Transcending the silos through project management office: Knowledge transactions, brokerage roles, and enabling factors

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Abstract

Organisations often suffer from knowledge flow gaps between operational and strategic management levels, leaving much knowledge trapped within operations' boundaries. Prior studies viewed the project management office (PMO) as a knowledge broker that can enhance the interaction between these levels. However, they take a single-faceted knowledge brokering perspective that fails to define the specific knowledge brokering roles of the PMO and offer highly fragmentary evidence on the associated enabling factors. To fill this void, we draw on the brokerage theory to develop a comprehensive theoretical framework in which we define specific knowledge brokering roles of the PMO and delineate their enabling factors for facilitating multidirectional knowledge transactions. We elaborate on three sets of knowledge brokering roles, each of which corresponds to one of three categories of knowledge transactions. Our model shows how PMOs can broker knowledge trapped in organisational silos by balancing bottom-up experiential learning with top-down deliberate learning while maintaining horizontal knowledge synchronisation.

Keywords

knowledge flow gaps, project management office, knowledge brokering roles

1 Introduction

Growing specialisation and projectification in organisations post challenges for organisational knowledge flow and exploitation. Prior studies (Bakker et al., 2011; Ali et al., 2018; Grabher, 2004) suggest that particularly project learning is likely to be trapped within project boundaries, exposing firms to organisational amnesia (Grabher, 2004), where firms fall into reinventing the wheel syndrome repeating past mistakes (Pemsel and Wiewiora, 2013; Swan et al., 2010). Known characteristics of project oriented structures, such as decentralisation,

goal-orientation and temporality, have been closely associated with a lack of motivation, opportunity and ability for project teams to share knowledge beyond project boundaries (Argote et al., 2003; Bartsch et al., 2013; Eriksson and Leiringer, 2015). Such organisational attributes are found to constitute organisational silos (Aaker, 2008; Lessard and Zaheer, 1996), organisational units that generate considerable localised knowledge but do not communicate with each other, or structural holes (Burt, 2004) impeding effective knowledge exchange between operational and strategic levels necessary for organisational growth and maturity. Organisations in the knowledge-based economy are exhibiting growing concerns about the silo effect and thus are in constant search for strategies for transcending the silos (i.e., bridging underexploited pockets of knowledge trapped in organisational silos at various levels) (de Waal et al., 2019; Lucas, 2018).

In attempt to overcome the silo effect, *knowledge governance* has emerged as an overarching knowledge-based understanding focusing on the interplay between strategic and operational organisational elements. Foss et al. (2010, p.456) define knowledge governance as "choosing organizational structures and mechanisms that can influence the process of using, sharing, integrating, and creating knowledge in preferred directions and toward preferred levels". Simply put, knowledge governance denotes the structural choices enacted by the organisation to influence individual knowledge sharing behaviour towards the achievement of organisational goals. The project management office (PMO) as one of the most recognised knowledge governance structures in organisations (Eriksson and Leiringer, 2015), has been widely acknowledged for its role in bridging knowledge flow gaps between projects and parent organisations (Pemsel et al., 2016). Although PMOs may differ in their functions, a knowledge intensive PMO creates a collaborative and interactive knowledge sharing culture with project managers to facilitate the elicitation of difficult-to-transfer knowledge (i.e., tacit knowledge) (Desouza and Evaristo, 2006). Eriksson and Leiringer (2015) suggest that the

PMO may serve as a strategic linkage providing higher management with key knowledge generated from projects. This literature highlights the mediating roles of the PMO managers in brokering knowledge between project managers and top managers.

Yet the literature on PMOs as knowledge brokers is limited (Pemsel & Wiewiora, 2013). Previous studies assume a one-size-fits-all brokering role, offer highly fragmentary findings on the enabling factors, and focus primarily on project level knowledge transactions. To address this deficiency, we extend Gould and Fernandez's (1989) typology of brokerage roles and its further development by Shi et al. (2009) to an organisational context where the PMO is deployed to define their context-specific roles. We elaborate on three sets of PMO knowledge brokering roles each of which corresponds to one of three categories of knowledge transactions performed within and across three levels of the organisation (i.e., projects, PMO and top management). We then analyse their enabling factors in terms of learning strategies, brokering techniques and competencies. In doing so, we enrich our understanding of the role of PMOs as knowledge brokers that have been widely recognised for their power for generating new knowledge yet suffering from the negative effects of organisational silos or structural holes.

2 Literature Review

Knowledge brokering refers to the act of mediating knowledge flow between otherwise separated bodies of knowledge (Hargadon, 1998). The usefulness of knowledge brokering as a construct lies on its potential to recognise the position of actors in a network and use it to redefine their role in facilitating knowledge flow from structural and relational standpoints (Jedd and Bixler, 2015). Several earlier studies focused on the role of senior managers in charge of several projects as the knowledge brokers (e.g., Bresnen et al., 2003; Newell et al., 2006). Although a few scholars (e.g., Julian, 2008; Pemsel and Wiewiora, 2013) studied the PMO as a knowledge broker, our understanding of its specific roles and how the PMO

facilitates knowledge flow (e.g., its learning strategies, brokering techniques used and brokering capabilities) remains limited. Table 1 presents a summary of this literature.

For brokering roles, a range of constructs have been introduced in the literature primarily focusing on knowledge flow between the PMO and projects where the PMO is viewed as supporter (Aubry, 2015), innovation stimulator and coordinator (Sergeeva and Ali, 2020). However, these studies do not follow a comprehensive categorisation of brokering roles and so offering a single-faceted understanding. That is, extensive focus has been given to PMO brokering roles at project level while less attention has been paid to similar roles at senior management and PMO levels. Gould and Fernandez (1989) present a comprehensive brokerage model defining various archetypes, including: representative, coordinator, gatekeeper, cosmopolitan and liaison, according to brokers' purpose and affiliation. Shi et al. (2009) further developed the model by considering the direction of knowledge transactions.

Knowledge transactions refer to the different forms of interpersonal exchange of learning and knowledge (Williams, 2007) that are facilitated by knowledge brokers who try to mobilise knowledge within and between groups (Hargadon, 1998). Particularly , cross-project knowledge transactions have received special scholarly attention investigating how the PMOs broker knowledge between projects (e.g., Dai and Wells, 2004; Desouza and Evaristo, 2006; Julian, 2008; Sergeeva and Ali, 2020). These studies present informative findings on how proven techniques and lessons from one project can be mobilised to support the implementation of others. However, their scope does not provide further understanding on how this knowledge can be brokered to support strategy development at higher management level and project standards at the PMO level. In addition, studying cross-project learning in isolation diminishes the opportunity of exploring potential learning interdependencies within and between the three distinct levels of organisational hierarchy (i.e., projects, PMO, higher management). Eriksson and Leiringer (2015) contend that knowledge transactions facilitated

by the PMO and the synergies among them are a crucial factor to maintain effective knowledge governance across the organisation.

In terms of the enabling factors, Chiambaretto et al. (2019) stress the importance of defining them to understand how the brokering process can be performed more efficiently. However, the literature offers highly fragmentary evidence on the enabling factors in terms of learning strategies, brokering techniques and competencies. For learning strategies, despite the broad literature agreement on two categories of learning strategies (i.e., bottom-up versus top-down), further analysis on which strategy is mostly relevant to the specific brokering roles of the PMO is lacking. Bottom-up learning strategy can be closely defined with the technical knowledge gained through the development of specific products (Newell et al., 2006) depending on prior individual experiences (Julian, 2008) and solutions from external sources (Eriksson and Leiringer, 2015). On the other hand, top-down learning strategy can be explained as the spread of the procedural knowledge of how to do things more efficiently (Newell et al., 2006) to enhance future performance (Julian, 2008; Pemsel and Wiewiora, 2013) building primarily on previous project experiences (Eriksson and Leiringer, 2015).

For knowledge brokering techniques, a body of research (Desouza and Evaristo, 2006; Curlee, 2008; Julian, 2008; Pemsel and Wiewiora, 2013; Eriksson and Leiringer, 2015; Sergeeva and Ali, 2020) considers two categories of knowledge brokering techniques the PMO utilises to facilitate different knowledge transactions. This includes interactive techniques, such as face-to-face talks and phone calls, and systematic techniques such as emails and status reports. Although few studies (e.g., Pemsel and Wiewiora, 2013) highlighted the importance of both interactive and systematic techniques in helping the PMO elicits and mobilises knowledge from and into projects, our knowledge remains highly limited on the brokerage techniques necessary to facilitate other knowledge transactions (e.g., PMO-top management, intra-PMO).

Finally, for individual attributes, the literature only offers limited evidence on the qualities mostly favourable to PMO managers to broker various knowledge transactions. For example, facilitation, and process and relationship promotion competencies to encourage project managers to share knowledge (Pemsel and Wiewiora, 2013). Brokerage literature defines three broad categories of capabilities, including: knowledge management, linkage and exchange, and capacity building (Chew et al., 2013). Relatedly, the literature categorises knowledge competencies into technical, organisational, and procedural (Kasvi et al., 2003).

Taken together, the literature takes a generalised knowledge brokering perspective towards the knowledge brokering roles of the PMO and presents fragmentary evidence on the enabling factors associated with each specific brokering role. To bridge this gap, we develop a theoretical model delineating key PMO knowledge brokering roles and defining critical enabling factors according to the knowledge transactions usually performed within and between different organisational levels (i.e., the higher management, PMO and projects).

Table 1. Summary of the Literature Studying the PMO from Knowledge Standpoint

Author	Knowledge Transactions	Learning Strategies	Brokering Techniques	Key findings
Dai and Wells (2004)	PMO-Projects, Projects-PMO, Cross-project	Bottom-up, Top-down	-	PMO repositories of project standards and lessons learnt are positively correlated with project performance
Desouza and Evaristo (2006)	PMO-Projects, Projects-PMO, Cross-project	Bottom-up, Top-down	Interactive, systematic	PMO categorisation according to their capacity to support explicit and tacit knowledge flow from, into and between projects.
Andersen et al. (2007)	PMO-Projects, PMO-Top Management	Bottom-up, Top-down	-	Efficient PMO develops project-related methodologies and procedures, conducts project training, and suggests new projects.
Curlee (2008)	PMO-Projects	Top-down	Interactive, Systematic	PMO offered projects training, standards and methodologies, and formal and informal communications.
Julian (2008)	PMO-Projects, Projects-PMO, Cross-project	Bottom-up, Top-down	Interactive, Systematic	PMO managers help cross-project learning by eliciting projects' knowledge and then exploit it to enhance the performance of other projects.
Pemsel and Wiewiora (2013)	Projects-PMO	Bottom-up, Top-down	Interactive, Systematic	PMO managers need to have more brokering capabilities (e.g., facilitation, Process and promotion, relationship promotion) to effectively elicit knowledge from project managers.
Aubry (2015)	PMO-Projects, Intra-project	Bottom-up, Top-down	-	PMO supportive role fosters project, business, and project management performance
Eriksson and Leiringer (2015)	PMO-Projects, Projects-PMO, PMO- Top Management, Top Management-PMO, Intra-PMO	Bottom-up, Top-down	Interactive, Systematic	PMO knowledge-based functions serve as knowledge governance mechanism facilitating both explorative and exploitative learning
Sergeeva & Ali (2020)	PMO-Projects, Projects-PMO, Top Management-PMO, Cross-project	Bottom-up, Top-down	Interactive, Systematic	PMO managers are innovation stimulators, supporters, and coordinators playing a key role in balancing and integrating innovation exploration and exploitation.
Wiewiora et al. (2020)	PMO-Projects, Projects-PMO, PMO- Top Management, Top Management-PMO, Cross-project, Intra-PMO	Bottom-up, Top-down	Interactive, Systematic	The PMO is a powerful tool strategically positioned to facilitate both bottom-up and top-down learning flows

3 Knowledge Brokering Roles of PMOs

The PMO as a mid-level organisational unit between project management and top management has been widely recognised as an intermediary entity facilitating knowledge transactions at different levels of the organisation (Julian, 2008; Pemsel and Wiewiora, 2013). We classify knowledge transactions into three key categories: bottom-up, horizontal, and top-down. Bottom-up transactions denote the explorative learning mainly originating from projects up to decision making level (Eriksson and Leiringer, 2015). Horizontal transactions involve intra-level knowledge synchronization, such as PMO roles in developing and maintaining proven techniques and methodologies within the projects and the PMO per se (Desouza and Evaristo, 2006). Finally, top-down transactions refer to exploitative learning cascaded from higher management level down to projects, such as the enforcement of new strategies that are derived from experience (Eriksson and Leiringer, 2015).

Within each knowledge transaction category, we define a set of knowledge brokering roles building on Gould and Fernandez's (1989) landmark brokerage typology and its extension by Shi et al. (2009). Gould and Fernandez (1989) defined brokerage as the process of mediating the flow of information between two actors lacking direct access. The authors further identified five nonoverlapping categories of brokerage roles, namely: coordinator, cosmopolitan, representative, gatekeeper, and liaison, depending on group affiliation and transaction purpose of the broker and brokered actors. A *Coordinator* denotes the worker who internally facilitates the flow of information between two teammates. For example, a PMO manager supports the communication between two peers within the PMO entity. A *Cosmopolitan* refers to the personnel who externally assists the communication between two actors belonging to the same group. For instance, a PMO manager facilitating the coordination of a critical task within a project. A *Representative* denotes a team player communicating team knowledge to external actors. A PMO manager communicating some

proven techniques of peer PMO members to a project manager is an example of this role. By contrast, a *Gatekeeper* communicates external information to the team. For instance, a PMO manager communicating only key project knowledge to his or her peers in the PMO for evaluation. A *Liaison* denotes the worker who mediates two external actors belonging to two different groups. For instance, a PMO manager communicating key strategies from senior managers to project managers. Although Gould and Fernandez's (1989) typology offers a promising starting point to define brokerage roles, it does not take into consideration the power differentials between mediated actors nor the direction of knowledge flow. For example, a *Cosmopolitan* brokering knowledge between two project workers may not be equal to another who mediates between two senior managers. Similarly, a *Liaison* mediating knowledge from projects up to higher management may not be the same as another who meditates conversely.

Shi et al. (2009) attempted to address this gap in their extension to Gould and Fernandez's (1989) typology. They identified three more brokerage roles by considering the hierarchical differences between mediated actors and the direction of information flow. For example, a *Cosmopolitan* brokering knowledge between two top managers has been differentiated from another who brokers two lower-level managers. Similarly, a *Liaison* brokering information from lower managers up to top managers has been differentiated from another who facilitates information flow from top to lower-level managers. Although the authors defined the role of *Representative* who links middle level management with top management, they did not define the *Representative* role that links middle level management with lower-level management.

In this study, we extend Gould and Fernandez's (1989) typology of brokerage roles and its further development by Shi et al. (2009) to an organisational context where the PMO is deployed to build a multi-directional framework of PMO brokerage roles. We consider the

Representative role that links middle level management with lower level management, which has not been discussed by Shi et al. (2009) and any others. In addition, we take into account the main attributes of projects as independent entities that differ in objectives and social capital (PMI, 2017), which suggests the need for a *Liaison* role to assist cross-project knowledge transactions between project managers. We define PMO knowledge brokering roles according to three key categories of knowledge transactions to enrich our understanding of how PMO managers broker knowledge to maintain effective knowledge governance in organisations. In total, we define ten distinct brokerage roles PMO managers act to facilitate bottom-up, horizontal, and top-down knowledge transactions. Flowing from this analysis, Figure 1 graphically illustrates the defined knowledge brokering roles within each category of knowledge transactions.

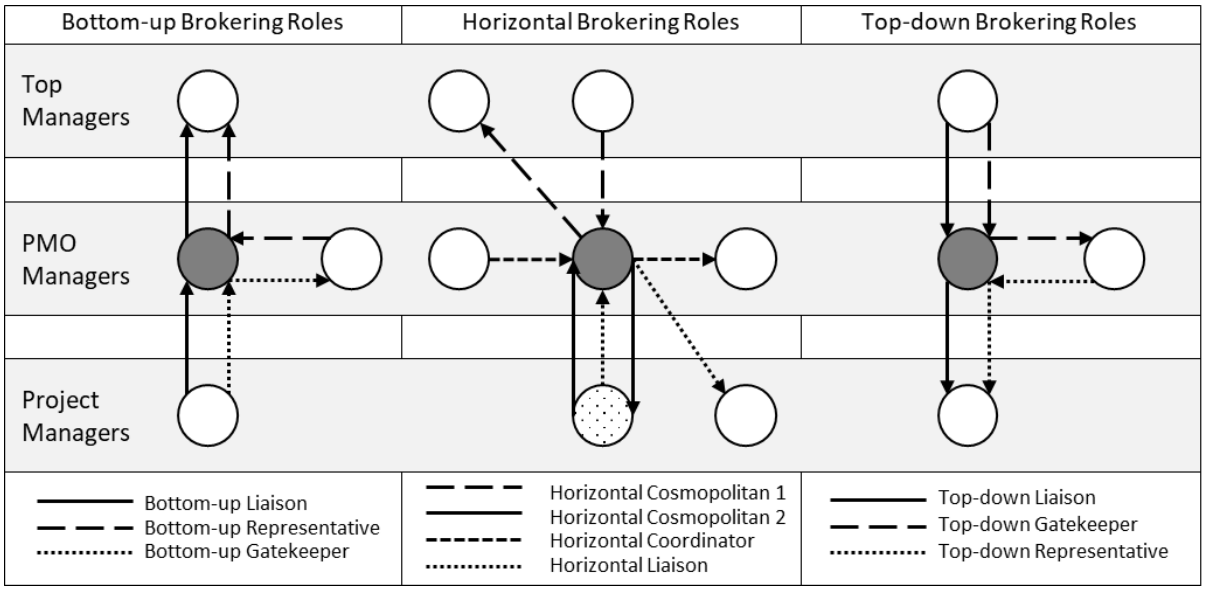

Figure 1. Knowledge Brokering Roles of PMOs
***Note**: grey circles represent knowledge brokers, white circles represent top, PMO and project managers, respectively as shown per each management level, and the dotted circle can be both a project team, for Horizontal Cosmopolitan, and a project manager, for Horizontal Liaison.*

3.1 Knowledge Brokering Roles in Bottom-up Knowledge Transactions

Focal PMO managers play a variety of roles in mediating knowledge transactions from low to higher level management. The knowledge transmitted can be proven projects' techniques

elicited by PMO managers who may evaluate and keep them as PMO archives for future use and/or communicate them to top management in an attempt to influence decision-making (Eriksson and Leiringer, 2015). The brokerage literature (Goldberg, 1989; Shi et al., 2009) suggests that *Liaison*, *Gatekeeper* and *Representative* roles involve brokering knowledge transactions between actors of different groups and thus they are likely to be played between two groups of different power. That is, these roles can be enacted between the three distinct levels of control of project management, PMO and top management. We therefore label these knowledge brokering roles associated with bottom-up transactions as *bottom-up liaison*, *bottom-up gatekeeper*, and *bottom-up representative* (see Figure 1). Below we explain how each role functions in bottom-up knowledge transactions.

3.1.1 Bottom-up Liaison

This brokering role involves PMO managers linking project managers with top managers through mediating bottom-up knowledge transactions. Providing a strategic link between operational and strategic levels is considered as one of the major functions of PMOs (Eriksson and Leiringer, 2015). The purpose of this role is to transmit the most critical knowledge generated at lower level (e.g., threats, opportunities) to top management directly without further debate/discussion at the middle management level (Shi et al., 2009). In so doing, more timely responses from top management to the operational environment are more likely as a result of the single escalation path provided as part of this knowledge brokering role (Desouza and Evaristo, 2006). In the absence of such intermediary roles, critical knowledge, especially knowledge about poor performance and nonconformities (i.e., uncomfortable knowledge), is likely to be hidden by project managers and hence underestimated by senior managers. (Love et al., 2019).

3.1.2 Bottom-up Gatekeeper

This brokering role denotes mediating bottom-up knowledge transactions between project managers and the PMO team by focal PMO managers. Through these transactions, the PMO performs one of its key knowledge governance functions in terms of building and maintaining a database of best practices (Eriksson and Leiringer, 2015). Specifically, this role involves eliciting the most promising lessons from projects for further integration and aggregation at the PMO repositories (see Goldberg, 1989; Shi et al., 2009). As such, bottom-up gatekeeper plays a key role in building PMO knowledge base crucial to develop strategic alternatives to higher management and provide continuous support to projects (Choi and Miller, 2021).

3.1.3 Bottom-up Representative

This role involves mediating bottom-up knowledge transactions from the PMO up to top management level by a focal PMO manager who represents the group to validate, integrate and communicate strategies to top management. The main objective of bottom-up representative is to build a communication platform through which PMO managers propose initiatives and keep top management informed (see Desouza & Evaristo, 2006; Shi et al., 2009). Andersen, Henriksen and Aarseth (2007) noted that a typical PMO provides higher management with recommendations on governance choices and proposals on new projects. Otherwise, project managers tend to shy away from reporting to senior managers and hide information about poor performance in particular (Love et al., 2019).

3.2 Knowledge Brokering Roles in Horizontal Knowledge Transactions

This includes knowledge transactions performed between two actors belonging to similar management level and facilitated by focal PMO managers. These transactions can be within the project where PMO managers may intervene to enhance key project processes (Julian, 2008). Given the three distinct levels of management of project management, PMO and higher management (Hobday, 2000), four possibilities can be identified as horizontal knowledge brokering transactions. This includes intra-project, inter-project, intra-PMO and

intra higher management transactions. While brokering knowledge transactions between projects (as independent entities) requires liaison roles, brokering such transactions within the PMO entails coordinator roles (Gould and Fernandez, 1989). We distinguish these roles at this type of knowledge transactions by adding the word *horizontal*. However, brokering knowledge transactions within a project or within higher management both call for cosmopolitan roles (Gould and Fernandez, 1989). We therefore use both the word *horizontal* and numbers to recognise these roles and thus *horizontal cosmopolitan 1* to refer to knowledge brokering roles within higher management team and *horizontal cosmopolitan 2* to knowledge brokering roles within project team.

3.2.1 Horizontal Liaison

This brokering role involves PMO managers linking project managers operating at different projects through facilitating horizontal cross-project knowledge flow transactions. We define this brokerage role under the liaison category because projects usually differ in their objectives (PMI, 2017) and each project can therefore be considered as an independent entity. In particular, PMO managers may seek to elicit and assess proven knowledge generated in a project with the intention of sending this knowledge back to another ongoing project (Wiewiora et al., 2020). Shi et al. (2009) noted that this procedure may be followed with the goal of verifying the viability of specific knowledge before turning it into organisational routine and/or suggesting it to top management as a strategic initiative.

3.2.2 Horizontal Cosmopolitan 1

This brokering role denotes PMO managers mediating knowledge transactions between two top managers. According to Shi et al. (2009), the main purpose behind brokering such knowledge transactions is the need to ensure that new strategies are scrutinised and approved by concerned top managers before enforcing them. For example, the coordinative role of the PMO with respective senior managers as part of the procurement process (Ershadi et al.,

2021). Therefore, PMO managers at horizontal cosmopolitan 1 role need to integrate necessary top management perspectives on new initiatives to increase their effectiveness.

3.2.3 Horizontal Cosmopolitan 2

This role denotes PMO managers' interventions to facilitate intra-project knowledge flow. These interventions are especially seminal for knowledge integration at early stages of projects (Terhorst et al., 2018). Julian (2008) holds that PMO leaders not only broker knowledge flow from and into projects, but also within the projects to enhance key processes. This is especially the case when PMO managers monitor the implementation of new strategies (Eriksson and Leiringer, 2015) and/or facilitate the emergence of new know-how (Desouza & Evaristo, 2006). This includes mediating knowledge flow between a project manager and another member from the project team. Aubry (2015) found that the supportive role of the PMO within project boundaries is a strong predictor to project performance and in turn project management maturity.

3.2.4 Horizontal Coordinator

This brokering role involves PMO managers facilitating internal knowledge transactions within the PMO. The objective of horizontal coordinators is twofold: to ensure that emerging strategic initiatives are thoroughly debated with peer PMO managers before proposing it to higher management (see Shi et al., 2009), and to translate new strategies cascaded from top management into operational activities that can be implemented as part of current or new projects (Eriksson and Leiringer, 2015). Therefore, it is related to both bottom-up strategy development and top-down strategy enforcement. However, knowledge exchange in this role is facilitated to a certain extent where perceived added value is no longer sensible (Müller et al., 2013).

3.3 Knowledge Brokering Roles in Top-down Knowledge Transactions

This includes mediating knowledge flow from higher to lower management level by focal PMO managers. These transactions can be new strategies to be enforced by higher management through PMO managers who translate these strategies into project-level action plans (Eriksson and Leiringer, 2015). Since liaison, gatekeeper and representative brokerage roles involve mediating knowledge transactions between actors of different groups (Gould & Fernandez, 1989), they are likely to be played between two groups of different power. These roles can be enacted between the three distinct levels of control, namely, project management, PMO and higher management. Therefore, to distinguish knowledge brokering roles associated with top-down knowledge transactions from those related to bottom-up and horizontal knowledge transactions, we add the word *top-down* to these roles in our framework: top-down liaison, top-down gatekeeper, and top-down representative.

3.3.1 Top-down Liaison

This brokering role involves PMO managers mediating top-down knowledge transactions between top management and projects. The main objective of this role is to convey critical knowledge in the form of strategic directions from top managers to lower managers directly without further discussion at the middle management level (Shi et al., 2009). In so doing, corporate-wide interests are seen to have more effective and timely representation at project level (Desouza and Evaristo, 2006). Sergeeva and Ali (2020) emphasise the integrative role of the PMO in communicating top management exploitative learning to project level, and its collective impact over the process of *innovation-as-usual*.

3.3.2 Top-down Gatekeeper

This brokering role denotes top-down knowledge transactions between higher management and the PMO team facilitated by focal PMO managers. Shi et al. (2009) argue that enacting this role is an effective way to protect strategy development efforts at middle management level from potential immature strategies communicated by top management. Thus, focal PMO

managers in such knowledge brokering roles are expected to allow mature and non-conflicting strategies (i.e., do not conflict with emerging PMO initiatives) while stemming immature and conflicting ones.

3.3.3 Top-down Representative

This brokering role involves mediating top-down knowledge transactions between PMO team and project managers by focal PMO managers. Such brokering role is pivotal not only to the PMO's function in strategy translation (Hobbs and Aubry, 2007), but also in retrieving the PMO's repositories in order to provide projects with proven knowledge and methodologies (see Julian, 2008; Eriksson & Leiringer, 2015). Hence, this role takes responsibility of delivering knowledge, mostly exploited from previous operations, to ongoing projects (Choi and Miller, 2021).

4 Learning Strategies, Brokering Techniques, and Key Competences

Defining these three aspects per every knowledge brokering role is crucial to understand how PMOs perform collective knowledge brokering (Julian, 2008) and in turn facilitate efficient knowledge governance. Learning and brokering strategies at PMO level play a key part in shaping the way in which knowledge is governed (Pemsel et al., 2016) while the level of competence determines the broker's capability in mediating different brokerage activities (Pemsel and Wiewiora, 2013).

4.1 Learning Strategies

Consensus in the literature can be seen regarding the learning strategies adopted in organisations. First, bottom-up learning strategy originating from projects as row product learning (Newell et al., 2006) through searching, experimenting, and innovating (Eriksson et al., 2017). This learning strategy is labelled differently by different scholars, for instance, explorative learning (Gibson and Birkinshaw, 2004), product learning (Newell et al., 2006), and experiential learning (Choi and Miller, 2021). On the other hand, top-down learning

strategy imposed by higher management through refining, standardising, and using, known as exploitative learning (Gibson and Birkinshaw, 2004), process learning (Newell et al., 2006), and deliberate learning (Choi and Miller, 2021). For the purpose of this study, we use deliberate versus experiential learning strategies for Choi and Miller (2021).

Bottom-up knowledge flows facilitate the determination of the overall direction of an organisation (Nonaka, 1988). Such knowledge flows enable middle and high-level managers to gain a variety of experience and knowledge from front-line managers, through which their beliefs can be revised and strategic decisions can be refined or tailored (Hutchison-Krupat & Kavadias, 2015; Mom et al., 2007). Such refined strategic decisions are more likely to be supported by employees (Heyden et al., 2017). Therefore, bottom-up knowledge brokering roles are generally more relevant to the process of experiential learning due to the focus on surfacing and eliciting knowledge from previous projects' experiences with the aim of informing decision making.

Experiential learning is of crucial importance to the maturity and growth of organisations since new knowledge is an essential element to sustain continuous improvement (Choi and Miller, 2021). Taking a closer look at the knowledge brokering roles defined in this study, we notice a clear theoretical pattern that bottom-up roles are highly supportive to experiential learning since their major function is to elicit, integrate and mobilise new projects' knowledge (see Eriksson & Leiringer, 2015). For Bottom-up Liaison, knowledge generated at project level is elicited and evaluated to be then communicated to higher management in an attempt to "link the origins of initiatives to the ultimate decision makers" (Shi et al., 2009, p. 1467). In a study of four organisations, Artto et al. (2011) link several integrative arrangements to the PMO including the support of more efficient reporting lines between projects and senior management.

Bottom-up Gatekeeper promotes eliciting the most promising lessons from lower level management (i.e., projects) for further integration and aggregation (see Goldberg, 1989; Shi et al., 2009) with the aim of building a PMO knowledge base (Eriksson and Leiringer, 2015). Turner and Lee-Kelley (2013) in a case study of a multinational PMO, investigate the underlying mechanisms to maintain knowledge exploration and exploitation, and show that PMO social capital and process elements help elicit and institutionalise projects' knowledge.

Knowledge and practices are evaluated and selected based on their potential to generate value for the organisation (Kim et al., 2014). Bottom-up Representative suggests new insights to top management building on knowledge gathered and refined from projects at the PMO (Eriksson and Leiringer, 2015). Dai and Wells (2004) in a study of 209 PMOs show that the majority of them directly reported to higher management with the motivation of improving the performance of projects. Brady and Davies (2004) in a longitudinal inductive study in two firms, found that knowledge flowing from projects was highly influential in deciding corporate level strategies of human resources and restructuring necessary to enhance further learning from projects. In so doing, knowledge generated from intra project experiential learning is elicited, evaluated, and integrated in preparation to influence future operations. Thus:

Proposition 1a: Bottom-up knowledge brokering roles are more likely to support experiential learning than deliberate learning.

Top-down knowledge brokering roles are generally more relevant to the process of deliberate learning since their roles involve putting strategies, methodologies and lessons inspired by past project experiences into operation (Choi and Miller, 2021). They can translate the strategy into concrete activities and monitor the implementation (Heyden et al., 2017). In this process, they need to deal with idiosyncrasies of project activities (Hornung et

al., 2010). Top-down knowledge flows tend to possess proven knowledge which is relevant to improving current and future activities (Mom et al., 2007) through, for instance, training and mentoring (Julian, 2008). This is how higher-level managers influence activities at lower levels of organisations.

For Top-down Liaison, since strategy enforcement usually originates from former experiences to support the implementation of projects (Eriksson and Leiringer, 2015), learning orientation associated with this knowledge brokering role is then more deliberate than experiential (see Choi & Miller, 2021). Hobbs et al. (2008) stress the PMO role in turning strategy into actionable project level activities. In addition, de Carvalho (2014) noted that strategy interpretation is the way in which parent organisations guide projects to follow wider business interests. Similarly for Top-down Representative, since strategy enforcement and retrieval of PMO repositories mainly involves using former knowledge to enhance subsequent operations (Eriksson and Leiringer, 2015), learning orientation of this knowledge brokering role is more deliberate (see Choi & Miller, 2021). Ward and Daniel (2013) show the significant role of the PMOs in developing efficient project management standards and facilitating their application in real project environment. Finally, Top-down Gatekeepers mainly broker deliberate learning (usually in the form of new strategies) originating from higher management level. Shi et al. (2009) argue that top-down gatekeepers' role is to protect strategy development efforts at middle management level from potential undeveloped strategies transmitted by top management. Sergeeva and Ali (2020) in a single case study, conducted 10 semi-structured interviews and concluded that the PMO plays a central role in helping higher management to refine emerging strategies and in turn assist them develop their innovative capabilities. In this way, PMO managers in such knowledge brokering roles play a key part in enhancing the quality of deliberate learning aiming at improving the performance of subsequent projects (see Choi & Miller, 2021). Hence:

Proposition 1b: Top-down knowledge brokering roles are more likely to support deliberate learning than experiential learning.

Horizontal knowledge brokering roles may involve more complex learning processes. They can facilitate knowledge flows between departments and teams with different goals (Landsberger, 1961), allowing organisational members to interpret information through multiple perspectives (Bhatt, 2001). Horizontal knowledge flows increase the breadth of knowledge base of managers (Mom et al., 2007). Bias can be mitigated through organisation-wide focus and a more comprehensive view (Heyden et al., 2017). Meanwhile, horizontal knowledge flows can also be used for planning and technical exchange for specific activities (Hinds and Kiesler, 1995). Middle managers often conduct horizontal roles to facilitate strategic decisions, or to support strategy implementation.

For Horizontal Liaison, PMO managers may directly apply new knowledge gained from a specific project in another. This brokering role is expected to mitigate potential competition between concurrent projects (Hansen et al., 2005) and help testing the viability and applicability of new knowledge in similar settings (Shi et al., 2009). This role then involves both collecting specific project knowledge and directly enforcing this knowledge in another projects. Simply put, Horizontal Liaisons help the flow of experiential project learning to the PMO where they evaluate and apply this knowledge in a different project and so facilitating the flow of deliberate learning (see Choi & Miller, 2021). Similarly for Horizontal Cosmopolitan 2, the learning orientation can also be both experiential and deliberate, as it involves monitoring the application of knowledge extracted from previous experience (i.e., strategy enforcement) as well as observing the emergence of new knowledge. Julian (2008) found that PMO managers not only broker knowledge flow from and into

project boundaries but also intervene within the project to mitigate bottlenecks, vitalise core processes, and ensure the application of best practices.

The role of Horizontal Coordinator helps debating proposed and enforced strategies before suggesting them to higher management and applying them at project level, respectively. Since top-down strategy enforcement involves exploiting former project knowledge to enhance subsequent operations (Julian, 2008), it is considered as an enabler of deliberate learning (Choi & Miller, 2021). Similarly, since bottom-up strategy development usually involves integrating and synthesising knowledge elicited from previous experiences (Shi et al., 2009), it is considered as an enabler of experiential learning (Choi & Miller, 2021). Therefore, horizontal coordinators support both experiential and deliberate learning.

However, the role of Horizontal Cosmopolitan 1 is different from the other three horizontal roles in terms of the learning orientation. This role involves receiving new strategies from higher management and verifying and approving them by concerned top managers (Shi et al., 2009) learning orientation of this knowledge brokering role is thereby more experiential (Choi & Miller, 2021). Deliberate learning in this role is less usual because of power differentials between top and PMO managers. Evidence shows that organisational hierarchy is likely to impede upward learning and teaching efforts could be made by middle managers (see Currie et al., 2015). Hence:

Proposition 1c: Horizontal knowledge brokering roles are more likely to support both experiential and deliberate learning, except for Horizontal Cosmopolitan 1 more likely to support experiential learning.

4.2 Brokering Techniques

Knowledge brokering techniques refer to the specific translation, coordination and alignment efforts brokers exert to facilitate knowledge flow within and between different organisational

entities (Wenger, 1998). The literature defines two key categories of knowledge brokering techniques based on their merits to transmit explicit versus tacit knowledge. Systematic knowledge brokering techniques, such as status reporting and IT (Pemsel and Wiewiora, 2013) are mainly used to facilitate the flow of explicit knowledge which refers to the form of knowledge that can easily be articulated and codified (Polanyi, 1966). Interactive knowledge brokering techniques, on the other hand, such as face-to-face meetings and workshops (Ali et al., 2018) are mainly agreed to facilitate the sharing of tacit knowledge which denotes the form of knowledge that cannot be shared without close interaction (Polanyi, 1966).

Since project managers are more concerned about the achievement of projects' objectives, they are less likely to share knowledge beyond projects' boundaries (Pemsel & Wiewiora, 2013). This is especially the case since knowledge sharing activities have indirect benefit on the accomplishment of projects' activities (Eriksson and Leiringer, 2015). In addition, much of projects knowledge is tacit, difficult to be shared using techniques other than direct interaction (Hobday, 2000). Tacit knowledge is personal and unique, so it needs to be transferred through social relationships and collaboration (Mascitelli, 2000).

The inherent attributes of projects suggest the need for a Bottom-up Liaison to adopt more interactive knowledge brokering techniques, such as face-to-face meetings and communications to elicit projects' knowledge (Pemsel and Wiewiora, 2013; Star and Griesemer, 1989). Desouza and Evaristo (2006) noted that should PMO managers be successful in their knowledge brokering role, they need to "create collaborative communities for project managers to share knowledge and learning that may be difficult to capture and document through conventional mechanisms" (p. 422). Social cohesion enhances individuals' motivations to share knowledge (Reagans and McEvily, 2003). Once particular projects' knowledge is elicited, bottom-up liaison is likely to communicate it to higher management (Hill, 2004; Hobbs and Aubry, 2007). Since projects as frontline operations sometimes bring

highly critical and urgent knowledge to higher management, the role of Bottom-up Liaison here is to directly communicate this knowledge to top management (Shi et al., 2009) without further debate at the PMO level. Therefore, it is more reasonable to PMO managers at this role to follow more interactive knowledge brokering techniques, such as direct calls or unscheduled meetings, to transmit such critical knowledge (e.g., threats) to top managers.

Bottom-up Gatekeepers, however, need both interactive and systematic knowledge brokering techniques in their transactions with project managers and the PMO, respectively. They are likely to use more interactive techniques, such as face-to-face meetings and communications, in their brokerage efforts with project managers (Pemsel and Wiewiora, 2013; Star and Griesemer, 1989). The aim of using such techniques is to elicit the tacit part of projects' knowledge which is usually performed through lessons learnt sessions. Nevertheless, research shows that these routine sessions are likely to be implemented unenthusiastically putting more focus on what was achieved (i.e. product knowledge) rather than underlying success elements (i.e., process knowledge) (Newell et al., 2006). The latter argument therefore highlights the importance of having more interactive knowledge brokering techniques necessary to the flow of knowledge from projects to the PMO. Once PMO managers in such role elicit particular projects' knowledge, they are likely to assess their viability to be embedded as part of the PMO repositories (Eriksson and Leiringer, 2015). Approved knowledge is then codified and stored in the PMO using systematic knowledge brokering techniques, such as reports (Keegan and Turner, 2001).

Similarity, PMO managers in Bottom-up Representative role are likely to use both interactive and systematic knowledge brokering techniques in their transactions with the PMO and the higher management, respectively. They performs two key functions of initiative proposing and reporting (see Shi et al., 2009). Proposing initiatives both requires eliciting tacit knowledge from peer PMO managers and promoting top management confidence in the

initiative they propose (Shi et al., 2009). Hence, it is more feasible to perform this function using more interactive knowledge brokering techniques (e.g., face-to-face meetings) rather than systematic ones (e.g., emails) in order to enrich the transferred knowledge by the social context in which it is applied and shared (Duffield and Whitty, 2014). Rodan & Galunic (2004) contend that those in Representative roles are in position to enhance the level of system integration which in turn contributes to more effective communication between brokered entities. Reporting, however, by its very nature is more systematic brokering technique (see Julian, 2008) that requires a reliable platform (e.g., IT infrastructure) to provide top management with periodic status reports. A well-designed IT system can clarify or visualise entire work processes (Zammuto et al., 2007), making reporting more effective and timely. The platform also helps to routinise the reporting behaviours (Jasperson et al., 2005). Thus:

Proposition 2a: Bottom-up knowledge brokering roles are more likely to adopt both interactive and systematic knowledge brokering techniques, except for Bottom-up Liaison is more likely to adopt more interactive techniques.

The role of Top-down Liaison is required when critical strategic directions are issued by top managers to be directly communicated to lower managers without further discussion at the middle management level (Shi et al., 2009). Such directions can be urgent instructions to avoid deviations in particular projects that must be transmitted in timely manners (Beringer et al., 2013). Benefiting from their easy access to top management and awareness of projects (Raes et al., 2011), PMO managers in this role are likely to follow more interactive knowledge brokering techniques, such as face-to-face meetings and direct calls, to elicit critical and urgent top managers' directions. Similarly, Top-down Liaison need to follow

more interactive techniques with project managers to make sure that urgent and critical instructions are actually put into action. This is attributed to the fact that project managers view themselves as free-thinkers, less obsessed with activities and ideas that do not match their own opinion or do not directly contribute to the project (Pemsel and Wiewiora, 2013). As such, interactive knowledge brokering techniques are highly essential to this role to negotiate, supervise and guide the enforcement of top management strategic directions at project level (Pemsel and Wiewiora, 2013).

However, Top-down Gatekeepers are expected to follow more systematic knowledge brokering techniques using, for instance, IT infrastructure and standardised procedures, to receive, scrutinise and pass on new strategies from top management to the PMO. Since strategy is usually articulated and enforced in codified forms (Eriksson and Leiringer, 2015), PMO managers are likely to use more formal and systematic knowledge brokering techniques (e.g., reports, plans) to regularly align lower management levels with newly imposed strategies (Liu and Yetton, 2007). Management control is necessary due to the self-interest of individuals (Guth and Macmillan, 1986). Those tools therefore can facilitate management control regarding target setting, monitoring, and corrective feedback which are crucial for effective strategy implementation (Daft and Macintosh, 1984). The comprehensiveness of the system can influence the strategy implementation results (Micheli et al., 2011).

For Top-down Representatives, the use of both systematic and interactive knowledge brokering techniques is essential. First, they need interactive techniques (e.g., face-to-face meetings) to translate strategies with peer PMO managers into operational activities (Hobbs and Aubry, 2007). Furthermore, interactive techniques, such as mentoring and training are especially needed to provide project managers with proven knowledge and methodologies (see Julian, 2008; Eriksson & Leiringer, 2015). Interactive techniques are especially needed to share the tacit part of that knowledge through direct interaction with project managers (Goffin

and Koners, 2011). Tacit knowledge is embodied in the minds of experts which requires personal contact to be transferred (Mascitelli, 2000). On the other hand, PMO managers in such knowledge brokering role use systematic techniques as part of their strategy implementation function (Eriksson & Leiringer, 2015). The latter aspect is justified by the classic managerial requirements of strategy implementation to benchmarking, monitoring and status reporting (Daft and Macintosh, 1984). Hence:

Proposition 2b: Top-down Liaison and Top-down Gatekeeper are more likely to adopt more interactive and systematic knowledge brokering techniques, respectively, while Top-down Representative is more likely to adopt both brokering techniques.

Since knowledge flow from projects is inherently problematic (see Swan et al., 2010; Zhao et al., 2015), PMO managers may need to exert interpersonal influence to stimulate project managers' knowledge sharing behaviour (Pemsel and Wiewiora, 2013). Moreover, evidence shows us that the majority of projects' knowledge is context-specific, can only be shared through close involvement (Hobday, 2000). Thereby, Horizontal Liaison needs to adopt more interactive knowledge brokering techniques such as meetings and mentoring (Pemsel & Wiewiora, 2013; Julian, 2008) in order to elicit and mobilise the hard-to-share part of knowledge from project to another.

PMO managers in Horizontal Cosmopolitan 1 is likely to depend more on systematic knowledge brokering techniques using, for instance, IT infrastructure and standardised procedures (see Star & Griesemer, 1989; Pemsel & Wiewiora, 2013). This is to facilitate the verification and approval of new strategies at top management level before enforcing them (Shi et al., 2009). In so doing, PMO managers in such role are more capable to develop the content of strategies while keeping clear track of changes and amendments.

For Horizontal Cosmopolitan 2, performing its functions requires PMO managers to have both interactive and systematic knowledge brokering techniques with projects' personnel to elicit generated (tacit) knowledge and monitor the application of strategies and learning. Interactive techniques are mainly needed to meet project teams knowledge sharing behaviour (Pemsel and Wiewiora, 2013) and to ensure effective strategy implementation (Eriksson & Leiringer, 2015). On the other hand, systematic techniques are needed at this role to enhance management control over strategy implementation through formal benchmarking and monitoring activities (Daft and Macintosh, 1984).

Since brokerage transactions of coordinator roles are completely internal within PMOs (Gould and Fernandez, 1989), the need for more interactive knowledge brokering techniques (e.g., face-to-face meetings) is of crucial importance (see Star & Griesemer, 1989; Pemsel & Wiewiora, 2013). In doing so, focal PMO managers in Horizontal Coordinator roles can effectively mediate the process of strategy development and translation within the PMO. Strategic initiatives need to be debated in person with peer PMO managers before proposing to higher managers while strategy translation is complicated by multiple objectives and their complex relationships (Shi et al., 2009). Therefore, Horizontal Coordinator needs to discuss with peer PMO managers and seek feedback in an interactive manner, using visualization tools (Kaplan and Norton, 2008).

Proposition 2c: Horizontal knowledge brokering roles are more likely to adopt more interactive knowledge brokering techniques, with the exceptions of Horizontal Cosmopolitan 1 is more likely to adopt more systematic techniques and Horizontal Cosmopolitan 2 is more likely to adopt both systematic and interactive techniques.

4.3 Key Competences

The literature defines three key functions to knowledge brokering: knowledge management, linkage and exchange, and capacity building (Chew et al., 2013). Based on these functions, a number of studies (Kasvi, Vartiainen and Hailikari, 2003; Ward, House and Hamer, 2009) define a range of competencies, including technical, organisational, and procedural, required to perform each function more effectively. Technical competency refers to the brokers' knowledge and experience in the elements and technologies required to produce a specific product; organisational competency reflects brokers' capability in coordination and collaboration; and procedural competency defines the level of brokers' proficiency in defining efficient production and operation processes (Kasvi et al., 2003). Generally, we notice theoretical patterns that technical competency is more essential to broker bottom-up knowledge transactions, organisational competency to help horizontal knowledge transactions, and procedural competency to facilitate top-down knowledge transactions.

For bottom-up knowledge transactions, the main objective of brokering them is to elicit, validate, integrate, and codify knowledge mainly generated from projects (Pemsel and Wiewiora, 2013) in order to develop the PMO knowledge base (Julian, 2008) necessary to inform further operations and propose new strategies to top management (Shi et al., 2009). In comparison, knowledge management function of brokering requires significant technical competency to identify, evaluate, synthesise and mobilise projects' knowledge to influence both the operations and decision making (Ward et al., 2009). Since project managers are likely to be more focused on product knowledge (Newell et al., 2006), PMO managers brokering bottom-up knowledge transactions are less likely to succeed in translating this knowledge unless they have sufficient technical competence. For example, if the project involves software development, concerned PMO managers then should be qualified and experienced in IT to better elicit, evaluate, integrate, and develop the unique knowledge flowing from the project. Hence:

Proposition 3a: technical competency is essential to perform bottom-up knowledge brokering roles.

In terms of top-down knowledge transactions, the purpose of these transactions is associated with strategy implementation (Eriksson and Leiringer, 2015), education (Desouza and Evaristo, 2006), and the application of strategic directions (Shi et al., 2009). In comparison, capacity building function of brokering necessitates considerable procedural competency to exploit existing organisational knowledge necessary to develop staff capabilities and project operations (Chew et al., 2013). That is, procedural competency reflects the ability of focal PMO managers in translating highly technical less generalisable product knowledge into highly procedural more generalisable process knowledge (Kasvi et al., 2003; Newell et al., 2006). Spalek (2012) noted that the main business justification for organisations to develop a PMO unit is to develop and enforce procedures and standards across the organisation. Hence:

Proposition 3b: procedural competency is essential to perform top-down knowledge brokering roles.

For horizontal knowledge transactions, the major objective behind them is to facilitate knowledge flow within every management level (i.e., projects, PMO and upper management). This includes intra project knowledge flow facilitations (Julian, 2008), inter project knowledge sharing (Newell et al., 2006), intra PMO knowledge base development (Eriksson and Leiringer, 2015), and intra higher management perspective integration (Shi et al., 2009). In comparison, linkage and exchange function of brokering encourages significant

organisational skills to enhance coordination and collaboration and in turn mutual learning (Chew et al., 2013). Evidence shows that PMO managers may intervene in the project environment to facilitate problematic knowledge transactions (Julian, 2008). Similarly, the development and maintenance of the PMO repositories of standards and processes require high levels of coordination and collaboration to have fruitful intra PMO knowledge transactions (Eriksson and Leiringer, 2015). Hence:

Proposition 3c: organisational competency is essential to perform horizontal knowledge brokering roles.

Moreover, a key category of competence known as liminality competence seems to be critical to liaison roles (i.e., bottom-up, horizontal, and top-down). Borg and Söderlund (2015) define liminality skills as the competence needed to alleviate role tensions resulted from linking two different external groups. The authors describe this skill as closely related to workers, who make the most of their in-between positions, moving back and forth to transfer knowledge between different groups and thus expanding their social network and increasing their learning potentials. Liaison roles involve mediating two external bodies of knowledge belonging to different groups (Gould and Fernandez, 1989). As such, they are most likely to experience role ambiguity and role conflict (Stamper and Johlke, 2003) where they can be lost in the "in-between world" (Kislov et al., 2017, p. 4). Therefore, liminality competence is more essential for liaison roles than for gatekeeper and representative roles that involve knowledge transactions with one external group members and cosmopolitan roles that involve knowledge transactions within one external group (Gould and Fernandez, 1989). Hence:

Proposition 3d: Liminality competence is essential to perform liaison roles.

5 Discussion and Conclusion

5.1 Theoretical contributions

The framework introduced in this study enhances our understanding on the specific knowledge brokering roles PMO managers are likely to play when they facilitate different knowledge transactions within and between different organisational levels. Prior studies presented oversimplified findings on PMOs' knowledge brokering roles by viewing them as a single-faceted construct and offering fragmentary findings on the enabling factors. For example, Pemsel and Wiewiora (2013) solely focused on the brokerage role of PMO leaders to facilitate cross project knowledge transactions, leaving unattended other multi-directional knowledge transactions. We recognise the multi-faceted nature of these roles and argue that they cannot be fully explained without defining the direction and purpose of knowledge flow and the characteristics of mediated entities. By extending Gould and Fernandez's (1989) typology of brokerage roles and its further development by Shi et al. (2009) to an organisational context where the PMO is deployed, we have elaborated three categories of PMO brokerage roles and developed a conceptual framework on how PMO managers broker knowledge transactions within and between three levels of hierarchy: projects, PMO and top management. We have categorised PMO knowledge brokering roles according to three sets of knowledge transactions: bottom-up, horizontal, and top-down. PMO managers assist bottom-up knowledge transactions by performing their bottom-up liaison, representative, and gatekeeper roles, facilitate horizontal knowledge transactions by playing the roles of horizontal coordinator, liaison, cosmopolitan 1, and cosmopolitan 2, and aid top-down knowledge transactions by acting as top-down gatekeeper, representative, and liaison. We have discussed horizontal knowledge transactions of various categories, inter-project, intra-project, intra-PMO, and intra top management, reflecting complexity of PMO knowledge

brokering roles that has not been recognised in prior research. In doing so, we respond to the recent call of Kwon et al. (2020) for considering the entire brokerage structure.

Our framework also defines the enabling factors in terms of learning strategies, knowledge brokering techniques, and capabilities associated with enacting each knowledge brokering role. Past studies have not fully considered the enabling factors for PMOs to perform their knowledge brokering roles more effectively. In that regard, our conceptual framework reveals key theoretical patterns. First, PMO managers in bottom-up knowledge brokering roles regularly support the flow of experiential learning by facilitating the elicitation, integration, and mobilisation of projects' knowledge to build the PMO knowledge repositories and inform decision making. This is also evident in competency needed to perform these roles more effectively. That is, technical competency seems to be the most essential capability to PMO managers in bottom-up knowledge brokering roles. This indicates that such PMO managers are the most involved people in bridging knowledge flow gaps between the projects and the parent firm. In so doing, knowledge generated at project-level is more likely to be mobilised to support decision making. This is in line with Eriksson and Leiringer's (2015) findings on the PMO functions of helping organisations to learn from projects experiences. However, our study takes further steps to define a range of bottom-up knowledge brokering roles and delineate the associated competencies.

Second, PMO managers in top-down roles play a central part in both implementing strategies cascaded by top management and retrieving PMO repositions to enhance the delivery of projects. These roles are found to facilitate the flow of deliberate learning wherein former projects knowledge is reflected in the form of new strategies from top management and new projects' processes from the PMO to enhance performance. This is also clear in the relevance of such PMO managers to procedural competency which reflects the capability of translating new strategies into workable processes and procedures. Our theoretical patterns are

therefore in line with Marsick & Watkins's (1999) key argument on the occurrence of organisational learning when personal knowledge is brought to the system while the system has its own policies and routines to put this knowledge in a wider use. These findings are also congruent with Choi and Miller's (2021) on the role of deliberate learning in building organisational routines. However, our study focuses on the PMO as intermediary entity supporting deliberate learning through a range of top-down knowledge brokering roles.

Third, PMO managers in horizontal knowledge brokering roles generally support the flow of both experiential and deliberate learning strategies as they help knowledge emergence versus application at project level, strategy development versus translation at the PMO, and strategy verification versus approval at upper management level. Our framework shows that organisational competency is especially essential to these roles to help intra level coordination and collaboration. These roles therefore play a key part in encouraging both knowledge generation (within the project) and standardisation (within the PMO) to achieve better knowledge governance across the organisation. These patterns are consistent with Wiewiora's et al. (2020) emphasis that the PMO structure facilitates both explorative and exploitative learning by eliciting feedforward and offering feedback within and between different organisational levels. However, by studying the PMO from a knowledge brokering perspective, our study presents a more nuanced understanding of the specific knowledge brokering roles and the associated enabling factors. We also show that PMO knowledge brokering roles can collectively enhance knowledge governance through facilitating the flow of knowledge both horizontally and vertically.

Our study also concludes that although interactive knowledge brokering techniques are key to facilitate knowledge elicitation from projects, the use of a range of systematic to interactive techniques seem to be more essential to broker different knowledge transactions in general terms. This highlights the need of PMO managers to purposefully use knowledge

brokering techniques to facilitate the flow of both explicit and tacit knowledge. This is in line with Pemsel & Wiewiora, (2013) who argue that PMO managers need to strategically use both systematic and interactive techniques with aim of mediating experiential and deliberate learning orientations. Our study is unique in that it defines a range of knowledge brokering roles and associated enabling factors including the need to systematic versus interactive knowledge brokering techniques per each knowledge brokering role.

Our research extends current literature on the viability of deploying PMO units to promote intra project collaboration (Fernandes et al., 2020), stimulate project innovation (Sergeeva and Ali, 2020), and adopt sustainable project management (Silvius, 2021). We focus on their intermediary roles in facilitating multi-directional knowledge transactions and explain how these roles collectively contribute to knowledge governance across the organisation. Moreover, our study complements recent research on overcoming the silo effect through inter-organisational knowledge brokering (e.g., Stjerne et al., 2019; Rubin and Ness, 2021) by focusing on intra organisational knowledge brokering within and between different managerial levels. We have developed ten testable propositions in our framework which enrich our understanding of the role of PMOs as knowledge brokers in organisations that have been widely recognised for their power for generating new knowledge (Swan et al., 2010) yet suffering from the negative effects of organisational silos or structural holes. Table 2 summarises the proposed framework and the main propositions.

Table 2: Summary of the Theoretical Framework

Bottom-up Knowledge Transactions					
Knowledge Brokering Role	**Knowledge Transactions**	**Purpose**	**Learning Strategy (P1a)**	**Knowledge Brokering Techniques (P2a)**	**Key Competences (P3a, P3d)**
Bottom-up Liaison	Projects to Top Management	Escalating critical knowledge	More experiential	More interactive	Technical, liminality
Bottom-up Gatekeeper	Projects to PMO	Building PMO knowledge base	More experiential	Balanced	Technical
Bottom-up Representative	PMO to Top Management	Building powerful communication and reporting platforms with top management	More experiential	Balanced	Technical
Top-down Knowledge Transactions					
Knowledge Brokering Role	**Knowledge Transactions**	**Purpose**	**Learning Strategy (P1b)**	**Knowledge Brokering Techniques (P2b)**	**Key Competences (P3b, P3d)**
Top-down Liaison	Top Management and Projects	Enforcing urgent strategic directions	More deliberate	More interactive	Procedural, liminality
Top-down Gatekeeper	Top Management and PMO	Shielding emerging PMO initiatives from immature and conflicting strategies	More deliberate	More systematic	Procedural
Top-down Representative	PMO and Projects	Strategy translation and knowledge exploitation	More deliberate	Balanced	Procedural
Horizontal Knowledge Transactions					
Knowledge Brokering Role	**Knowledge Transactions**	**Purpose**	**Learning Strategy (P1c)**	**Knowledge Brokering Techniques (P2c)**	**Key Competences (P3c, P3d)**
Horizontal Liaison	Inter-project	Exploit and develop projects' knowledge	Balanced	More interactive	Organisational, liminality
Horizontal Cosmopolitan 1	Intra Top Management	Strategy verification and approval	More experiential	More systematic	Organisational
Horizontal Cosmopolitan 2	Intra-project	Monitoring strategy implementation and knowledge emergence	Balanced	Balanced	Organisational
Horizontal Coordinator	Intra-PMO	Facilitating strategy development and strategy translation	Balanced	More interactive	Organisational

5.2 Practical Implications

The theoretical framework presented in this study also offers important implications to the practicing managers. First, understanding how PMO managers collectively broker different types of knowledge transactions offers an effective tool to knowledge governance in organisations. The suggested knowledge brokering roles provide interrelated mechanisms that balance between knowledge standardisation and knowledge experimentation. In this way, knowledge generated at project level contribute to new strategy development necessary to enhance future projects' performance and so forth. Second, identifying key skills and techniques as enablers to each of the defined roles is vital to organisations to review the professional requirements for recruiting PMO personnel. In so doing, more informed decisions can be made by human resources management in hiring, delegating and upskilling PMO managers to ensure that they are fully competent to broker a specific range of knowledge transactions.

5.3 Limitations and Future Research Directions

This study has some limitations that may inform future research directions. First, this is a conceptual paper, and we focus on developing a theoretical model (with ten propositions) of knowledge brokering roles of PMO managers in a comprehensive way. The ten propositions we developed need to be empirically tested and validated in future research through quantitative methods in the project management context (Scott-Young et al., 2019). Data can be collected through surveying PMO managers in different organisations. The concepts or variables in the proposition need to be measured. For the ten knowledge brokering roles, they can be measured by asking questions based on our definitions of the ten roles (in Section 3). Alternatively, Gould and Fernandez (1989) offered a sophisticated approach for measuring different types of brokerage roles, which may be useful. For P1a-1c, deliberate learning can be measured according to Nembhard and Tucker (2011), while the measurement of

experiential learning can be developed based on the definition and elaboration by Choi and Miller (2021). For P2a-2c, the measurement items of interactive knowledge brokering techniques can be adapted from those of social processes (Akgün et al., 2005; Ali et al., 2018), and the measurement of systematic knowledge brokering techniques needs to be developed in light of prior research (Pemsel and Wiewiora, 2013). For technical (P3a), procedural (P3b), and organisational (P3c) competencies, measurement can be derived from Kasvi's et al. (2003) definitions of the three constructs. The measurement of these concepts can also be informed by our further explanations and references in Section 4.3. For P3d, the qualitative research of discovered attributes of Borg and Söderlund (2015) liminality competence, which can be used to develop the measurement. Some control variables for companies and individuals should be included. After collecting data, statistical analysis can be conducted to test the ten propositions in this paper.

Moreover, our study assumes a typical organisational structure that consists of higher management, PMO, and project management. However, organisations can have more complex and bigger structures that include more management levels, such as programme and portfolio management (PMI, 2017). As such, future studies could focus on more complex forms of organisations to investigate the way in which the PMO broker knowledge. Likewise, this study has only focused on organisations explicitly employing a PMO division as a middle level management. Future studies may also need to focus on organisations that do not deploy an explicit PMO division and identify how knowledge is brokered.

5.4 Conclusion

Our framework is among the first to define a comprehensive set of PMO knowledge brokering roles and to identify key enabling factors for their effective functioning. The PMO knowledge brokering function has profound potential to effectively govern organisational knowledge as it balances bottom-up experiential learning with top-down deliberate learning

while maintaining horizontal knowledge synchronisation. The PMO provides higher management with continuous feedforward to inform decision making necessary to enhance subsequent feedback to projects in the form of new strategies. Meanwhile, the PMO helps keep active iterations of knowledge generation versus standardisation within each management level. Thus, the proposed knowledge brokering roles together with their enabling factors play a crucial part in maintaining iterative and continuous organisational learning processes essential to the maturity and growth of organisations.

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