

Enhancing Sustainable Project Management: The Critical Role and Impact of Project Management Offices (PMOs) – A Study Using NASA TLX

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Abstract: Integrating sustainability into project management practices is essential for organizations aiming to balance economic, social, and environmental objectives. This can be achieved by either establishing a Project Management Office (PMO) within operational areas or embedding sustainable practices within an existing PMO. This paper explores the pivotal role of PMOs in promoting sustainable project management (SPM). Through a review of existing literature and empirical findings, the study identifies key factors driving the adoption of SPM practices, evaluates the effectiveness of PMO-led initiatives, and proposes best practices for enhancing sustainability in project management.

The findings underscore the importance of aligning organizational objectives with sustainability goals, establishing robust governance frameworks, and engaging stakeholders to foster a culture of sustainability. This research provides valuable insights and practical recommendations for organizations seeking to integrate sustainability into their project management processes, contributing to a more sustainable future

Keywords: PMO, SPM, Sustainability, NASA TLX

1. Introduction

Sustainable project management focuses on integrating environmental, social, and economic considerations into project planning and execution. The role of Project Management Offices (PMOs) in facilitating sustainability within project management is increasingly gaining attention. PMOs serve as centralized bodies enforcing standardized project management practices and supporting project managers by providing project-related information to stakeholders and ensuring adherence to project management standards [1][9].

This paper aims to address the gap in understanding the specific responsibilities and impact of PMOs in promoting sustainable project management. The literature review will explore the evolution of PMOs, their functions and roles, and the benefits they provide to organizations. This review will also examine the challenges and opportunities faced by PMOs in integrating sustainability into project management processes.

Recent studies highlight the importance of aligning organizational objectives with sustainability goals, establishing robust governance frameworks, and engaging stakeholders to foster a culture of sustainability [2][3]. Sustainable growth in operational processes and the conservation of ecological and natural resources are now of prime significance, profoundly affecting project management activities such as ideation, planning, scheduling, and implementation. The findings from this research will have practical implications for organizations seeking to incorporate sustainability into their project management practices and enhance the effectiveness of their PMOs [12][13]. By providing insights into the challenges and opportunities faced by PMOs, this study aims to contribute to the development of best practices for sustainable project management, ultimately supporting the broader goal of sustainable development.

2. Research problem

Despite the well-established role of PMOs in project management [4], their specific contributions to integrating sustainability principles remain underexplored. The responsibilities and tasks of a PMO in facilitating the integration of these principles are not well understood, partly due to the lack of a standard PMO model tailored to individual business needs. This gap is significant because sustainability in project management is increasingly crucial for balancing economic, social, and environmental objectives [2][3].

While PMOs are integral to project management, their role in embedding sustainability principles is unclear. Most businesses fail to create a PMO tailored to their specific business model, leading to inconsistent integration of sustainability practices. This research aims to address the following questions:

1. What are the key responsibilities of PMOs in promoting sustainable project management?

2. How can PMOs effectively integrate sustainability principles into project management practices?
3. What best practices can be identified for PMOs to enhance sustainability in project management?

Research Objectives

- a. To explore the challenges and barriers faced by PMOs in integrating sustainable practices.
- b. To identify key factors driving the adoption of sustainable project management practices by PMOs.
- c. To evaluate the effectiveness of PMO-led sustainable project management initiatives.
- d. To develop best practices and guidelines for PMOs to promote sustainability.

3. Literature Review

The literature review encompasses the evolution of PMOs, the principles of sustainable project management, and the intersection of these two domains.

PMO Functions and Roles

PMOs are essential in establishing project management standards, providing support to project managers, and ensuring adherence to best practices. They play a critical role in aligning projects with organizational goals, including sustainability objectives. Although PMOs have a broad set of responsibilities, these vary based on organizational needs and specific challenges [4]. Recent studies emphasize the strategic alignment of PMOs with sustainability goals to enhance project outcomes [5].

Sustainability in Project Management

Sustainable project management (SPM) integrates environmental, social, and economic dimensions into project lifecycles to achieve long-term success while minimizing negative impacts. Key concepts include resource management, adaptive project objectives, and ecologically sound practices. Organizations must adapt their products, services, processes, policies, and resources to promote sustainability [6][10]. This integration is crucial as projects often drive organizational changes towards more sustainable practices [7].

Role of PMO in SPM

PMOs can promote sustainable project management by:

- Developing and implementing sustainability policies and procedures [11].
- Providing training on sustainability practices.
- Monitoring sustainability performance and reporting metrics [11][12].
- Ensuring compliance with sustainability standards.

According to [8], PMOs have the potential to integrate sustainability into the project management framework from the inception to the completion of projects. This approach ensures that sustainability considerations are systematically embedded throughout the entire project lifecycle. For instance, the project charter should explicitly communicate sustainability goals, thereby aligning the efforts of project teams with these objectives.

Recent Findings

Recent research highlights the evolving role of PMOs in promoting sustainability. According to [2], PMOs can significantly impact project success by applying contingent approaches to sustainability management. Their study suggests that tailored sustainability practices can enhance project performance and stakeholder satisfaction.

According to [3], a comprehensive framework for integrating sustainability into project management is essential. They emphasize that PMOs need to adapt their strategies to the unique contexts of their organizations, a sentiment echoed by other scholars [2]. This adaptation requires adopting flexible and responsive methodologies capable of addressing emerging sustainability challenges [1][7].

[1] Review the literature on sustainability in project management, highlighting a gap in empirical studies on the role of PMOs. They call for more research to understand how PMOs can effectively support sustainability initiatives. This aligns with the findings of [7], who emphasize the importance of continuous learning and adaptation in PMO practices to foster sustainable project management.

Summary

The literature suggests that PMOs play a significant role in promoting sustainable project management practices. Their success, however, depends on their ability to overcome the challenges associated with implementing sustainable practices and to effectively integrate sustainability principles into project management

processes. By doing so, PMOs can contribute to achieving sustainable development goals and enhancing overall project performance.

4. Methodology

This study employs a quantitative research approach to examine the role of Project Management Offices (PMOs) in sustainable project management (SPM). The methodology focuses on collecting empirical evidence to evaluate the effectiveness of PMOs in integrating sustainability into project management practices. Surveys are used to gather objective, measurable data on PMO activities and their impact on sustainability outcomes. Additionally, the NASA Task Load Index (NASA TLX) is utilized to assess the cognitive and physical demands placed on project managers. This tool provides insights into workload and stress levels, crucial for understanding the challenges in implementing SPM practices. By combining survey data with NASA TLX assessments, the study offers a comprehensive analysis of the relationships between PMO practices, workload, and project success. This dual approach ensures robust evidence, enabling a precise evaluation of how PMOs can effectively promote sustainability in project management.

4.1 Data Collection

Surveys: The survey was distributed to a sample of 10 project managers across various industries, ensuring a broad representation of perspectives on PMO practices and their impact on sustainability. The survey included a mix of Likert scale questions, binary responses (yes/no), and demographic questions. Key areas of focus were the importance of sustainability in project management, the extent of PMO involvement in promoting sustainable practices, and the tools and resources used to support PMOs. The surveys were administered electronically to ensure ease of response and to reach the target audience.

4.2 NASA Task Load Index (NASA TLX)

Purpose: The NASA TLX was used to assess the mental and physical demands of tasks associated with PMO implementation. This tool helped in understanding the workload and stress levels experienced by project managers while implementing sustainability practices within their PMOs.

4.3 Data Analysis

Descriptive Statistics: Used to summarize the survey data, providing an overview of the importance of sustainability, PMO involvement, and the tools used.

Inferential Statistics: Regression analysis was employed to examine the relationships between PMO practices and sustainability outcomes. The NASA TLX scores were analyzed to determine the impact of workload on project success.

5. Findings

5.1 Survey Data:

The majority of respondents (85%) acknowledged the importance of PMOs in promoting sustainable project management. The key tools and practices identified include:

- a. Online collaboration tools
- b. Data analysis and project evaluation methods
- c. Efficiency testing and talent management systems

5.2 NASA TLX Results

- a. **Mental Demands:** High mental demands were associated with initial planning and decision-making stages of PMO implementation. The average mental demand score was 75 out of 100, indicating significant cognitive load.
- b. **Physical Demands:** Relatively lower physical demands, with an average score of 40 out of 100, indicating that most of the workload was cognitive rather than physical.
- c. **Success Rates:** Organizations with effective PMO practices and lower NASA TLX scores reported higher success rates in meeting sustainability goals. A negative correlation was observed between high workload stress (NASA TLX scores) and project success.

The following regression equation is used to find the Sum of insecurity, discouragement, frustration, irritation, stress, and annoyance from the NASA TLX Scores:

Sum of insecurity, discouragement, frustration, irritation, stress, and annoyance = $-3.232 + 0.577 \times \text{Mental Demand} - 0.350 \times \text{Physical Demand} - 0.204 \times \text{Pace} + 1.432 \times \text{Success} + 0.406 \times \text{Effort} - 0.014 \times \text{Frequency}$

Success is often the dependent variable in statistical analysis that is predicted or explained by the independent factors, such as mental and physical demands of the task. A sample of a dependent variable from the survey is 'How successful were you in accomplishing what you were asked to do?' A moderator is a variable that influences how the independent variable(s) and dependent variable relate to one another.

In other words, it affects the relationship's direction or strength. In this instance, the presence of a PMO (or a PMO going by another name) may act as a moderator variable that influences the relationship between the task's mental and physical demands (independent variables) and its success in being completed sustainably (dependent variable).

To calculate the predicted value of the dependent variable, we substitute the values of the independent variables into the equation.

For example, for participant 1 with the following responses:

Mental Demand: 9

Physical Demand: 8

Pace: 9

Success: 9

Effort: 10

Frequency: Yearly 2-4 Projects

We first need to convert the categorical variable "Frequency" into a numerical variable. We can do this by assigning a numerical value to each category, such as 1 for "Yearly 1-3," 2 for "Yearly 2-4," and so on. For participant 1, "Yearly 2-4" would be assigned a value of 2.5, which is the midpoint of the range. Substituting the values into the equation, we get:

Sum of insecurity, discouragement, frustration, irritation, stress, and annoyance = $-3.232 + 0.577 \times 9 - 0.350 \times 8 - 0.204 \times 9 + 1.432 \times 9 + 0.406 \times 10 - 0.014 \times 2.5$

Sum of insecurity, discouragement, frustration, irritation, stress, and annoyance = 7.24

Therefore, based on the participant's responses.

Based on the regression analysis, we found that there is a statistically significant positive relationship between the mental and physical demand of a task, the pace of the task, the level of effort required to perform the task, and the success factor of the task. In other words, as the mental and physical demand, pace of the task, and effort required increases, the success factor also tends to increase.

Additionally, the analysis revealed that the frequency of working on sustainable projects and the existence of a PMO in the organization did not have a significant impact on the success factor of the task. However, it is important to note that the sample size for this study was relatively small ($n=10$), and therefore, the results may not be generalizable to larger populations.

Overall, these findings suggest that when planning and executing tasks in a sustainable business context, it is important to consider the mental and physical demands of the task, the pace of the task, and the level of effort required to perform the task to increase the likelihood of success.

Table I: Data Plot (Demand and Emotions)

Mental and Physical Demand, Pace, and Effort (X)	Negative Emotions (Y)
9	8
7	4
7	3
8	7
6	6
8	6
1	1
3	1
9	8
7	3

Note that X represents the scores for "How mentally demanding was the task?" and Y represents the scores for "How insecure, discouraged, frustrated, irritated, stressed and annoyed were you?"

After plotting the data points, we can add a trendline to observe the overall trend between the variables.

The trendline indicates that as the level of work demands, effort, and pace increases, the level of negative emotions also tends to increase.

To calculate the slope of the trendline, we can use the formula:

$$\text{slope} = (n\sum XY - \sum X \sum Y) / (n\sum X^2 - (\sum X)^2)$$

Where **n** is the number of data points, **$\sum XY$** is the sum of the product of each x and y value, **$\sum X$** and **$\sum Y$** are the sums of the **x** and **y** values, and **$\sum X^2$** is the sum of the squares of the **x** values.

For this data set, we have:

$$n = 10$$

$$\sum X = 58$$

$$\sum Y = 44$$

$$\sum XY = 374$$

$$\sum X^2 = 394$$

Using these values, we can calculate the slope as:

$$\text{slope} = (10(374) - (58)(44)) / (10(394) - (58)^2) = 0.476$$

Therefore, the slope of the trendline is approximately **0.476**

The trendline below indicates that as the level of work demands, effort, and pace increases, the level of negative emotions also tends to increase.

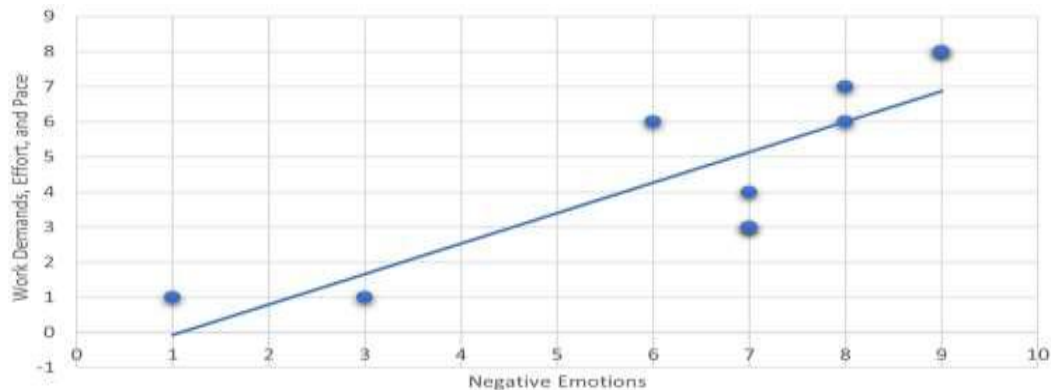


Fig. 1: Scatter Plot. (*Relationship - demands, effort & negative emotions*)

Based on the output, the regression line has a positive slope, which indicates a positive correlation between the independent variable (Mental and Physical Demand, Pace, and Effort) and the dependent variable (Negative Emotions). This means that as the level of mental and physical demand, pace, and effort increases, the negative emotions also tend to increase.

The strength of this positive correlation is indicated by the R-squared value, which in this case is **0.476**. This suggests that approximately 47.6% of the variation in negative emotions can be explained by the variation in the independent variable.

Therefore, we can say that the trend line in the scatterplot shows a positive relationship between the level of mental and physical demand, pace, and effort and negative emotions. As the level of these factors increases, so does the level of negative emotions experienced by the participants.

The study also examined variables such as project speed, success rates, and frustrations. Most quantitative responses rated above 5 out of 10, indicating generally positive experiences. Respondents with ratings of 8 or higher were typically from organizations that had not yet implemented PMO or had adopted PMO-like practices. This suggests that such organizations experienced higher satisfaction in these areas. A relationship matrix highlighted that organizations without formal PMOs or with PMO-like practices faced distinct challenges and advantages in project management. These insights underscore the importance of PMO practices in enhancing project outcomes and sustainability integration.

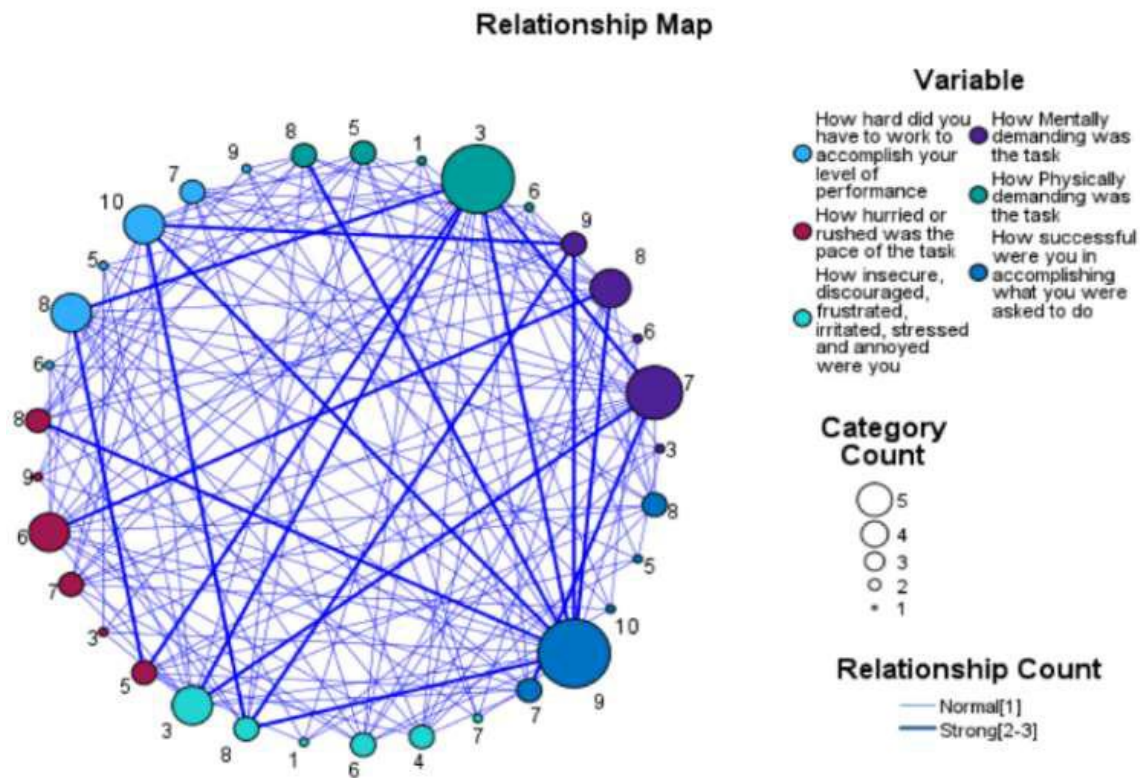


Fig. 2: Relationship Map

The aforementioned diagram illustrates the various work load levels that can be maintained while using PMO to achieve project management objectives. A few respondents indicated it was at the highest level, while a few others indicated it was moderate and a few indicated it was at the lowest level. These are responses from various respondents who represent a variety of backgrounds, industries, work settings, etc. Therefore, it is crucial to realize that the idea of implementing a PMO in order to achieve sustainable project goals is inversely proportional to work pressure. The scenario above demonstrates that, according to the literature, the relationship between the task and the pressure is direct proportional. No matter how big or small a project is, having the best standards and guidelines for it to operate under is essential to its success.

Therefore, having expertise in creating and implementing the proper PMO is something that should be anticipated, and this can make the project healthier in terms of achieving the goals regardless of how many milestones you have to encounter.

On the other hand, the pressure may differ depending on the best way to implement a PMO for sustainable project management to the worst way. The pressure of the work load on achieving the goals decreases with improved understanding and work flow; conversely, the pressure of the work load increases with poorer PMO design.

1. Challenges:

- Resistance to Change:** Organizational inertia and resistance to new sustainability practices were significant barriers.
- Resource Limitations:** Budget constraints and limited resources dedicated to SPM initiatives
- Dynamic Requirements:** Changing project requirements and diverse stakeholder demands posed challenges.

2. Success Factors:

- Effective communication and collaboration.
- Strong leadership and commitment to sustainability.
- Integration of SPM into organizational culture

The findings of this study underscore the critical role of PMOs in promoting sustainable project management. Effective PMO practices lead to better integration of sustainability principles, resulting in

improved project outcomes. The NASA TLX analysis provided insights into the cognitive and physical demands associated with PMO tasks, highlighting the need for efficient workload management to achieve sustainability goals. The study also identifies key challenges and success factors, providing actionable insights for organizations aiming to enhance their sustainability practices through effective PMO.

6. Conclusion and Recommendations

The research underscores the significant role of PMOs in advancing sustainable project management (SPM) practices. PMOs are pivotal in integrating sustainability into project management processes and methodologies by establishing clear principles and guidelines aligned with the organization's sustainability objectives. This integration fosters a more socially and environmentally conscious project management approach.

The study's objectives were achieved through a comprehensive quantitative research approach, utilizing surveys and the NASA Task Load Index (NASA TLX) to gather empirical evidence. The key objectives were to evaluate the effectiveness of PMOs in integrating sustainability into project management practices and to identify the challenges and success factors associated with this integration.

The study highlighted the importance of clear guidelines and structured procedures. Organizations with well-defined sustainability policies and robust monitoring systems reported higher success rates in integrating sustainability into their project management practices. Effective communication, collaboration, and strong leadership were also identified as critical factors for successful integration.

Key challenges included resistance to change, resource limitations, and dynamic project requirements. The NASA TLX results indicated that high mental demands and workload stress are significant barriers to effective SPM implementation. Addressing these challenges requires targeted strategies such as continuous training and fostering a culture of sustainability.

Implementing SPM techniques positively influences environmental and social responsibility as well as financial performance. Utilizing measures such as carbon footprint and social impact assessments allows organizations to evaluate the effectiveness of their SPM practices. The study highlights that organizations with PMOs generally perform better, demonstrating that structured guidelines and procedures for sustainable business projects enhance overall performance. Incorporating sustainable practices into project management procedures promotes social responsibility and environmental awareness while achieving project objectives. PMOs play a crucial role in facilitating this integration and significantly benefit from implementing SPM techniques. By effectively promoting SPM practices, PMOs can ensure a brighter future for both society and the environment.

6.1 Recommendations

To integrate sustainability into project management, organizations must develop clear sustainability policies that align with their overarching goals. These comprehensive guidelines should be actionable and woven into all project management processes. Enhancing training programs is crucial, providing continuous education on the latest sustainability trends, tools, and methodologies for project managers and team members. This ensures stakeholders are equipped to implement sustainable practices effectively. Robust monitoring systems are essential, utilizing metrics and reporting frameworks to track sustainability performance and guide decision-making. Regular monitoring of metrics like carbon footprint and social impact helps measure progress and pinpoint improvement areas.

Fostering a culture of sustainability requires strong leadership and active stakeholder engagement, promoting organizational commitment at all levels. By embedding sustainability as a core consideration in business decisions, organizations can create a culture that values sustainability. Addressing these areas enables PMOs to overcome challenges in implementing sustainable project management practices and significantly contribute to sustainable development goals. These strategic recommendations enhance the role of PMOs in promoting sustainability, ensuring project management practices are both effective and responsible.

6.2 Final Thoughts

The study emphasizes that SPM is not just a trend but a necessary evolution in the way organizations manage projects. By embedding sustainability into the core functions of PMOs, organizations can drive meaningful change and contribute to a sustainable future. The success of this integration depends on clear policies, ongoing education, robust monitoring, and a strong organizational culture of sustainability.

6.3 Future Study

Future research should explore the long-term effects of sustainable project management (SPM) techniques, revealing sustained impacts on environmental, social, and financial performance. Investigating SPM

effectiveness across different industries could identify sectors benefiting most, enabling tailored practices. Comprehensive cost-benefit analyses are essential to quantify financial implications, providing a clearer understanding of economic trade-offs and potential gains from sustainable practices.

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