ENHANCING PRODUCTIVITY IN INFRASTRUCTURE DEVELOPMENT: THE KEY ROLE OF PROJECT MANAGEMENT OFFICES

Mahmoud Ershadi[1], Marcus Jefferies[2], Peter Davis[3] and Mohammad Mojtahedi[4]

[1,2&3] *School of Architecture and Built Environment, University of Newcastle, University Drive, Callaghan NSW 2308, Australia*

[4] *School of Built Environment, University of New South Wales, NSW, Australia*

Infrastructure development contributes to economic growth and constitutes the backbone of industries. The importance of this underpinning sector of the construction industry has led contracting organizations to adopt robust project management mechanisms; enabling them to tackle ever-increasing complexities and uncertainties associated with infrastructure delivery. Project management Office (PMO) is one of the emerging concepts that has been introduced to centrally coordinate projects and integrate project management arrangements in support of on-target delivery of large-scale infrastructure projects. Previous research underlines the potential benefits of employing these entities in the construction industry. However, there is a paucity of research on the role of these units in enhancing productivity in construction operations. This study focuses on this area and explains the requirements for boosting productivity in infrastructure delivery. The opinions of 20 construction management experts in Australian organizations were obtained and their suggestions were thematically analysed to develop a framework for boosting productivity by leveraging PMO units. The results revealed that employing such units can result in achieving higher productivity outcomes by emphasizing initiatives such as resource optimization; safety improvement; cost minimization; and waste control. The suggested approach provides construction contractors with insights on how to employ PMO entities and run them effectively to achieve satisfactory outcomes in infrastructure delivery.

Keywords: development; infrastructure delivery; project management office

INTRODUCTION

Infrastructure development is known as a risky, uncertain, labour-intensive, and multi-discipline sector with high project management complexities (Khattak and Mustafa, 2019). In today's modern construction industry, projects are considered as key components of an integrated system (Trinh and Feng, 2019). They share business benefits and objectives which makes their delivery process complex. Furthermore, a systematic perspective should be adopted to manage both the interrelations of individual projects and the relevant subprojects of a large infrastructure megaproject.

[1] mahmoud.ershadi@uon.edu.au

Ershadi, M, Jefferies, M, Davis, P and Mojtahedi, M (2021) Enhancing Productivity in Infrastructure Development: The Key Role of Project Management Offices *In:* Scott, L and Neilson, C J (Eds) *Proceedings of the 37th Annual ARCOM Conference,* 6-7 September 2021, UK, Association of Researchers in Construction Management, 422-430

Previous research has argued that PMO incorporates characteristics to address project management matters concerning both the internal and external environment of an organization (Parchami Jalal and Matin Koosha, 2015). Regarding the interdisciplinary nature of construction projects, the internal environment deals with the interactions of several functional teams under the leadership of executives to achieve a specified target. Meeting the design and engineering specifications of deliverables also requires meticulous quality assurance throughout construction to enable project managers in identifying deviations and rectifying errors in advance.

Performing quality assurance requires interdisciplinary coordination by creating a common language both among technical teams, as well as between technical teams and auditors. More importantly, the organizational culture which depends upon the project management maturity level impacts PMO features in an organization. Mature organizations are more willing to adopt advanced PM technologies towards promoting resource productivity; while those with a lower level of maturity are more likely to rely on simple and traditional stand-alone project controlling and reporting mechanisms (Oliveira *et al.,* 2017).

Achieving productivity in managing all types of resources has been among major concerns of researchers (Zhan *et al.,* 2020). Recently, some studies in the construction sector endeavoured to improve labour productivity (Nguyen *et al.,* 2020, Toan *et al.,* 2020), a group of studies emphasized productivity in assets in construction projects (Cooper *et al.,* 2020), and another category of researchers attempted to explore how productivity can be achieved from a business and organizational perspective (Snyman and Smallwood, 2017). There is a need to study productivity from a systematic perspective so that key types of resources can be considered. PMO as a hub for project management can undertake key roles in addressing important aspects of productivity in projects. The present study explains one of the important applications of the PMO concept in enhancing productivity outcomes in infrastructure development projects.

PMO Phenomenon in the Construction Industry

The PMO phenomenon was first introduced to the literature in the late 1990s. This organizational concept has been theorized as a hub for the establishment of project management practice, as well as the centralized management of projects under its domain (Oliveira *et al.,* 2017). Three roles are generally assumed for PMOs: supportive, controlling, and directive. They are complementary to each other to provide full support of the project management practice in project-based organizations. The supportive role involves providing infrastructure such as processes, databases, knowledge repositories, etc. The controlling aspect refers to the operational oversight of operations in terms of complying with tools and methods; while the directive aspect extends the span of control to cover strategic matters of managing projects such as governance and portfolio-level decisions (Project Management Institute, 2017). These roles are interrelated since emphasizing just one aspect while neglecting others would not guarantee to make a difference in the PM environment.

The functions and services that PMOs deliver to a construction organization justify their existence and their value to the construction business. The PMO services for construction organizations aim to not only support projects but also to track business benefits (Szalay *et al.,* 2017). According to a survey conducted by Desta (Desta *et al.,* 2006) in the German AEC sector, the frequent tasks undertaking by PMOs in this

sector include (1) Information dissemination (73.5%), (2) methodology development (67.6%), (3) monitoring and control (64.7%), (4) document lessons learned (52.9%), (5) resource allocation (50%).

Studies on PMO Roles in the Construction Sector

An effective PMO is expected to support projects, control operations, and execute strategies. In this regard, proper support mechanisms such as reporting systems and methodologies are required to allow for informed decisions at the portfolio level. A mere focus on supportive functions makes PMO a passive entity without the capability of enforcing methods and policies in projects. It is advised in previous research that without establishing a structure for project governance, the PMO may fail to deliver its expected value (Singh *et al.,* 2009). A culture of governance should be established to intervene in project operations and decisions in order to minimize deviations from targets and maximize the productivity of all parties that contribute to the project delivery. PMO units fulfil a variety of functions towards addressing these three roles in order to bring maximum value to all aspects of a multi-project environment.

Evidence from previous research reveals that PMO contributes to organizational project management and can help address the complexities of megaprojects such as infrastructure development projects (Khalema *et al.,* 2015). Infrastructure development projects employ a wide variety of resources and multiple stakeholders are involved in their execution. Any improvement in the allocation and utilization of resources would bring significant value to the whole project. Introducing the concept of PMO in the construction industry has opened up windows for practitioners to seek more productive resources and apply them effectively throughout the project with minimum resource idleness and overallocation. Table 1 maps out the findings of previous studies about the role of PMO in the construction context. While other studies focused on the general roles, this study specifically elaborates on the roles of PMO in enhancing resource productivity.

METHODS

This study was conducted using a literature review and expert opinion on the role of PMO in promoting productivity in infrastructure development. Literature reviews assess the current state of research on a topic by bringing together relevant ideas, theoretical discussions, and findings from separate studies. The retrieval of the extant literature helps to achieve a better understanding of the topic and different perspectives of researchers around relevant concepts. The role of PMO was investigated by reviewing relevant literature and eliciting theoretical discussions and findings concerning the topic.

Then, the opinions of experts were obtained through an online survey tool. They were asked to provide their view on the findings of the literature review. A purposive method was used to select participants to provide their comments on the implications of PMO role concerning three aspects of resource productivity. In this method of sampling, researchers rely on their judgement on recruiting the most suitable participants based on a set of criteria. The criteria which were used for purposive sampling include (1) employees who work in collaboration with a PMO unit in main construction contracting companies based in New South Wales, Australia, (2) more than 5 years of experience in project management. Initially, a list of 65 eligible participants was developed and invitation email was sent to all the potential participants, out of which 20 participants agreed to complete the survey.

The link of the online questionnaire was shared with the selected experts via email invitations. A total of twenty responses were received in the survey tool. The demographic analysis revealed that 40% had more than 15 years of PM experience, 40% with 11 to 15 years, and 20% with 5 to 10 years.

Table 1: An overview of previous research on PMOs in the construction industry

Study	Country	Contribution of the study	Findings on PMO roles
(Desta *et al.*, 2006)	Germany	Discusses the role of PMO in achieving a higher level of PM maturity in the German Architecture, Engineering, and Construction (AEC) industry.	Major roles include (1) disseminating information, (2) develop methodology, (3) project monitor and control
(Qi *et al.*, 2014)	China	Explores the relationship between PMOs and other levels of organisational project management, including single projects, programmes, and portfolios.	The role of the PMO is more significant with the increase in the number of projects and the delivery complexity.
(Parchami Jalal and Matin Koosha, 2015)	Iran	Suggests variables in the context of organisations that relate to project management offices' characteristics in the Iranian construction industry.	In organizations that have considered project management in organization strategies and visions; the supporting role of PMO is more evident.
(Kiani *et al.*, 2015)	Iran	Explores the relationship between the existence of PMOs and the success of projects.	PMO plays a prominent role in enhancing the chance of project success.
(Wood *et al.*, 2016)	Australia	1) Identifies the motivations encouraging construction organisations to deploy PMOs. 2) Explains the important role of PMOs in construction organisations.	The roles which always seen in PMOs include (1) auditing, (2) admin support, (3) coordination, and (4) facilitation of decisions.
(Oliveira *et al.*, 2017)	Portugal	Proposes a set of functions for supportive PMOs in the construction sector.	To determine PMO roles in an organization, it is essential to consult the needs and ideas of stakeholders
(Bredillet *et al.*, 2018)	Canada	1) Conceptualises the co-evolution of PMO and project portfolio management. 2) Analyses how PMOs change and evolve.	PMO plays a role in evolving portfolio management and adapts to organizational context influence

The literature review resulted in identifying eight roles that should be undertaken by PMOs to ensure a satisfactory level of resource productivity. Content Validity Ratio (CVR) was used for ensuring an acceptable level of validity using the following formula. All eight items achieved a minimum CVR ratio of 0.8 and were confirmed as valid roles to be considered. This CVR ratio determines the validity of individual items and ranges from +1 to -1 with positive values indicating that at least half the experts rated the item as essential. In formula 1, "n_e" represents the number of participants indicating the item is "essential" and "N=20" indicates the total number of participants (Alberti, 2016):

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}}, (1)$$

RESULTS AND DISCUSSION

The importance of resource productivity in infrastructure development projects

According to the resource-based view, organizations exploit strategic resources to achieve sustainable competitive advantage. A different set of resources need to be used optimally to deliver the maximum value to the business (Chahal *et al.,* 2020). Three kinds of resources need to be taken into account in projects to achieve business objectives in light of sustainability principles, which include human resources, capital resources, and material resources (Zhong *et al.,* 2018). Human capital resources include labour, technicians, supervisors, professionals, and managers who are employed in projects to undertake specified responsibilities towards the accomplishment of project activities. This category of resources constitutes the main pillar of project performance and proper allocation, and management of these resources play a prominent role in productivity outcomes (Felberbauer *et al.,* 2019).

Physical capital resources as another category of resources refer to real estate, equipment, tools, assets, machinery, and inventory of materials, which are used throughout the project lifecycle to deliver the final facility and infrastructure (Perkins *et al.,* 2019). As a primary source of production, this group of resources should be applied productively to ensure maximum benefits. The third type of resources refers to financial capital, which encompasses resources in terms of funds. Promoting productivity of financial resources enables construction organizations to maximize their revenues from their investments (Fulford and Standing, 2014). Productivity improvement should be sought in all these three types of resources to achieve expected business outcomes. The next section introduces findings related to the role of PMO in improving resource productivity in infrastructure development projects.

PMO roles in achieving resource productivity

The roles validated by obtaining experts' comments have been discussed as follows:

PM developer: One of the fundamental roles of PMOs is to develop project management tools and methods (Ershadi and Atashfaraz, 2016, Barbalho *et al.,* 2017). This contribution is necessary to ensure that tools and methodologies are in place to support project management activities across an organization. It enhances collaboration and improves task delegation for managing and controlling project activities. Industry best practices are benchmarked by PMOs to set a basis for optimal PM procedures and methods (Wood and Ma, 2008).

Auditor: The role of PMO is not limited to the development of tools and methods; but also includes auditing to ensure that project management tasks are being executed based on the developed tools and methods (Desta *et al.,* 2006, Oliveira *et al.,* 2017). Compliance with methods and procedures improves the consistency of processes and is necessary for process integration across different projects. Auditing projects in terms of compliance with the project management processes help to identify bottlenecks and barriers to productivity.

Director: Providing strategic direction to projects in the framework of a governance structure is another potential role that can be considered towards boosting productivity (Parchami Jalal and Matin Koosha, 2015, Aubry and Brunet, 2016). Achieving productivity targets requires setting clear objectives and directing project teams to implement corrective actions and initiatives towards meeting them. Interventions in project activities may be required to help in resolving operational and managerial issues which hinder productivity targets.

Performance manager: PMO is partly or fully accountable for the delivery of projects. Monitoring the performance and taking proper actions in response to deviations is a necessity for these entities towards achieving higher resource productivity (Parchami Jalal and Matin Koosha, 2015, Amer and Elayoty, 2018, Sandhu *et al.,* 2019). PMOs manage the performance of project teams to ensure that they are aligned with the organization's productivity goals. They act as decision support centers for senior managers to ensure that all projects are on track and meet performance baselines.

Mentor: PMOs assist project managers and other team members in their decisions and actions, which is a key to adding higher value to the project management environment. Mentoring connects experienced project managers to junior project team members so that they can share best practices and experience (Singh *et al.,* 2009). These units have access to an extensive body of knowledge and best practices from current and previous projects to share with staff. Their advice would decrease human errors and improve their decisions throughout the project life cycle.

Coordinator and facilitator: Infrastructure development projects are among large undertakings which require extensive coordination and communications. PMOs play a central role in the project management environment to reconcile conflicting priorities and influence conflict resolutions. They support project teams in identifying and managing stakeholders (Parchami Jalal and Matin Koosha, 2015). Facilitation of cross-departmental and cross-organizational communications enable PMOs to speed up collaborative decisions on day-to-day project concerns.

Resource manager: Optimal allocation and application of resources in infrastructure projects ensures that the right resources are assigned to the right activities at the right time. PMOs contribute to achieving a higher level of productivity by centralized allocation, monitoring, and control of an organization's resource pool (Qi *et al.,* 2014). This role of PMO capacitates construction organizations to run more projects with limited resources without compromising sustainability objectives.

Risk controller: Infrastructure development projects are among risky large-scale undertakings which are affected by numerous uncertainties. PMOs can take a key role in capturing risks and providing directions to address them (Qi *et al.,* 2014). Assessment and prioritization of risks are necessary to focus resources on tackling the most critical risks which may derail projects from their baseline.

Mapping PMO roles against three aspects of resource productivity

To clarify the role of PMOs in achieving resource productivity, the eight roles are mapped against the corresponding aspects of resources. These roles contribute to enhancing the productivity of human, physical, and financial capital resources by emphasizing relevant mechanisms, tools, and management approaches as detailed in Table 2. This table summarizes the suggestion of experts on the potential impacts of these roles in boosting resource productivity.

CONCLUSIONS

While previous studies highlight the general roles of PMO in the construction industry, this paper contributes to the body of knowledge by shedding light on its specific role in enhancing the productivity of resources. Maintaining a high level of resource productivity is vitally important in large infrastructure development projects that are multi-discipline and risky. Well-defined project management mechanisms would contribute to encouraging consistency and integration in managing projects. This study introduced PMOs as effective structures to provide a suitable basis for

achieving resource productivity. They capture improvement opportunities and coordinate all involved parties to minimize risks and maximize productivity. It was found that eight roles are vital to enhancing productivity by these entities in the infrastructure development projects. Their systematic analysis of project management issues gives the decision-makers a deeper understanding of the root causes of issues and potential solutions to deal with them.

Table 2: PMO roles and three aspects of resource productivity

Roles	Resource productivity		
	Human capital resources	Physical capital resources	Financial capital resources
1) PM developer	Role boundaries and responsibilities	Methods of managing physical assets	Methods of project budgeting and cost planning
2) Auditor	Compliance with assigned responsibilities	Asset auditing	The accordance of financial statements with standards
3) Director	Dismissal and appointment in project teams	Asset management strategies	Strategies of project financing
4) Performance manager	Performance appraisal of the project team	Monitoring the performance indicators of equipment	Cash flow management
5) Mentor	Best practices to manage human resources	Best practices to optimize the operation of equipment	Best practices to manage cash flow and control costs
6) Coordinator and facilitator	Facilitate collaborations with stakeholders	Collaborative asset management decisions	Collaborative decisions on project budgeting and financing
7) Resource manager	Employ qualified team members	Optimize project procurement and control the construction waste	Optimize allocation of funds
8) Risk controller	Addressing human resource risks and improving safety	Addressing risks of physical asset	Addressing financial risks

The contribution of PMOs influences and enriches management practices in three areas of human, physical, and financial capital resources. Failure to define and establish productivity targets and metrics would lead to unsatisfactory outcomes in the proper allocation and control of these three types of resources. This study shed light on the impact of PMO roles to enhance productivity in these three categories of resources. However, more research still needs to be carried out to quantify this impact and model the relationship of PMO capabilities. The authors suggest that future research considers focusing on a case study to empirically examine and develop the findings of the present study.

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