technological advancement and power generation capabilities. Therefore, the current study specifically examines the following research question:

What are the determinants of project portfolio risk management effectiveness for digital transformation in the U.S. electric utility industry?

Research Underpinnings

The foundational understanding of digital transformation's implications for project portfolio analysis was informed from the results of a qualitative thematic analysis that identified eight critical implications of digital transformation for project portfolio management (Mican et al., 2021). Some of these implications included technological interconnection vulnerabilities, dynamic risks, complex digital environments, and opportunities like real-time data integration. Recognizing the limitations of the qualitative approach, Mican et al. (2021) recommended future research evaluate these implications from a practitioner perspective using empirical, quantitative methods. In direct response, an empirical research identified the determinants of risk management effectiveness in project portfolios within the European financial technology (FinTech) industry (Khalil-Oliwa & Jonek-Kowalska, 2024). This study analyzed survey responses from 105 FinTech project managers using Partial Least Squares - Structural Equation Modelling (PLS-SEM), a quantitative analysis tool specifically recommended for social science research characterized by predictive testing of theoretical models or frameworks, particularly when dealing with relatively small samples ($n < 200$) and suspected non-normality in the data distribution (Hair, Risher, Sarstedt, & Ringle, 2019). Through this methodological approach,

Khalil-Oliwa and Jonek-Kowalska (2024) developed and validated research instruments and established an analytical framework for understanding project portfolio risk management effectiveness (PPRME).

Building upon this established research foundation and explicit calls for empirical research in varying contexts (Khalil-Oliwa & Jonek-Kowalska, 2024; Mican et al., 2021), by addressing a gap in industry-specific application and geographic context. While Khalil-Oliwa and Jonek-Kowalska (2024) assessed the determinants of project portfolio risk management effectiveness in the European financial technology (FinTech) industry, this research extends their framework by evaluating these factors within the context of digital transformation initiatives in the U.S. electric utility industry. The electric utility industry presents unique challenges and operational contexts that differ significantly from the European financial technology environment, particularly in terms of regulatory frameworks, infrastructure requirements, and digital transformation drivers. Additionally, the focus on the United States market provides valuable insights into the unique determinants of project portfolio risk management effectiveness within a different regulatory and business environment.

To ensure methodological consistency this study leveraged Khalil-Oliwa and Jonek-Kowalska's (2024) validated research model and instruments with established scales. The following sections review literature to develop hypotheses and the initial research model. Data collection was conducted through an online survey targeting workers with direct experience in the electric utility industry, seeking practitioner-relevant insights aligned with Mican et al.'s (2021) original research recommendations. Following the methodological precedent established by Khalil-Oliwa and Jonek-Kowalska, data analysis and model development utilized Partial Least Squares - Structural Equation Modelling (PLS-SEM) via SmartPLS software.

RESEARCH BACKGROUND

The goal of this research is to identify the determinants of project portfolio risk management effectiveness (PPRME) relevant to power producers in the United States electric utility industry and address the research question: *What are the determinants of project portfolio risk management effectiveness for digital transformation in the U.S. electric utility industry?* Existing literature is reviewed to establish a theoretical understanding of DT and the related organizational mechanisms of portfolio risk and effective program and project management (i.e., the dependent variable). This is followed by identifying the driving factors (i.e., independent variables) of effective management of project portfolio risk management.

Digital Transformation and Project Portfolio Risk Management

Digital transformation is an enabler for modern organizations pursuing meaningful organizational adaptation and growth. The digitalization of the approach and tasks of risk management have been identified as key contributors to organizational and project success (Karkukly, 2019; Mican et al., 2021). Strong risk management cultures are built over time with consistent leadership examples, prioritization, and demonstrate strong strategic alignment throughout the organization (Karkukly, 2019; Khalil-Oliwa & Jonek-Kowalska, 2024; Kolatch, 2022; Muntés-Mulero et al., 2019).

Khalil-Oliwa & Jonek-Kowalska (2024) developed a model for risk management in project portfolios with project portfolio risk management (PPRM) effectiveness as the dependent variable and independent variables of organizational context, organizational governance, risk management processes, senior management involvement/support, and strategic orientation and found FinTech organization's risk management processes had the greatest impact on PPRM effectiveness. Additionally, they identified the importance of senior management involvement

for influencing governance, strategic orientation, and risk management processes for these organizations.

Project portfolio risk management effectiveness. Project portfolio risk management effectiveness (PPRME) is the cumulative impact of associated activities, organizational focus, stakeholder engagement, and workforce acumen. As such, the effectiveness of its PPRM can significantly impact the quality of organizational outcomes and initiatives. The primary elements comprising project portfolio risk management include the organization's portfolio of digital transformation initiatives, the associated risks, and the overall effectiveness of their risk response.

Project, portfolio, and program management. The Project Management Institute (PMI) is a worldwide certification body for project management and provides guidelines that inform the practice of project, portfolio, and program management. PMI produces the industry standard for project management, the Project Management Body of Knowledge, or PMBOK. The PMBOK provides standards and principles governing the roles, responsibilities, and actions for managing projects and delivering desired project outcomes (PMBOK Guide, 2021). The conception of projects, programs, portfolios and their management utilized in this study was based on the framework established by the PMI.

Projects are a mechanism for organizations to transform holistically (i.e., organizationally) and intrinsically (i.e., operationally) and implement strategic objectives that can improve, sustain, or create competitive advantages (Fridgeirsson, Ingason, Jonasson, Kristjansdottir, & Rosen, 2021). Project management also supports efficient stakeholder alignment & engagement (Kaufman & Kock, 2022). Stakeholders represent the entities and individuals most impacted by the actions and results associated with project activities. Similarly,

programs combine multiple projects that align the management of initiatives to optimize the strategic benefit to their owners (PMBOK Guide, 2021). Programs can have a wider impact and greater influence on achieving strategic objectives than singular projects, primarily through association with benefits that are not realized until after projects are completed (Gemino & Reich, 2023).

Portfolios, or collections of projects and programs, are managed according to the same philosophy with additional focus placed on achieving aggregate value (Khalil-Oliwa & Jonek-Kowalska, 2024; PMBOK Guide, 2021). Generally, the organization's primary purpose in developing a project portfolio is to execute its strategic plans, objectives, and goals (Sanchez, Robert, & Pellerin, 2008).

Driving Factors of Project Portfolio Risk Management Effectiveness

This study extends Khalil-Oliwa & Jonek-Kowalska's (2024) work by applying their model to the electric utility industry within the United States. Key independent variables from the prior work were modified based on findings from other literature informing further contextualization of the relevant factors. The research model examined is depicted in Figure 1. A review of relevant extant literature informed the conceptualization of the factors included in the developed research model. The model describes the hypothesized influence of senior management support, stakeholder engagement, organizational risk management culture, and the project portfolio risk management processes on overall PPRME for organizations implementing digital transformation in the U.S. electric utility industry.

Insert Figure 1 about here

Senior management support. A key factor in improving the effectiveness of project risk management in the organization is the quality and consistency of the support of its top leadership

or senior management. An organization's leaders benefit from a steadfast focus on the value proposition of strategic initiatives and ensuring that the activities associated with risk management are prioritized. Senior managers are advised to avoid distraction by the novelty of technological advancement due to the risk of compromising the rigor of strategic execution (Romero, Flores, Herrera, & Resendez, 2019).

Effective leaders seek to understand the biases to which they and their organizations are prone, thereby minimizing their potential adverse effects (Davidson, Parnell, & Davenport, 2024; Mullins et al., 2023). Risk-informed decision-making helps organizational leaders optimize the allocation of available resources. Composite input from throughout the organization can provide a comprehensive view of the issues impacting the organization. Leaders tend to receive greater overall support from their followers when they empower and engage agents by sharing decision-making authority where appropriate (Badewi, 2022; Elkhatib, Zitar, Alnaqbi, Alnaqbi-W, Alharmoodi, & Baydoun, 2023; Holzmann et al., 2022). Organizations that value employee engagement can benefit from an improved quality in meta-risk analysis (Karkukly, 2019; Khalil-Oliwa & Jonek-Kowalska, 2024; Reyck, Grushka-Cockayne, Lockett, Calderini, Moura, & Sloper, 2005).

Senior management support is a key factor in improving the effectiveness of project and risk management in the organization. This factor helps to ensure that the value proposition of strategic initiatives is realized and can help to shield project teams from resource draining distractions on non-priorities (Romero et al., 2019).

Hypothesis 1. Senior management support improves project portfolio risk management effectiveness.

Stakeholders. Risk awareness is important for all project stakeholders. External stakeholders (SH) including customers, partners, regulatory authorities, and the public benefit

from active involvement early in the project life-cycle. Early stakeholder engagement clarifies customer input, deliverables, and beneficial metrics. Ongoing collaboration with all stakeholder groups invites diversity and improves risk identification and awareness (Kheir, Jacoby, & Verwulgen, 2022; Romero et al., 2019; Santos, Varela, & Martinez-Galan, 2022; Veera, 2024; Vial, 2019).

Stakeholder interactions exhibiting honesty and transparency can promote engagement and build trust. Contributions from all stakeholders tend to increase when inclusivity, trust, and open communication are encouraged (Mullins et al., 2023; PMI, 2023a; Santos et al., 2022).

Diverse and data-driven input can improve the effectiveness of decision-making and risk management associated with digital transformation. These outcomes are promoted by engaged stakeholder collaboration with experts and impacted parties both within and external to the organization or project team (Battisti, Shams, Sakka, & Miglietta, 2020; Elkhatib et al., 2023).

Hypothesis 2. Stakeholder engagement improves project portfolio risk management effectiveness.

Organizational risk management culture. From a programmatic perspective, risk represents the potential challenges and opportunities that can impact the execution or outcomes of initiatives, either positively or negatively (PMBOK, 2021). Managing risks is a key process in project, program, and portfolio management.

While project risk management is focused on specific, individual initiatives, enterprise risk management addresses organizational threats and opportunities and informs responses based on the holistic capacity and culture of the organization. Enterprise risk management leverages all of the organization's resources and assets, including policies and procedures, and informs the efficiency and quality of risk management activities throughout the organization (PMI, 2019).

The culture developed within an organization distinctly impacts on the quality of decision-making. The organization's risk management culture impacts decision-making, resource allocation, workforce preparedness, and stakeholder involvement. As with stakeholder engagement, early risk identification and analysis should be prioritized by the organization. Strong risk management cultures are developed over time (Muntés-Mulero et al., 2019) and sustained by consistent leadership and organizational strategic alignment. Leaders in these organizations often recognize that corporate, experiential knowledge is a key asset (Gemino & Reich, 2023; Khalil-Oliwa & Jonek-Kowalska, 2024; Kolatch, 2022; PMI, 2023a; Vial, 2019).

Hypothesis 3. Organizational risk management culture is positively related to project portfolio risk management effectiveness.

Project portfolio risk management. Another key factor impacting the likelihood of organizational success is the quality of its processes for project and risk management. An organization's project portfolio risk management processes inform the frameworks employed, prioritization assigned, and quality of risk awareness and responses. Organizational adoption of project management frameworks helps empower agents to improve outcomes of initiatives. Empowered and appropriately trained workforces provide better support to leadership. Organizational investments in project management skill development can mitigate the adverse impact of ineffective senior management (Badewi, 2022; Bushuyev & Ivko, 2024; Frederico, 2021; Kaufmann & Kock, 2022; Kheir et al., 2022; Müller, Locatelli, Holzmann, Nilsson, & Sagay, 2024; PMI, 2023a; Santos et al., 2022; Veera, 2024; Vial, 2019).

Workforce upskilling helps to mitigate challenges associated with technology adoption. Strategic project management training, and development of the associated skillsets can improve organizational change adoption and maturity. Digital transformation is better supported by an adequately trained, skilled, informed, and incentivized workforce (Kaufmann & Kock, 2022;

Müller et al., 2024; PMI, 2023a; Rauniyar, Wu, Gupta, Modgil, & Lopes de Sousa Jabbour., 2023; Romero et al., 2019; Vial, 2019).

An organization's project management office (PMO) has the important role in leading organizational digital adoption and transformation. PMO agility improves the responsiveness to disruptive technology & the processes for managing DT initiatives. By helping lead the organization in project risk management, the PMO supports informed decision-making by increasing stakeholder understanding of digital transformation risks and the associated impacts (Hussain, Ahmad, & Minhas, 2024; Karkukly, 2019; Teslia et al., 2022).

Hypothesis 4. Project portfolio risk management processes improve project portfolio risk management effectiveness.

Hypothesis 5. Organizational risk management culture improves the quality of project portfolio risk management.

Research questions and hypotheses. Addressing the challenges and opportunities intrinsic to the risks associated with technological advancement through digital transformation is a mission-critical objective for organizations in the domestic electric utility industry. Senior management in these organizations recognize that the effective management of these technological initiatives will be a prime accountability for the project and portfolio managers in their organizations. These factors informed the primary research question at the core of this research and the five hypotheses investigated.

RESEARCH METHODS

To test the hypotheses developed from an investigation of related literature, this study employed a quantitative survey design using validated measurement scales to examine determinants of project portfolio risk management effectiveness in the U.S. electric utility industry and built on previous theoretical and empirical findings (Khalil-Oliwa & Jonek-

Kowalska, 2024; Mican et al., 2021). The following sections describe the data collection, measurement instrument, and analysis.

Data Collection Methodology

Population sample. The population of interest was workers in the U.S. electric utility industry with experience conducting, supporting, or impacted by digital transformation projects and initiatives. This study sampled participants that included, project managers, portfolio managers, product managers, project engineers, project controls specialists/administrators, and portfolio managers. Respondents were recruited via the Prolific platform, resulting in a final combined sample of two hundred twenty-two (222) participant responses were included in the study.

Measurement instrument. The instrument was adapted from prior validated studies and included 83 items (5-point Likert scale), along with demographic control items. The model utilized 68 observable indicators representing key constructs: PPRME, PRM, SMS, SHE, ORMC, and PPRM. Attention check questions were embedded to promote response validity. Multiple procedural remedies were applied to reduce common method bias, including temporal separation (Jordan & Troth, 2019), randomized item ordering, and varied item wording.

Data Analysis Method

The collected data was analyzed using advanced statistical methods to detect relationships between theorized constructs and provide meaningful interpretation for evaluation of the research model. IBM SPSS Statistical software¹ was used to perform data cleaning, organizing, and generating descriptive statistics. The proposed and resultant research models

¹ Version 30.0.0.0 (172).

were analyzed with Partial Least Squares - Structural Equation Modeling (PLS-SEM) using SmartPLS software².

RESULTS

Demographic data collected for all participants from both surveys was summarized in Table 1. This data provided insight into key attributes and characteristics of the participants included in the final dataset. The predominant aggregate profile is as follows: Male (65.3%), college educated (78.3%), employed in the Information Technology (IT) or Software sectors (44.6%), worked in the eastern United States (46.8%), and no more than fifteen (15) years work experience in the Electric utility industry (87.4%).

In terms of job roles within the Electric utility industry, there were comparable numbers of Project, Portfolio, or Program Managers (36%) and Technical / Analyst roles (34.2%). Similarly, the number Senior Leaders / Managers (32) were comparable to the number of Consultants (34) retained in the final data set. Most of the participants (62.2%) worked in organizations with five hundred or fewer (< 500) employees

Insert Table 1 about here

Reflective measurement model metrics

Indicator reliability. A systematic assessment of the model was conducted to determine the optimum reflective measurements and structural model. Forty item indicators were retained in the final model. Indicators exceeding the recommended threshold of > 0.70 were retained. Indicators with loadings between 0.40 and 0.70 were removed to achieve the average variance

² V.4.1.1.4.

extracted (AVE) greater than 0.50 (Hair, Hult, Ringle, & Sarstedt, 2017). The final loadings for the retained indicators are listed in Table 2.

Collinearity. There were no potential collinearity issues identified in the model indicators as all variance inflation factor (VIF) values were below three. The results are also listed in Table 2.

Insert Table 2 about here

Internal consistency reliability. Both common standards for measuring internal consistency reliability, Cronbach's Alpha (α) and composite reliability, were applied to assess the internal consistency reliability of this model. Neither standard indicated a concern with internal consistency reliability in the initial nor the optimized model.

Convergent validity. In the proposed model, convergent reliability was problematic for all variables save for organizational risk management culture. The model optimization achieved via removal of low-load indicators served to increase the convergent reliability of the model, as measured by the average variance extracted (AVE). The final results for internal consistency reliability and convergent validity are summarized in Table 3.

Insert Table 3 about here

Discriminant validity. Discriminant validity results provided strong support for the structural path model as both the Heterotrait-Monotrait (HTMT) and Fornell-Larcker criteria were satisfied. Using the strict standard for HTMT < 0.85, all constructs demonstrated acceptable discriminant validity. The Fornell-Larcker test also exceeded the base criteria as the square roots of the AVE exceeded the value of the associated construct correlations. The results summarized

in Tables 4 and 5 provided confidence that the constructs measure unique factors with minimal risk of redundant or overlapping measurements.

Structural Model Metrics

Having assessed the reliability and validity of the model constructs, it was appropriate to begin analysis of the Structural model metrics. Analysis of the structural or inner model provided key assessment of the latent variables and the theorized path relationships when applying PLS-SEM technique (Hair et al., 2017; Sabol, Hair, Cepeda, Roldan, Alain Yee Loong, 2023).

Insert Tables 4 and 5 about here

Bootstrapping analysis was utilized to measure the relevance of the structural path model relationships and identify any statistically significant path coefficients. Bootstrapping analysis is a nonparametric procedure that estimates models using many data subsamples and provides indication of the statistical significance of model path relationships (Hair et al., 2017; Ringle, Wende, & Becker, 2024). The bootstrapping results provided the primary assessment of the hypothesized model relationships and identified the independent variables with the greatest influence on the primary dependent variable. These are depicted in Figure 2 and listed in Table 6.

Insert Figure 2 about here

Insert Table 6 about here

Two of the five independent latent variables, organizational risk management culture (ORMC) and senior management support (SMS), had a statistically significant impact on PPRM Effectiveness (PPRME). Organizational risk management culture exhibited the greatest influence on PPRME (0.37), almost fifty percent greater than the measured relevance of senior

management support on PPRME (0.25). In addition, ORMC also had a statistically significant influence on the secondary endogenous variable, PPRM (0.20).

Effect size. There were no statistically significant ($p < 0.05$) effect sizes (f^2) for any exogenous variable on the primary endogenous variable in this model, as noted in the far-right column of Table 6.

Coefficient of determination. The coefficient of determination (R^2) was measured to assess the model's predictive power. Overall, the model indicated a moderate explanatory power (0.25 - 0.49), as the amount of variance explained (R^2) was 0.306, or 30.6% for the primary endogenous variable, PPRME. The explained variance for the secondary endogenous variable, PPRM was not statistically significant at $p < 0.05$.

Predictive Assessment. Predictive relevance measures the model's predictive power for data external to the measured sample. Values of $Q^2 > 0$ indicate predictive relevance (accuracy) (Hair et al., 2017). The results of this assessment indicated that there is medium predictive relevance, Q^2 , for PPRM Effectiveness (0.21) in this model. There was also small predictive relevance for Portfolio Risk Management Process (0.01) in the model. The results of both the coefficient of determination (in-sample) and predictive relevance (out-of-sample) assessments are depicted in Table 7.

Insert Table 7 about here

Latent variable correlations. The analysis indicated that there is no extreme collinearity present between the model constructs, as most of the statistically significant ($p < 0.05$) correlations are moderate, measuring between -0.16 and 0.45. The moderate correlation identified supports the results of the discriminant validity assessment that there was no

significant concern for redundancy in construct specification (moderate overlap) (Hair et al., 2022).

Importance Performance Map Analysis. The IPMA analysis identified the constructs and indicators that best support model improvement. The construct-level IPMA graph in Figure 3 displays the results with Importance (Total effects) on the x-axis and the Performance (rescaled latent variable scores) on the y-axis.

The results of the construct-level mapping of Importance - Performance indicated that organizational risk management culture and senior management support had the highest importance (~ 0.36) with moderate performance (~ 20). Senior management support indicated secondary importance (~ 0.26) with moderate performance (~ 27). These results for importance supported the model results of ORMC and SMS having the greatest impact on PPRME, as the areas that can provide the most significant improvement for PPRME.

Stakeholder engagement had moderate importance (~ 0.05) with slightly higher performance (~ 32). Project portfolio risk management had lower importance (~ 0.11) with moderate performance (~ 25). The demographic variable of organizational size had near-zero importance, but a relatively high performance (~ 52). These results indicated that according to this model, changes in these variables would not garner significant improvements in PPRME.

Insert Figure 3 about here

The results of the indicator-level IPMA graph in Figure 4 display the indicators with the greatest importance (moderate, 0.04 - 0.56) for the optimized model, representing key leverage points for improving overall PPRME. All of the reported indicators map to the two most impactful constructs for PPRME, ORMC and SMS.

Insert Figure 4 about here

Research Model Results

Figure 2 details the optimized research model results. The preceding measurement (external) and structural (internal) results confirm that the model satisfied the criteria for indicator and internal consistency reliability, convergent & discriminant validity, multicollinearity, path significance, explained variance, and other recommended empirical analysis for PLS-SEM. The resultant model included forty (40) observable (measurable) indicators with loadings ranging from 0.55 to 0.86. All items are listed in Table 2.

Senior management support. The final model incorporated eight items of Senior Management support. The support and involvement of Senior Management were noted as important aspects of effective risk management in organizations. Senior leaders should understand the value that thorough risk analysis provides and are responsible for ensuring that risk management is prioritized (Khalil-Oliwa & Jonek-Kowalska, 2024; Romero et al., 2019). The model reflects the benefits associated with engaged and involved senior leaders for the project team and overall project and risk management in the organization. Senior managers provide support to the project team in the form of resources and responsiveness. Supporting risk-informed decisions helps to ensure team needs are understood and addressed.

Stakeholder engagement. The final model contained seven items relevant to PPRME. Stakeholder engagement was also identified as a notable component of project portfolio risk management. Key customers, leaders, and affected groups should collaborate and engage in the decision-making process to promote trust and broaden risk awareness (Kheir et al., 2022; Mullins et al., 2023). Building trust with stakeholders, with intentional engagement and active collaboration, improves overall risk awareness in the organization (Kheir et al., 2022; PMI,

2023a). This research supports the need for key stakeholders to be involved early in the process to ensure early risks, desired outcomes, and beneficial measures are clearly identified and aligned (Romero et al., 2019).

Organizational risk management culture. Ten (ORMC indicators were included in the final model. The culture of risk management established, promoted, and sustained in the organization was the most impactful factor for project portfolio risk management effectiveness identified in this study. Determined to be the most important construct, ORMC represented over thirty-six (33.8%) percent of the composite effect on PPRME.

The model highlights several important aspects of effective risk management cultures including the need for defined processes, roles, and responsibilities. The managers providing direct leadership of the projects and programs need to have adequate training and experience to navigate the instituted processes efficiently. This supports findings from literature indicating that strong risk management cultures are developed over time with engaged leaders and an appropriately informed and empowered workforce (Khalil-Oliwa & Jonek-Kowalska, 2024; Kolatch, 2022; Muntés-Mulero et al., 2019; Romero et al., 2019).

Project portfolio risk management (process). Though not a statistically significant contributor to the effectiveness of PPRM in this model, eight elements of the process of PPRM supported the overall model structure. The processes of risk management were a key component of the organization's RM culture.

The model revealed a strategic imperative for effective risk management in the project portfolio. Clear roles and responsibilities support process efficiency. Risks and key dependencies should be assessed and prioritized with process tools employed to support timely reporting. These results are aligned with guidance from the literature on the value of investing in project

and risk management skill development to improve project outcomes and limit risk exposure (Frederico, 2021; Kaufmann & Kock, 2022; Müller et al., 2024; Veera, 2024).

Project portfolio risk management effectiveness. The scale of investment in transformative projects within the electric utility industry belies the need for structured, robust approaches to portfolio risk management. Seven indicators were retained in the final model that exhibited value in improving the quality of project portfolio risk management. Managing project and portfolio risks is not only about limiting unfavorable outcomes, as the organization needs to be able to capitalize on opportunities that emerge in the marketplace. Effective risk management enables the execution of organizational goals by informing key decisions and limiting the impact of aggregate risks. The quality of the organizations' response to risk is correlated to its management effectiveness.

Demographic moderators. Once the model was optimized, bootstrapping analysis was conducted to assess the performance of the model when assessed with specific categorical and ordinal demographic variables. These variables included geographic region, education, employment industry, job role, gender, and work status. Some of the noteworthy statistically significant ($p < 0.05$) results were as follows and summarized in Table 8 and 9.

Insert Table 8 and 9 about here

The PPRME variance explained (R^2) for several subgroups exceeded the R^2 of the overall model (0.31). The level of education seemed to correlate with the variance explained by different groups within the model. Participants with college degrees measured with the highest level of PPRME variance explained (0.63) for all subgroups. While the sub-sample of participants with no college degree also exceeded the total sample performance (0.47). Regionally, responses from

workers in the southwest United States explained nearly sixty percent (0.59) of the variance in PPRME when analyzed in the model. The model performed above the sample average for core members of the project team. Project, portfolio, and program managers (0.49) and technical roles such as engineers and administrative analysts (0.47) were both measured at nearly fifty percent of explained variance. There was only a moderate difference in the PPRME explained variance between men (0.44) and women (0.42).

Many demographic subgroups exhibited unique relationships with each model hypothesis. The standardized total effect (0.26) was significant for hypothesis one examining the positive relationship between senior management support and project portfolio risk management effectiveness. However, the total effect of this relationship was greater for women (0.54), workers in the southwest US (0.45), and project, portfolio, & program managers (0.32). The greatest total effect on PPRME measured in the model was from organizational risk management culture (0.37). This relationship proved even more impactful for both women (0.39) and men (0.38), workers in the eastern US (0.37), project managers (0.51) and engineers (0.35). This relationship was over twice the average for college educated workers (0.19) indicating the importance of education and training for building and sustaining strong risk management cultures. The positive effect of ORMC on the quality of PPRM processes was another statistically significant relationship in the model. College educated workers (0.19) rated this relationship just below the average (0.19), however women (0.27) rated this relationship significantly greater than men.

The model did not identify a significant ($p < 0.05$) positive relationship between either stakeholder engagement or PPRM processes and PPRM effectiveness. However, certain subgroups measured a significant positive relationship for these constructs and PPRME. Men

(0.15) and workers without college degrees (0.21) both identified a significant positive relationship between SHE and PPRME. These same subgroups, men (0.23) and non-degreed workers (0.39), along with technical analysts (0.33) identified a significant positive relationship between PPRM processes and overall PPRM effectiveness. This indicates that males and less educated workers value inclusion and process rigor above the average worker in the domestic EUI.

These unique results by various demographic subgroups provide insight into stakeholders and organizational members that may benefit from increased focus in key organizational, project, and risk management activities.

DISCUSSION

Based on these results, there are several findings that align with previous academic research. Practitioners can leverage these insights to improve their effectiveness in project portfolio risk management of digital transformation. These findings also provide valuable insights for organizations conducting digital transformation in the U.S. electric utility industry.

Practitioner Perspective

The research reveals that strengthening the risk management culture and level of senior leadership support are the primary levers for increasing effectiveness of executing project objectives. Effective risk management has a distinct impact on the organizations' ability to execute digital transformation projects and initiatives successfully. Strong risk management cultures are strengthened by informed people and efficient processes. Project and portfolio managers' skills are developed with time and experience. A culture with engaged leadership and clear processes can better support this development (Karkukly, 2019; Khalil-Oliwa & Jonek-Kowalska, 2024; Muntés-Mulero et al., 2019; Santos et al., 2022).

The roles and responsibilities of each member of the organization should be clear to them and every other person in their work environment. Role clarity and transparent communication improve risk analysis, response, and awareness. Risk-informed decisions lead to better outcomes over time. Early engagement from all levels of the organization are needed to improve the quality and clarity of information known about the risks and opportunities likely to be encountered. Effective risk management is supported by collaborative partnerships between leaders, stakeholders, and the project team (Badewi, 2022; Kheir et al., 2022; Vial, 2019). Ensuring that communication channels are diverse and free flowing improves trust and beneficial collaboration between members of the organization and key stakeholders.

Acceptance of input and feedback from subordinate members of the project team, can help mitigate the adverse impact of self-bias on decision-making. Trust throughout the organization is built when the contributions from project teams and customers are valued (Davidson et al., 2024; Elkhatib et al., 2023; Mullins et al., 2023). Projects are executed more effectively when senior management is actively involved throughout the process. Project selection, portfolio management, resource allocation, and crisis management are all improved by collaborative engagement from leaders with their project teams. However, engagement does not mean autocracy. Project teams should be allowed to exercise autonomy and carry the primary responsibility for executing the tasks, actions, and decisions in their area of influence and expertise.

Leaders in the organization improve the value derived from key initiatives by investing in workforce development. An empowered and appropriately trained workforce can serve as a ballast mitigating managerial knowledge gaps and improving the outcomes of high leverage projects and initiatives (Bushuyev & Ivko, 2024; Müller et al., 2024; PMI, 2023a; Rauniyar et

al., 2023; Vial, 2019). This research indicates that advanced education can improve risk awareness and response. An informed workforce makes better decisions and can better support the strategic goals of the organization. Strategic awareness and process acumen enable members of the project team to identify gaps, communicate issues, and resolve blockers independently. Strong risk management cultures are best supported and sustained by educated workers.

Implications for the Electric Utility Industry

Digital transformation is a mission-critical objective for organizations in the electric utility industry, unlocking tremendous business value by upgrading electrical infrastructure, scaling renewable energy sources, and distributed energy integration. DT in the EUI also necessitates upskilling the workforce to better utilize advanced technology like artificial intelligence and big data analytics. Stakeholder management is also affected as digital advancement can result in rapid changes in customer expectations and marketplace dynamics.

Meanwhile the risks encountered by organizations in the EUI associated with digital transformation continue to grow in complexity. Rapid technological change introduces challenges associated with managing the quality and quantity of available data. Greater digital connectivity increases cyber risk exposure, and external regulations to ensure data privacy and integrity. Internally, senior leaders must be equipped with clear strategic vision and roadmaps for managing change. Senior managers are responsible for aligning others with the leaderships' strategic vision, overcoming resistance to change to foster employee buy-in. The scale of investment and risks for digital transformation in the EUI necessitates a structured, informed, and robust approach to project portfolio risk management.

This research identified two factors driving PPRM effectiveness during organizational digital transformation. First, to harness the tremendous value that digital transformation provides in reimagining operations, organizations need a robust digital risk management culture. Strong

ORMC includes defined processes, roles, and responsibilities for project portfolio management. Organizations should leverage all of their available resources - human, capital, & experience - to promote effective project risk management (PMI, 2019). This helps to ensure that activities from project selection, stakeholder engagement, requirements gathering, crisis, and risk management are executed with efficiency and clarity on strategic objectives. Organizations need to invest in the skill development and education of their workforce, to support and enhance large investments made in developing and leveraging new technology. Doing so can cultivate a strong ORMC characterized by project and portfolio managers with relevant experience, adequate training, and the ability to navigate established processes effectively. Healthy organizational risk management cultures create project leaders and teams equipped to leverage previous lessons learned to continuously improve project execution and outcomes delivered. Strong ORMC become more effective by ensuring all members maintain strategic alignment with core competencies, goals, and their industry to maximize technological investment (Frederico, 2021; Muntés-Mulero et al., 2019; Teslia et al., 2022; Yaghubi, Doroodian, & Adibi, 2023).

The second most impactful factor driving PPRM effectiveness of EUI digital transformation is supportive, engaged, and involved senior leaders. This result aligns with literature recognizing senior management support as a key factor in improving the effectiveness of project and risk management in the organization (Romero et al., 2019). Project execution and performance are enhanced by senior managers that promote and sustain engagement with their project teams responsible for implementing high value organizational priorities and DT initiatives. Senior leaders in the organization should be engaged in the full project lifecycle, helping teams navigate the inevitable challenges and disruptions that emerge. Providing teams with needed resources, clear guidance, and shared accountability for project execution and

success. Senior managers should help eliminate the distractions that keep project teams from executing their objectives.

This research also demonstrated that certain stakeholder demographics place greater priority on different factors for PPRM effectiveness, such as stakeholder engagement and PPRM process rigor and tooling. Leaders should value the contributions from all organization stakeholders, recognizing the contribution they make to value creation and strategic success. Senior leaders have to engage effectively with both their project teams and key stakeholders in order to understand how to support their unique needs. Building organizational trust helps improve strategic alignment, risk awareness and response, along with increasing business value derived.

Managing project and portfolio risks is not simply an exercise in minimizing adverse exposure. The organization and its members should be poised to exploit the opportunities revealed in their environment to maximize the effectiveness and return on digital transformation investment.

LIMITATIONS & FUTURE RESEARCH

This research identified actionable insights for organizations conducting digital transformation in the electric utility industry. Given these results, limitations in this study should be acknowledged as they can present opportunities for additional research.

Limitations

Potential shortcomings include reliance on participant perceptions of the measured constructs, solicitation of a random sample with no controls for uniform responses from particular demographic subgroups, geographic regions, job roles & functions, or work experience levels.

The final participant sample consisted of 222 respondents reporting some work experience in the electric utility industry. There were an additional eighty (80) respondents that completed the survey who provided valuable insights for PPRM effectiveness for digital transformation in other industries. Inclusion of their input would provide additional clarity on the factors driving PPRME. The participant pool was limited by financial and time constraints. Collecting more data from target participants may have improved the statistical significance and practical relevance of the overall model as demonstrated by the variance in results between each participant sample pool (Rounds 1 & 2).

Future Research

Based on the research results presented here, as well as acknowledgement of limitations in this study, several opportunities for additional research are revealed. The following directions for future research are recommended:

1. Extending the research through applications of the model in other industries.
2. Exploring other notable mediating relationships between stakeholder engagement, organizational risk management culture, and other factors implied by the research.
3. Comparative analysis of the model relationships between multiple, distinct industries.
4. Applying the model through expansion to understand the influence of project portfolio risk management effectiveness on organizational imperatives for digital transformation like project success and strategic execution.

CONCLUSION

Building upon an established research foundation, the current study extends the work of both Mican et al. (2021) and Khalil-Oliwa and Jonek-Kowalska (2024), which investigated the impact of project portfolio risk management effectiveness on digital transformation, by addressing a gap in the industry-specific application and geographic context. This research

extends prior frameworks by evaluating digital transformation initiatives in the U.S. electric utility industry. This extension addresses both sectoral and geographic research gaps.

An online survey was administered to 222 U.S. electric utility workers with direct experience in digital transformation initiatives. The study identified organizational risk management culture (ORMC) and senior management support (SMS) as the primary drivers of project portfolio risk management effectiveness (PPRME) for digital transformation in the U.S. electric utility industry. Key indicators for ORMC included organizational structure, processes, roles & responsibilities for project portfolio management, and the experience of both project & portfolio managers in risk management. The identified importance of organizational risk management culture suggests that electric utilities must go beyond merely implementing risk processes. They need to foster a culture where risk management is a core value, consistently promoted by leadership, and deeply embedded in organizational processes, roles, and responsibilities.

For senior management support, impactful indicators encompassed senior management's involvement in project selection, risk-based decision-making, responsiveness to resource requests, sharing responsibility for project success, and supporting team development. The critical role of senior management support underscores that top leadership must be actively involved, not just nominally supportive. By empowering project teams, sharing decision-making authority, and consistently providing support in the form of resources and responsiveness, senior management can foster trust and mitigate the adverse impacts of biases. Investing in employee upskilling can help them navigate new digital tools and foster a culture that encourages experimentation and adaptability.

For organizations in the U.S. electric utility industry, effective project portfolio risk management for digital transformation is not merely a technical undertaking but a fundamental organizational imperative. Robust organizational risk management cultures and consistent, proactive senior management support should be bedrocks in these organizations. These elements improve navigation of the inherent complexities and uncertainties of digital change. A well-defined risk management culture, strong leadership, and a skilled workforce are key components that support investments in new digital infrastructure, increasing the value delivered.

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TABLES & FIGURES

Figure 1. Research Model

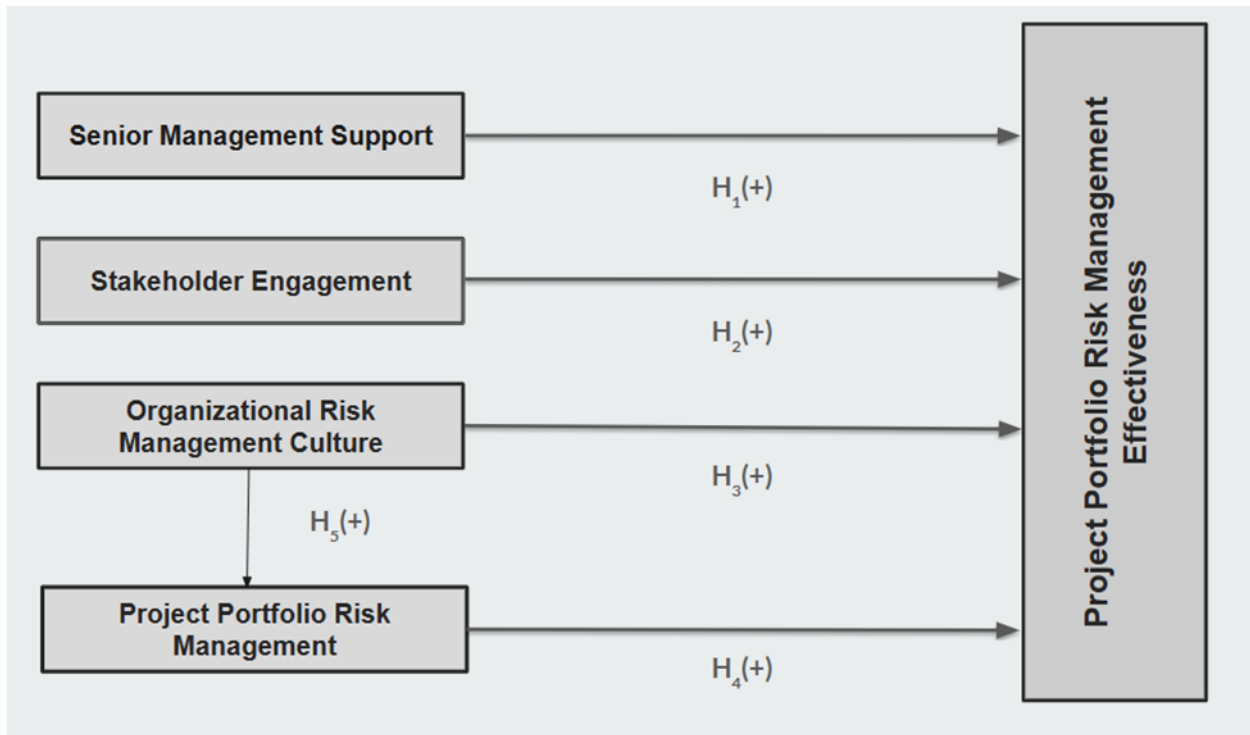
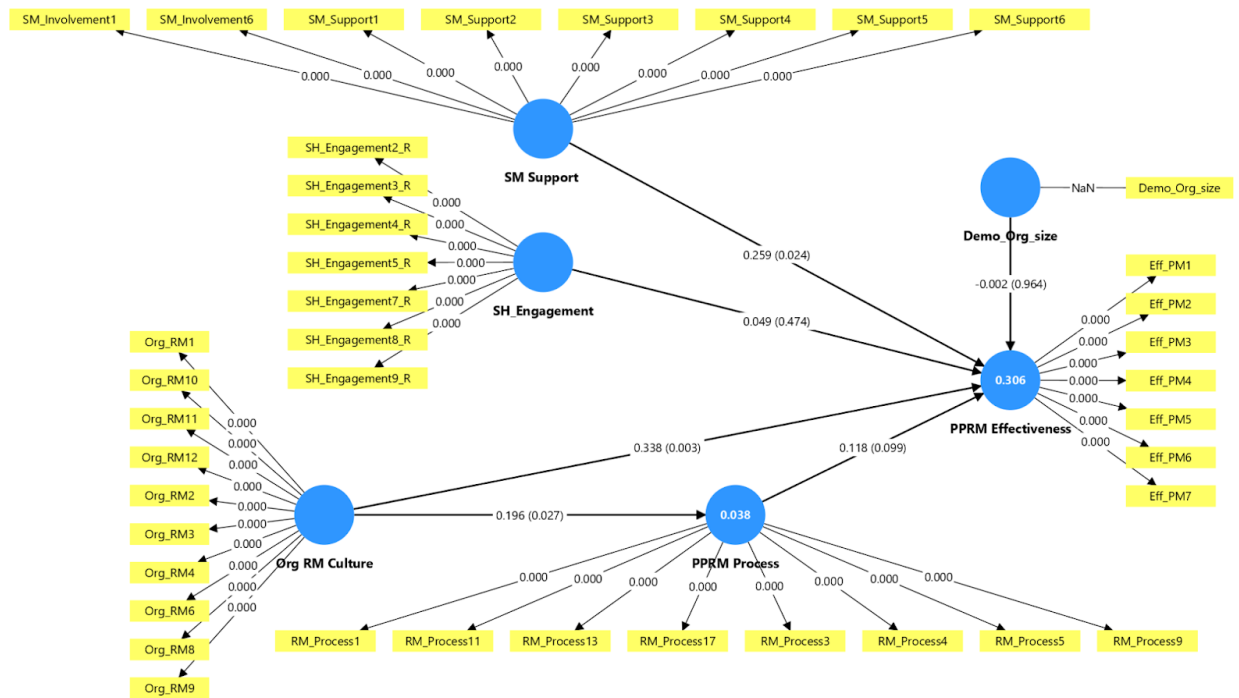
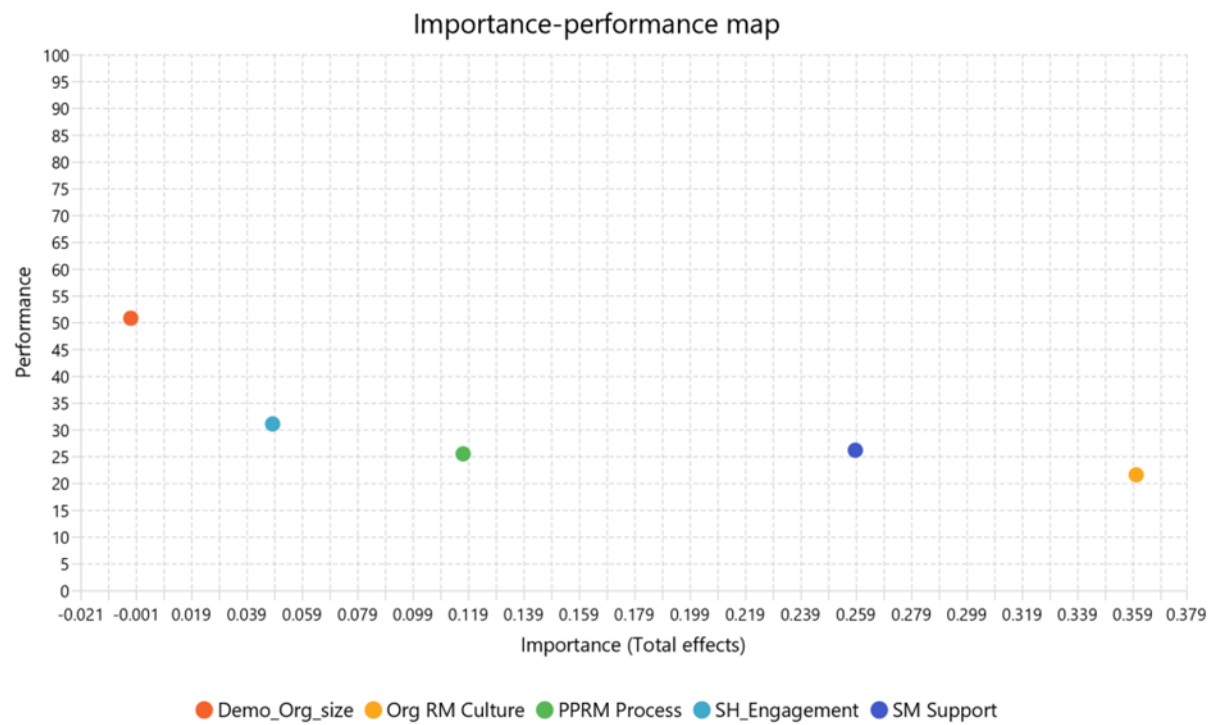


Figure 2. Research Model Result*



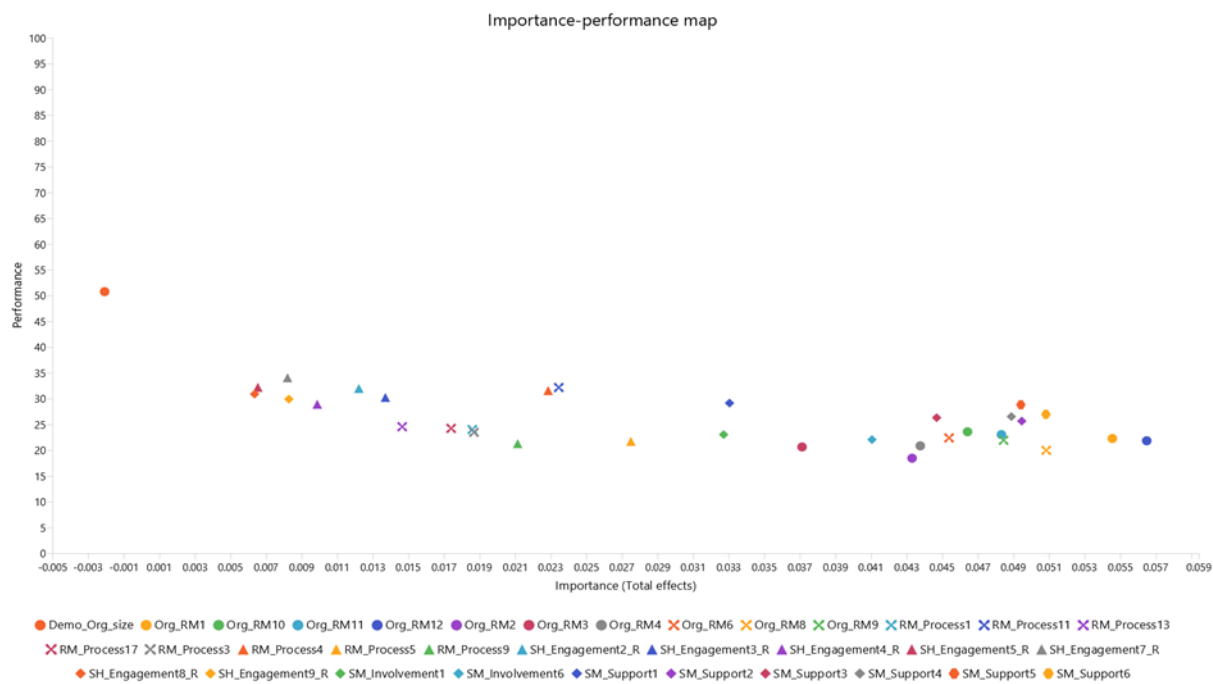
* Model analysis generated from SmartPLS (Ringle et al., 2024)

Figure 3. Importance-Performance Map (Constructs)*



*Model analysis generated from SmartPLS (Ringle et al., 2024)

Figure 4. Importance-Performance Map (Indicators)*



*Model analysis generated from SmartPLS (Ringle et al., 2024)

Table 1. Participant Demographics*

Variable	<i>n</i>	%	Variable	<i>n</i>	%
<i>Gender</i>			<i>Country of Birth</i>		
Female	75	33.8	USA or territories	203	91.4
Male	145	65.3	Outside of USA	18	8.1
prefer to not say	2	0.9	not reported	1	0.5
<i>Student</i>			<i>Education</i>		
No	125	56.3	Some college or less	48	21.7
Yes	43	19.4	Associates, Technical, or Bachelors	111	50
not reported	54	24.3	Graduate or Professional (advanced)	63	28.3
<i>Work Status</i>			<i>Job Role</i>		
Full-Time	135	60.8	Consultant (external partner)	34	15.3
Part-Time	34	15.3	Project, Program, or Portfolio Manager	80	36
Unemployed (job seeking)	14	6.4	Senior Manager / Leader	32	14.4
Not reported	39	17.6	Technical / Analyst	76	34.2
<i>Area of Country Worked</i>			<i>Industry Employed</i>		
Eastern US	104	46.8	Construction / Manufacturing	57	25.7
Midwest US	41	18.5	Consulting, Engineering, Technical	35	15.8
Western US	58	26.1	IT / Software	99	44.6
throughout US	19	8.7	Utilities, Telecom, Nuclear, Oil & Gas	31	13.9
<i>Years worked in EUI</i>			<i>Organization size</i>		
1 - 5	116	52.3	< 50	39	17.6
6 - 15	78	35.1	50 - 100	45	20.3
16 - 25	19	8.6	101 - 500	54	24.3
26 - 35	4	1.8	501 - 1000	36	16.2
36 - 50	4	1.8	> 1000	48	21.6
51+	1	0.5			

**n* = 220

Table 2. Final Factor Loadings

Item	Factor Loading (outer)	VIF	Item Wording
<i>Variable (DV): Project Portfolio Risk Management Effectiveness (PPRME): Eff PM</i>			
Eff_PM1	0.79	2.11	<i>Managing risks in a portfolio of projects increases the likelihood of achieving portfolio goals.</i>
Eff_PM2	0.81	2.22	<i>Portfolio risk management allows you to make more informed decisions.</i>
Eff_PM3	0.77	2.05	<i>Portfolio risk management improves stakeholder risk awareness.</i>
Eff_PM4	0.77	1.99	<i>Risk management allows development of a portfolio of projects with variable levels of risk.</i>
Eff_PM5	0.77	1.94	<i>Portfolio risk management provides a better understanding of the individual projects.</i>
Eff_PM6	0.76	1.84	<i>Portfolio risk management improves overall organization efficiency.</i>
Eff_PM7	0.80	2.07	<i>Portfolio risk management facilitates the organization's strategic goals.</i>
<i>Variable (IV): Organizational Risk Management Culture (ORMC): Org_RM</i>			
Org_RM1	0.81	2.68	<i>Defined organizational structure for project portfolio management.</i>
Org_RM2	0.76	2.07	<i>Defined process for project portfolio management.</i>
Org_RM3	0.73	2.50	<i>Defined roles in the project portfolio management process.</i>
Org_RM4	0.74	2.50	<i>Defined responsibilities for roles in the project portfolio management process.</i>
Org_RM6	0.69	1.73	<i>Formalized project management process.</i>
Org_RM8	0.77	2.59	<i>Experience of Project Managers in the project management process.</i>
Org_RM9	0.78	2.74	<i>Experience of Portfolio Managers in the portfolio management process.</i>
Org_RM10	0.79	2.24	<i>Risk management as a component of portfolio project management.</i>
Org_RM11	0.78	2.30	<i>Experience of Project Managers in the process of risk management.</i>
Org_RM12	0.79	2.57	<i>Experience of Portfolio Managers in the process of portfolio risk management.</i>
<i>Variable (IV): Project Portfolio Risk Management / Process (PPRM)</i>			
RM_Process1	0.74	1.93	<i>There is a defined risk management strategy.</i>
RM_Process3	0.77	2.35	<i>There are defined roles in the project portfolio risk management process.</i>
RM_Process4	0.75	1.99	<i>There are defined responsibilities for roles in the project portfolio risk management process.</i>
RM_Process5	0.81	2.08	<i>There is a defined risk management process for projects.</i>
RM_Process9	0.67	1.54	<i>There is consideration of risk assessment when prioritizing projects.</i>
RM_Process11	0.71	1.61	<i>There is a process for managing project dependencies.</i>
RM_Process13	0.65	1.61	<i>Information on the level of risks in the projects is included in portfolio reports.</i>
RM_Process17	0.69	1.62	<i>Dedicated technological tools are utilized in the portfolio risk management process.</i>
<i>Variable (IV): Stakeholder Engagement (SE)</i>			
SH_Engage2	0.82	2.09	<i>Identification of key stakeholders.</i>
SH_Engage3	0.86	2.79	<i>Regular presentation of portfolio objectives to key stakeholders.</i>
SH_Engage4	0.83	2.62	<i>Regular presentation of progress on project objectives to key stakeholders.</i>

SH_Engage5	0.67	1.61 <i>Collecting the organization's experience in portfolio management for future use.</i>
SH_Engag7	0.67	1.62 <i>Prudent approach to risk management in the organization.</i>
SH_Engage8	0.72	1.87 <i>Gathering information from stakeholders about risk in the organization.</i>
SH_Engage9	0.75	1.93 <i>Gathering information in the organization on how the risk management process is carried out (i.e., identifying, assessing, and controlling risks).</i>

Variable (IV): Senior Management Support (SMS)

SM_Involve1	0.55	1.67 <i>Involvement of senior management in the process of selecting projects for the project portfolio.</i>
SM_Involve6	0.59	1.59 <i>Senior management decision-making on the project portfolio based on risk analysis and assessment.</i>
SM_Support1	0.77	2.48 <i>Senior management has been responsive to requests for additional resources when the need has arisen.</i>
SM_Support2	0.79	2.43 <i>Senior management shares responsibility with the project team to ensure project success.</i>
SM_Support3	0.80	2.13 <i>Senior management supports the project in crisis.</i>
SM_Support4	0.78	2.50 <i>Senior management gives us authority and supports our decisions regarding the project.</i>
SM_Support5	0.78	2.05 <i>I agree with senior management on the degree of authority and responsibility the project manager (team) has over the project.</i>
SM_Support6	0.82	2.44 <i>Senior management support of project team training and development.</i>

Table 3. Construct Reliability & Convergent Validity

Construct	Abbr.	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted
Project Portfolio Risk Management Effectiveness	PPRME	0.90	0.90	0.92	0.62
Organizational Risk Management Culture	ORMC	0.92	0.92	0.93	0.58
Project Portfolio Risk Management / Process	PPRM	0.87	0.88	0.90	0.52
Stakeholder Engagement	SE	0.88	0.92	0.91	0.58
Senior Management Support	SMS	0.88	0.89	0.91	0.55

Table 4. Heterotrait-Monotrait (HTMT) Ratio

Variable	Org Size	ORMC	PPRME	PPRM	SE
Organization size (demographic) (Org Size)					
Organizational Risk Management Culture (ORMC)	0.14				
Project Portfolio Risk Management Effectiveness (PPRME)	0.07	0.49			
Project Portfolio Risk Management / Process (PPRM)	0.18	0.21	0.30		
Stakeholder Engagement (SE)	0.05	0.31	0.29	0.32	
Senior Management Support (SMS)	0.04	0.35	0.46	0.31	0.42

Table 5. Fornell-Larcker Matrix

Variable	Org Size	ORMC	PPRME	PPRM	SE	SMS
Organization size (demographic) (Org Size)	1.00					
Organizational Risk Management Culture (ORMC)	-0.13	0.76				
Project Portfolio Risk Management Effectiveness (PPRME)	-0.06	0.45	0.78			
Project Portfolio Risk Management / Process (PPRM)	-0.16	0.20	0.27	0.72		
Stakeholder Engagement (SE)	0.02	0.28	0.27	0.29	0.76	
Senior Management Support (SMS)	0.00	0.30	0.41	0.29	0.36	0.74

Table 6. Tests of Hypotheses (Total effects)

Hypothesis	Sample Mean	Standard Deviation	t-stat	p-value	Support	f^2 value
<i>H1: Senior management support improves PPRM effectiveness.</i>	0.25	0.12	2.26	0.02*	yes	0.08
<i>H2: Stakeholder engagement improves PPRM effectiveness.</i>	0.06	0.07	0.72	0.47	no	0.00
<i>H3: Organizational risk management culture is positively related to PPRM effectiveness.</i>	0.37	0.12	3.15	0.00*	yes	0.14
<i>H4: Project portfolio risk management processes improve PPRM effectiveness.</i>	0.12	0.07	1.65	0.10	no	0.02
<i>H5: Organizational risk management culture improves the quality of project portfolio risk management.</i>	0.21	0.09	2.22	0.03*	yes	0.04

Table 7. R^2 and Q^2 Values

Variable	R^2 value (Adj)	Q^2 value
Project Portfolio Risk Management Effectiveness (PPRME)	0.31 (0.29)	0.21
Project Portfolio Risk Management / Process (PPRM)	0.04 (0.03)*	0.01

Table 8. Demographic variances in Coefficient of Determination (R^2)

Hypothesis Link: Variable relationship	Gender (F/M)	Region worked	Job role	Education (Degree / noDegree)
PPRME (R^2)	F (0.42) / M (0.44)	SW (0.59) / E (0.26)	PM (0.49) / T&A (0.47)	noD (0.47) / D(0.63)

$p < .05$

Table 9. Demographic Variances in Construct Relationships: Factor Loadings

Hypothesis Link: Variable relationship	Gender (F/M)	Region worked	Job role	Education (Degree / noDegree)
<i>H1: Senior management support improves PPRM effectiveness.</i>	F: 0.54	SW: 0.45	PM: 0.32	
<i>H2: Stakeholder engagement improves PPRM effectiveness.</i>	M: 0.15			noD: 0.21
<i>H3: Organizational risk management culture is positively related to PPRM effectiveness.</i>	F: 0.39 / M: 0.38	E: 0.37	PM: 0.51 / T&A: 0.35	D: 0.75
<i>H4: Project portfolio risk management processes improve PPRM effectiveness.</i>	M: 0.23		T&A: 0.33	noD: 0.39
<i>H5: Organizational risk management culture improves the quality of project portfolio risk management.</i>	F: 0.27			D: 0.19

$p < .05$