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Facilitating multidirectional knowledge flows in project-based organizations: the intermediary roles of project management office

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Abstract

Project-based organizations (PBOs) have been widely recognized as powerful generators of knowledge and innovation owing to their autonomous, multidisciplinary, and goal-oriented operations in the form of projects. However, evidence shows that PBOs are likely to suffer a knowledge flow gap between operational and strategic management levels leaving much of PBOs' knowledge trapped within project boundaries. Although several studies advocated the use of project management office (PMO) to enhance the interaction between these levels, very few examined PMO knowledge brokering roles. This study therefore tries to synthesis theories and evidence around PMO knowledge brokering roles to produce a theoretical understanding on how PMO managers mediate every knowledge flow transaction in PBOs. A theoretical model identifying three key levels of knowledge flow transactions, each of which is mediated by a set of knowledge brokering roles, has been developed. The model heights the powerful potentials of PMO knowledge brokering roles in governing PBOs' knowledge by balancing bottom-up explorative with top-down exploitative knowledge flow transactions. Theoretical contributions, practical implications and future research directions have also been outlined as part of this study.

Keywords: knowledge brokering; project management office; project-based organizations

1 Introduction

Knowledge has long been recognized as the most valuable resource determining how tangible resources are allocated to handle every single issue in organizations (Alavi & Leidner, 2001). That is, employees' specialist knowledge needs to be elicited, integrated and exploited to support decision-making and in turn achieve competitive advantages (Grant, 1996). Since traditional organizational forms are more professionally clustered, integrating different professional views can be more challenging and time-consuming. The increasingly fierce market competition and the pressing need to knowledge generation and innovation, therefore, necessitated a growing number of organizations to adopt more project-based structures (Sydow, Lindkvist and DeFillippi, 2004; Kerzner, 2005; Mueller, 2015).

PBO is a form of organizing in which the majority of business operations are deployed around projects (Söderlund, 2005; Pemsel, Müller and Söderlund, 2016). In specific, the achievement focus, decentralization, and multidisciplinarity of projects' teams are viewed as the most significant attributes turning projects into "powerful generators" of new knowledge (Wiewiora et al., 2014). Swan, Scarbrough and Newell (2010) noted that projects as temporary entities enjoy a comparatively high level of autonomy and flexibility allowing parent organizations respond to their environment in a timelier manner.

Nevertheless, ample evidence shows that project learning is likely to be "trapped" within project boundaries (Bakker et al., 2011) exposing PBOs to "organizational amnesia" (Grabher, 2004; Ali, Musawir and Ali, 2018). That is, project characteristics, such as decentralization, goal-orientation and temporality have been closely associated with lack of project teams' motivation, opportunity and ability to share knowledge outside project boundaries (Argote, McEvily and Reagans, 2003; Bartsch, Ebers and Maurer, 2013; Eriksson and Leiringer, 2015). This in turn constitutes a "structural hole" (see Burt, 2004) impeding effective knowledge synchronization between PBOs' operational and strategic levels. Therefore, PBOs need to maintain

better congruence between knowledge exploration at project level and knowledge exploitation at organizational level so that projects' knowledge contributes to organizational maturity and the latter leads to better knowledge governance at project level (Brady & Davies, 2004; Eriksson & Leiringer, 2015; Pemsel et al., 2014).

One key theoretical understanding coined in literature as an overarching concept to govern the interaction between micro and macro organizational knowledge processes is knowledge governance (KG). Foss, Husted and Michailova (2010) defines KG as the process of deciding organizational structures and procedures that in turn impact micro level processes of generating, disseminating, integrating and exploiting knowledge in pursuit of corporate-wide objectives. One of the most recognized KG structures in PBOs is the PMO, which is promoted as a middle level management between project management and top management levels (Pemsel et al., 2016) and as an enabler of organizational learning (Eriksson & Leiringer, 2015). Although PMOs can differ in their functions, a knowledge intensive PMO creates a collaborative and interactive knowledge share culture with project managers facilitating the elicitation of knowledge hard to be transferred other than direct interaction (Desouza & Evaristo, 2006). Eriksson and Leiringer (2015) show that PMOs can also serve as a strategic linkage providing higher management with key knowledge generated from projects. This in turn highlights the significance of the mediating roles played by PMO managers between project managers and top management.

In general, such intermediary roles have attracted growing research in the context of knowledge management literature. Most of these studies base their theorization on the construct of knowledge brokering. Hargadon (1998) defines knowledge brokers as the mediators, between otherwise isolated groups, benefit from their in-between position to elicit, synthesize and mobilize knowledge across the boundaries. For example, the brokering roles R&D firms' researchers to facilitate collaboration between research producers and users (Gagnon, 2011), the mediating roles of principal investigators between universities and industries to achieve commercialization goals (Kidwell, 2013), and the intermediary roles of hybrid middle level managers between different organizational levels in healthcare sector (Burgess and Currie, 2013; Currie, Burgess and Hayton, 2015).

However, only few studies focused on the knowledge brokering roles of PMOs in the context of PBOs. For example, Julian (2008) found that PMO managers not only promote inter-project exploitative learning by reusing previous projects' lessons, but also explorative learning by adopting training and mentoring endeavors. Relatedly, Pemsel and Wiewiora (2013) found that PMOs still need more capabilities to meet project managers' attitudes to share knowledge. Although these studies tried to explain how PMO managers broker particular type of knowledge flow (i.e. interproject, project-to-organization), they do not offer a holistic explanation to the determinants of potential brokering roles of PMO managers between different PBO levels. Therefore, this study tries to produce an original conceptual understanding on how PMO managers broker knowledge flow transactions within and between the three PBO levels (i.e. projects, PMO and top management). This study in part responds to Zhao, Zuo and Deng's (2015, p. 13) calls "to build consensus-based systems and shared mechanisms" to promote the governance of learning in PBOs.

The remainder of this study is organized as follows. First, we review relevant literature to introduce in-depth understanding on what turns knowledge flow in PBOs into a challenge, the practices and processes used to manage knowledge, how knowledge governance can be performed through the PMO, and PMO functions and competences needed in brokering knowledge flow at different PBO levels. Next, a comprehensive theoretical framework is synthesized to cover three distinct types of knowledge flow transactions mediated by PMO managers, namely, bottom-up, horizontal, and top-down knowledge brokering transactions. Finally, the paper is concluded with a discussion to the contributions and implications of the theoretical framework along with potential directions for future research.

2 Literature Review

This section reviews the state-of-the-art literature on knowledge management in PBOs in order to base our arguments on a firm theoretical basis. Firstly, reasons behind flawed knowledge flow in PBOs is synthesized before reviewing and categorizing most prevalent knowledge management practices and processes suggested in literature. Next, knowledge governance, as an overarching methodology to govern knowledge in PBOs through PMOs, is discussed. Finally, PMO

knowledge brokering roles are discussed, and the theoretical gap is underlined.

2.1 Problematic Knowledge Flow in PBOs

Evidence on learning in PBOs is highly ambivalent (Swan et al., 2010). While there is ample evidence supporting the significant potentials of projects in producing new knowledge, equal evidence shows that projects' knowledge is likely to be "trapped" within project boundaries, however (Bakker et al., 2011). That is, knowledge flow from and between projects is found to be particularly problematic exposing PBOs to "organizational amnesia" (Grabher, 2004), where firms fall into reinventing the wheel syndrome repeating past mistakes (Pemsel & Wiewiora, 2013; Swan et al., 2010).

Extant literature attributes problematic knowledge flow in PBOs to the unique characteristics of projects as temporary organizations. That is, project characteristics are found to undermine project teams' motivation, opportunity and ability to share knowledge outside project boundaries (Argote, McEvily and Reagans, 2003; Bartsch, Ebers and Maurer, 2013). For example, the unique experience of projects has been associated with projects teams' lack of ability and motivation to identify perceived benefits to the applicability of learning outside the project (Bartsch et al., 2013). Similarly, time pressure in projects is also linked to project teams' lack of opportunity to establish social ties, with colleagues in other parts of the PBO, necessary for effective knowledge flow (Eriksson & Leiringer, 2015). Furthermore, project teams are also found to be less motivated to share knowledge owing to the absence of formal structures and incentives stemming from the transient nature of projects (Bartsch et al., 2013).

Goal-orientation is another key projects' attribute found to limit project workers' tendency to share knowledge outside project boundaries. That is, project personnel are found to be more obsessed with the delivery of work packages (Pemsel & Wiewiora, 2013) within the usually predefined projects' constraints of time, cost and quality. The extreme focus on delivery may therefore explain the so-called common practice of conducting lessons learned sessions at the end of projects (see OGC, 2017) when projects teams are not only exhausted but also face potential termination. Evidence supports the lack of value of conducting lessons learned at the end of projects as captured lessons are found to be less valuable and most of reported was about achievement rather than its underlying success elements (Newell et al., 2006).

One quite relevant challenge to cross-project learning is the potential competition over scarce resources between ongoing projects (Hansen et al., 2005). This especially the case when projects overlap in the use of tangle and intangible resources. Project teams therefore are less likely to cooperate unless parent organizations put in place effective mediating practices to bridge interproject knowledge share gap, such as knowledge governance (see Eriksson and Leiringer, 2015) and knowledge brokering (see Pemsel and Wiewiora, 2013).

In short, project attributes are two-sided. Multidisciplinarity, autonomy and achievement-orientation are key to effective intra-project knowledge generation and innovation helping parent organizations to respond to their environments in a timely manner. However, unique experience, time-bound and achievement focus have been identified as the major reasons for project personnel's lack of motivation, opportunity and ability to share knowledge outside project boundaries. Therefore, PBOs need to ensure that projects' learning is actually accumulated at organization level and that learning is thoroughly exploited both in strategy development and in the implementation of current and future projects.

2.2 Knowledge Management Practices and Processes in PBOs

In response to the substantial difficulties facing PBOs to elicit and leverage projects' knowledge, several contributions seen in literature suggesting a variety of remedies. These remedies can be positioned along a continuum ranging from systematic top-down formal practices to relational bottom-up informal processes mainly to stimulate knowledge flow from and between projects (see Figure 1). In essence, these studies build on two distinct schools of thought. On the one hand, studies treating knowledge as a more tangible commodity that can be captured, stored and retrieved apart from its context (see Hartmann and Dorée, 2015). In other words, a view tends to confuse the construct of "knowledge" with that of "information". On the other hand, research recognizing the highly tacit nature of knowledge as embedded understanding within the social and cultural contexts of projects (see Wiewiora *et al.*, 2014). That is, a perspective considering that

knowledge cannot be separated from the context in which it is generated, shared, and utilized.

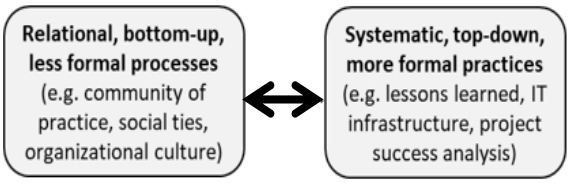

Fig. 1 Continuum of Knowledge Management Techniques

In terms of the more systematic top-down formal knowledge management practices, such as lessons learned exercise (Shokri-Ghasabeh & Chileshe, 2014), use of intranet software (Kivrak et al., 2008), and project success analysis (Todorović et al., 2015), several studies seen in literature advocating their use. Particularly, the most acknowledged technique both in practical and academia is lessons learned exercise, which is also known as "post-mortem" documentation (Julian, 2008). Lessons learned practice, which involves recapping and codifying significant project teams' experiences crucial to improve the performance of subsequent projects, is usually held at the end of projects as part of post-project reviews (see OGC, 2017). Once implemented, documented lessons are stored in firm repositories for future retrieval usually with the aid of IT infrastructure (Newell et al., 2006).

Despite the fact that the vast majority of contemporary PBOs have lessons learned policies in place, evidence shows that only few PBOs actually perform them (Keegan & Turner, 2001). Even when they are implemented, the value of gathered lessons and the transparency to what happens to them afterwards is questioned (Carrillo et al., 2013). Julian (2008) points out to the detrimental consequences of the phenomenon of "red light learning" over organizational learning where lessons learned practice is formally enforced to the extent that project personnel perceive them as punitive. Similarly, Shokri-Ghasabeh and Chileshe (2014) in a survey to construction firms in Australia, found that the most significant barriers to lessons learned practice is the lack of project teams' time, resources and clear guidelines for proper implementation.

Accordingly, the mechanistic nature of lessons learned as a formally enforced practice is found to leave less consideration to project teams social and relational context in which knowledge is basically generated, applied, and shared. This argument is supported by a range of contributions seen in literature. For example, Goffin and Koners (2011) conducted five case studies at leading German firms to uncover how NPD project personnel perceive lessons learned practice. The authors found that project teams were convinced that lesson leaned are highly depended on the context in which it is created, applied and shared and therefore less likely to be transferred "other than by direct interaction" (p. 314). Likewise, Duffield and Whitty (2014) found that lessons learned practice is less likely to succeed unless it aligns people aspects, such as culture and social ties, with system aspects, such as IT and policies.

On the other side of the continuum, the more relational bottom-up informal knowledge management processes come into existence (see Figure 1). Several scholarly investigations seen in literature scrutinizing the impact of such people-oriented processes over knowledge management and organizational learning in PBOs. In that respect, organizational culture may be considered as the most investigated process to its potential impact on how learning is framed at PBOs. In a study to a number of PBOs in Finland, Ajmal and Helo (2010) found that cultural manifestations in PBOs were crucial in defining the way in which knowledge is managed. Relatedly, Mueller (2014) identifies a range of tangible and intangible cultural artifacts as the most crucial to efficient cross-project knowledge flow.

Other studies focused on how interproject and project-organization cultural difference can be a major concern to the viable accumulation and exploitation of projects' knowledge. That is, Swan, Scarbrough and Newell (2010) show that project knowledge is less likely to be translated into institutionalized resource unless projects are deeply embedded within their organizational setting. Likewise, Hartmann and Dorée (2015) posit that cross-project learning is unlikely to occur unless it is rooted through the historical, cultural and organizational contexts of PBOs. The authors noted that "if projects are perceived as sender/receiver islands, then lessons learned remain messages in bottles—freely afloat on the ocean of knowledge, arriving at new shores by chance" (p. 10). Similarly, Wei and Miraglia (2017) argue that the alignment between projects and parent firms' organizational culture is of crucial importance to knowledge share behavior at project team level.

Other body of literature tried to identify the ideal cultural attributes for effective cross-project knowledge

share. That is, Wiewiora *et al.* (2013) found that cultures characterized by evident collaboration and cooperation artifacts were more ready to share project lessons and even those unsuccessful. In a later study, Wiewiora *et al.* (2014) noted that collaborative and interactive working environment is more likely to stimulate trust, which is a crucial determinant to effective implementation of knowledge share practices. Therefore, the multifaceted nature of organizational culture received special academic focus to its potent impact over collective learning at PBOs.

Beside organizational culture, several contributions adopted more relational people-centered processes to explain how learning in project-based setting can be promoted. That is, Bartsch, Ebers and Maurer (2013) in a large scale study surveyed 218 projects in Germany found that social capital was a crucial factor in increasing project teams' motivation, opportunity and ability to share knowledge at different PBOs' levels. Other studies investigated how PBOs can learn through communities of practice (Ruuska & Vartiainen, 2005), coordination behavior (Wen & Qiang, 2016), co-creation practices (Eriksson & Leiringer, 2015), and effective communication (Yap et al., 2017).

Another body of literature argued in favor of balancing the management of both relational and systematic knowledge management practices and processes in pursuit of optimal outcomes. That is, Anand, Ward and Tatikonda (2010) conclude that both technical and social knowledge creation practices are crucial to more successful process improvement projects. Similarly, Arumugam, Antony and Kumar (2013) postulate that technical support along with social antecedents are both equally important in promoting project teams' learning potentials and in turn achieving wider organizational outcomes. Likewise, Almeida and Soares (2014) posit that there is a need to corporate-wide strategies to balance knowledge codification with personalization to overcome inherent knowledge flow difficulties seen in PBOs. Moreover, Mueller (2015) in a case study including five Austrian PBOs, the author found that project personnel use a range of formal to informal techniques in order to share knowledge across project boundaries.

Accordingly, effective PBO-wide knowledge management strategy should balance between the both ends of the continuum (see Figure 1). This means that higher management not only need to enforce formal systems and policies to manage knowledge but also to promote a collaborative and interactive organizational culture. Pemsel, Müller and Söderlund (2016) point out that corporate level knowledge management strategies should maintain effective orchestration with organizational learning processes at operational level. Thus, in order to ensure better levels of knowledge flow at PBOs, knowledge management should be seen as an ongoing process. This process needs to present feedforward from prevailing project knowledge culture and social ties to help decision makers with providing feedback in the form of updated knowledge management strategies and so forth. In so doing, the need to overarching models and theorizations to govern knowledge flow transactions is emphasized.

2.3 KG through PMOs

Literature on holistic strategies to govern knowledge processes in organizations is still emerging. In particular, KG as one of the most recognized constructs used for this purpose, is defined by Foss, Husted and Michailova (2010) 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" (p. 456). In the context of PBOs, it is the work of Pemsel *et al.* (2014) that defines KG as "a strategic combination of knowledge processes and their enabling formal and informal mechanisms that allows moving the organization to set knowledge-based goals" (p. 9). KG therefore tries to adopt top-down formal knowledge management efforts to influence the learning behavior of project personnel. How the personnel react then provides bottom-up response to higher management embodied in the achievement of knowledge-based goals.

Pemsel, Müller and Söderlund (2016), in a large-scale study surveyed 20 project-based firms, categorize KG strategies into six distinct groups through analyzing KG characteristics at four organizational levels, namely, firm, top management, middle management and project management level. The authors then posit that effective KG strategies are highly dependent on how KG choices are made at different PBOs' levels. Later study by Pemsel, Söderlund and Wiewiora (2018) conclude that both "managements' and employees' level of readiness for learning" determine the extent to which organizational capability is developed. This study identities four distinct configurations to KG at PBOs ranging from highly interactive to highly formalistic. The ideal configuration, the authors

argue, is that balances the use of both formal and informal KG mechanisms in pursuit of PBO-wide outcomes.

However, the fact that PBOs usually function at two different levels of operation, namely, project and organization (Hobday, 2000) has attracted several studies stressing the dire need to maintain effective orchestration between these two levels. This is mainly to ensure that projects' learning is actually contributing to the aggregation of knowledge at firm level, in the one hand, and that knowledge is conducive to the continuous improvement of projects' performance (Brady & Davies, 2004). Several studies seen in literature stressing not only the crucial importance of enhancing project-to-organizations knowledge flow (e.g. Swan, Scarbrough and Newell, 2010) but also but also cross-project ones (e.g. Zhao, Zuo and Deng, 2015). From this point of departure, the key roles of PMOs as middle level management in KG are underscored.

The Project Management Institute defines the PMO as "an organizational structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools, and techniques" (PMI, 2017, p. 48). In particular, PMO is a strategy developed to eliminate issues related to project planning, communication and lessons learned practice through acting as central organizational body for knowledge integration and as a repository of good practices (Desouza & Evaristo, 2006). Portfolio management office, program management office, project management center of excellence, and directorate of project management are all referring to the umbrella term of PMO (Julian, 2008).

Eriksson and Leiringer (2015) in a conceptual study investigate the extent to which PMO functions can serve as KG mechanisms. The study concludes that four out of seven recognized PMO functions are learning-oriented and can act as KG mechanisms facilitating both explorative and exploitative project learning; namely, the establishment and maintenance of lessons learned repository, development and maintenance of project management standards, training and mentoring, and strategic management. The authors therefore emphasize that PMOs are best positioned to enhance the process of reusing knowledge through introducing continuous development to project management methodologies, relevant training and consulting services, and strategic connections to project knowledge at corporate level. As such, PMOs are more capable of taking a central role in governing knowledge at PBOs.

However, PMOs can differ in their characteristics that in turn impact their capacity to govern knowledge both positively and negatively. Desouza and Evaristo (2006) in a study to the PMO division of 32 IT firms classify PMOs into four archetypes based on their capacity to manage knowledge. These archetypes categorized PMOs from wholly administrative to highly knowledge intensive, namely, the supporter, the information manager, the knowledge manager, and the coach. While the supporter roles are mainly focused on projects' reporting, the information manager provides a source of information for both project evaluation and reporting. Both of these types have almost no authority to influence projects and project success are usually related to functional departments. By contrast, the knowledge manager and the coach maintain a rich repository of best practices providing project teams with necessary mentoring and training needed to contextualize knowledge. Whereas the knowledge manager PMO has less enforcement authority to the knowledge it preserves, the coach archetype is on contrary. That is, the coach PMO acts as an enforcer of best practices and as a center of excellence to ensure continuous project improvement.

Hence, PMO as a key organizational apparatus to govern knowledge requires more detailed synthesis on the specific mix of mechanisms used to achieve better governance of PBOs' knowledge. These mechanisms need to interact in a way that promotes and motivates learning endeavors at different organizational levels (Eriksson et al., 2017). In this paper, we focus on PMO knowledge brokering behavior as an umbrella concept to other key KG mechanisms used to accomplish particular knowledge-based objectives.

2.4 Knowledge Brokering and PMOs

Knowledge brokering was originally coined in literature by Hargadon (1998) who defines knowledge brokers as the intermediaries, between otherwise isolated bodies of knowledge, benefiting from their in-betweenness state to elicit, integrate and mobilize knowledge across the boundaries. Research identifies three key functions to knowledge brokering: knowledge management, linkage and exchange, and capacity building (Chew et al., 2013; Ward et al., 2009). Knowledge management involves the elicitation, integration and mobilization of specialist knowledge to support decision making. Linkage and exchange denote the process of coordinating knowledge exchange be-

tween various bodies of knowledge especially the transactions between knowledge producers and users. Finally, capacity building involves developing the experience and expertise of the personnel through empowering them with proven knowledge and know-how. Table 1 depicts these functions along with the means needed to perform each of these functions effectively:

Table 3 Key Skills Necessary for Effective Knowledge Brokering (adapted from Kislov, Wilson and Boaden, 2017)

Knowledge Management Skills	Linkage and Exchange Skills	Capacity Building
• Searching and retrieving evidence • Appraising evidence • Synthesizing evidence • IT skills • Tailoring resources to local needs	• Mediation skills • Negotiation skills • Networking skills • Interpersonal skills • Stakeholder influencing skills	• Teaching skills • Mentoring skills • Facilitation skills • Change management skills • Improvement skills

Table 4 Key Skills Necessary for Effective Knowledge Brokering (adapted from Kislov, Wilson and Boaden, 2017)

The literature defines two key bridging strategies knowledge brokers use to mediate the relationship between brokered parties depending on the extent to which the relationship is perceived as competitive or cooperative (see Chiambaretto, Massé and Mirc, 2019). First, *tertius gaudens*, which means the third party who fills the gaps between mediated bodies (see Burt, 2004), is more appropriate when the relationship between brokered parties is competitive. In other words, knowledge brokers using this strategy is less likely to have their brokered parties in direct interactions. Second, *tertius iungens*, which denotes the third party who bridges the gaps, is more likely to be used when the relationship between the mediated parties is perceived as cooperative (see Obstfeld, 2005; Obstfeld, Borgatti and Davis, 2014). That is, knowledge brokers using this strategy facilitates the interaction and coordination between the mediated parties.

Building on the construct knowledge brokering, several studies seen in knowledge management literature trying to explain how the process of knowledge flow from, into and within organizational levels can be mediated. The vast majority of these studies were conducted in or based on generic non project-based organizational structure. For example, the brokering roles of IT professionals between different business units (Pawlowski & Robey, 2004), R&D firms' researchers between research producers and users (Gagnon, 2011; Tortoriello, Reagans and McEvily, 2011), Tourists' Information Centre staff between their company and tourists (Wong & McKercher, 2011), patient safety workers in healthcare industry (Waring et al., 2013), hybrid middle level healthcare managers at different organizational levels (Burgess and Currie, 2013; Currie, Burgess and Hayton, 2015), principal investigators between universities and industry (Kidwell, 2013), and sales workers in NPD businesses (van den Berg et al., 2014). Other studies focused on knowledge brokers as they are in independent positions. For example, knowledge brokers in healthcare industry (Chew et al., 2013; Kislov et al., 2017), comics publishing business (Boari & Riboldazzi, 2014), environmental R&D firms (Quintane & Carnabuci, 2016), and between competitive business units in video game company (Chiambaretto et al., 2019).

In comparison, only few studies focused on knowledge brokering in PBO context. Most of these contributions considered knowledge brokering roles as part of PMOs' functions as middle level management between the operational level represented by the projects and the strategic level represented by top level management (see Hobday, 2000). For example, Julian (2008) in a qualitative study interviewed 20 PMO managers to investigate their mediating roles in promoting cross project learning. The author found that PMO leaders not only broker knowledge retrospectively in the form of reporting and lessons learned practices but also prospectively in the form of mentoring, training, and developing standards and methodologies. Relatedly, Pemsel and Wiewiora (2013) in a multiple case study research interviewed 64 project managers from seven different PBOs. The study found that PMOs as knowledge brokers still require more capabilities to meet project managers' knowledge share attitudes. Therefore, there is an evident practical mismatch between PMOs knowledge brokering efforts and pro-

ject managers' knowledge sharing behavior calling for more interactive theoretical explanations.

What is lacking, therefore, is a detailed theoretical understanding on how PMOs' managers need to broker different management levels within PBOs for more effective knowledge-laden goals accomplishment. Chiambaretto, Massé and Mirc (2019) argue that we not only need to understand the behavior of those in brokering roles, but also how the brokering transactions are performed more concretely. Indeed, extant literature on PMO knowledge brokering roles offers only scant explanation and this conceptual study therefore is taking the opportunity to integrate evidence from other disciplines, such as healthcare and R&D studies, to provide more in-depth synthesis on how knowledge flow transactions at different PBO levels can be brokered by PMO managers.

3 Theoretical Framework: PMOs' Knowledge Brokering Roles and Knowledge Flow Transactions

PMO as a middle level management between operational level, represented by projects, and strategic level, represented by top level management, has been widely recognized as an intermediary entity facilitating knowledge flow transactions at different PBOs' levels (Julian, 2008; Pemsel & Wiewiora, 2013). Apart from its crucial role in developing and maintaining proven techniques and methodologies, PMO can actively contribute to strategy development process and constantly provide projects' personnel with required training and mentoring (Eriksson & Leiringer, 2015). Therefore, in-depth synthesis to the potential PMO knowledge brokering roles, in mediating knowledge flow transactions at different PBO level, is needed. Building on Gould and Fernandez's (1989) brokerage typology and its extension by Shi, Markoczy and Dess (2009), PMO managers mediate knowledge flow at PBOs using three key types of brokering transaction:

3.1 Bottom-up Knowledge Brokering Transactions

This includes three types of transactions (see figure 2). First, project level to PMO level then to top management level knowledge flow. Since PMO managers mediate this transaction between two independent bodies of knowledge, liaison is the term used to describe PMO managers performing this role (see Gould and Fernandez, 1989). Second, project level to PMO level transaction where PMO managers broker knowledge flow between projects as an outsider and their PMO team as an insider. This type of brokering is usually termed as gatekeeping (see Gould and Fernandez, 1989). Finally, the transaction originating from PMO level to top management level. In this transaction PMO managers benefit from their in-group colleagues before brokering knowledge up to top management level. This type of brokers is widely known as representatives (see Gould and Fernandez, 1989). Each of these three brokering roles to be discussed with more in-depth synthesis as follow:

3.1.1 Bottom-up Liaison

This brokering role involves PMO managers linking project managers with top managers through mediating a bottom-up knowledge flow process. Such PMO managers therefore try to elicit, validate and integrate projects' knowledge motivated by the goal of championing strategic alternatives to top managers (see Hobbs and Aubry, 2007; Shi, Markoczy and Dess, 2009). This brokering archetype is especially relevant to the process of prospective learning since project level knowledge is mobilized as a feedforward up to decision-making level (Julian, 2008).

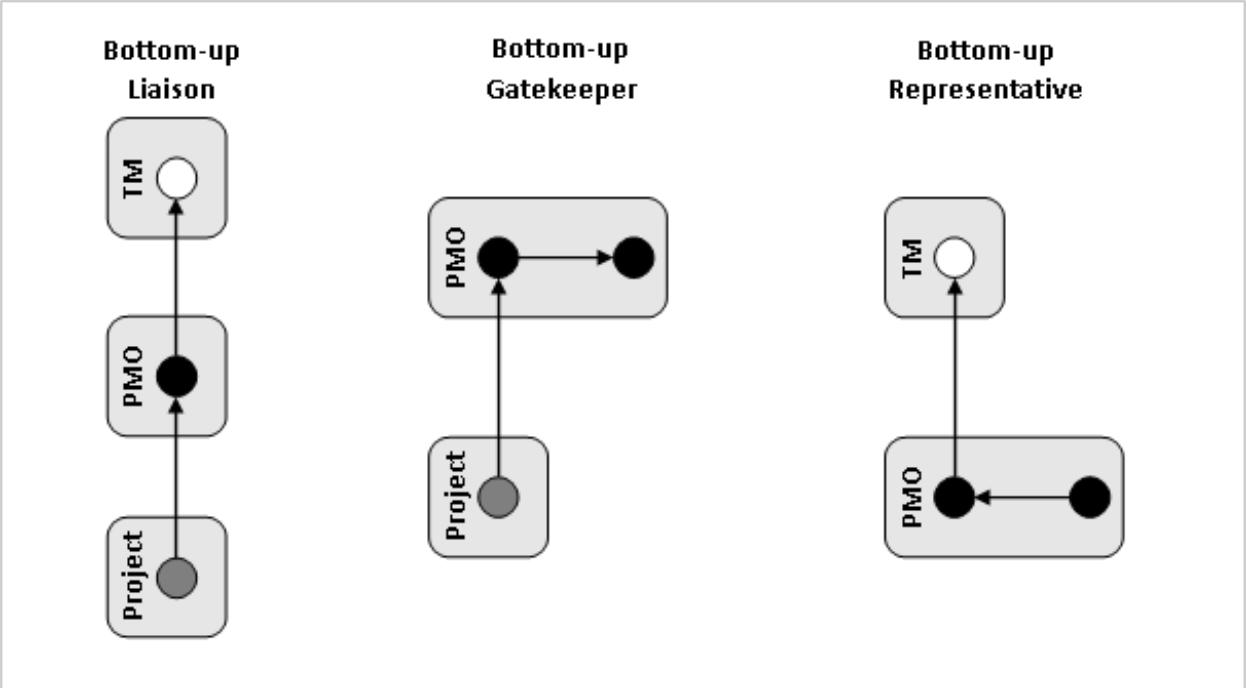

Fig. 2 Graphical Representations to Bottom-up Knowledge Brokering Transactions (Note: Top manager is abbreviated as TM)

However, knowledge flow from projects has long been found to be problematic (Swan et al., 2010; Zhao et al., 2015). That is, project managers are less likely to share knowledge in effective manner unless PMO managers adopt more relational boundary encounters, such as informal meetings, coffee breaks, and interactive communications to elicit projects' knowledge (Pemsel & Wiewiora, 2013; Star & Griesemer, 1989). This requires PMO managers to have significant linkage and exchange capabilities in terms of interpersonal and networking skills (see table 1). Therefore, 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" (Desouza and Evaristo, 2006, p. 422). In so doing, the visionary mismatch between project managers, who are more obsessed with the realization of projects' goals, and PMO managers, who have more program/portfolio level objectives, is more likely to be alleviated.

Similarly, interpersonal and networking skills are also crucial in promoting top managers confidence in the strategies proposed by PMO managers acting this role (see Shi, Markoczy and Dess, 2009). In addition, such PMO managers should own a particular set of knowledge management skills necessary to the success of championing strategic alternatives before higher management bodies. In specific, knowledge evaluation, integration and articulation skills are needed to tailor gathered projects' knowledge to the needs of top managers (see table 1). Moreover, since liaison role involves mediating two different bodies of knowledge, the experience of such in-betweenness has been associated with role ambiguity and role conflict (Stamper & Johlke, 2003) where knowledge brokers can be lost in the "in-between world" (Kislov et al., 2017, p. 4). Accordingly, there is a crucial need to specific type of skills, Borg and Söderlund (2015) term as "liminality competence", in the face of the role tensions experienced during such in-between operations.

In terms of the bridging strategy, since project managers are not structurally equivalent to PMO managers, bottom-up liaisons are expected to follow *tertius iungens* strategy (see Obstfeld, Borgatti and Davis, 2014). In this strategy PMO managers tend to allow direct interactions between project managers and top

managers when required. This strategy is especially important to motivate lower level managers to share knowledge by allowing them participate in the process of championing initiatives to higher management level (Westley, 1990; Shi, Markoczy and Dess, 2009).

3.1.2 Bottom-up Gatekeeper

This brokering role denotes the bottom-up knowledge flow transaction manipulated by focal PMO managers between project managers and PMO team. That is, this role involves synthesizing projects' knowledge before filtering out the most promising aspects to peer PMO managers for feedback (see Gould and Fernandez, 1989; Shi, Markoczy and Dess, 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. Therefore, this brokering archetype is more involved in the process of prospective learning by promoting knowledge integration and accumulation for future need (Julian, 2008).

Since project managers are more "passionate" about their projects (Pemsel and Wiewiora, 2013), focal PMO managers need to use more coincident boundary objects in their operations with project managers, such as informal meetings and interactive communications (Pemsel & Wiewiora, 2013; Star & Griesemer, 1989). This is to ensure better knowledge elicitation by meeting project managers knowledge sharing behavior. Focal PMO managers therefore need to develop their linkage and exchange skills especially in networking and interpersonal influence (see table 1). In addition, PMO managers should also be competent in their knowledge management function in order to ensure better quality manipulation to the knowledge coming in from projects. In particular, in terms of developing their knowledge evaluation, integration and tailoring skills (see table 1). However, this brokering role does not need to have significant liminality competence since it is partially dealing with outsiders (see Borg and Söderlund, 2015). In other words, between their peer group in PMO and project managers as outsiders.

Bottom-up gatekeepers are expected to follow *tertius gaudens* as a bridging strategy since their major function is to control the quality and quantity of knowledge inflow to PMO group (see Shi, Markoczy and Dess, 2009). That is, such PMO managers act as a shield filtering out promising knowledge to the process of championing initiatives. Therefore, they are less likely to allow peer PMO managers to take over this privilege.

3.1.3 Bottom-up Representative

This role involves the bottom-up knowledge flow transaction originated from the PMO up to top management level and mediated by a focal PMO manager. That is, PMO team works to validate, integrate and communicate strategies to a focal PMO manager who represents the group interests in the process of championing strategic alternatives. The major objective of bottom-up representative is to build a powerful communication platform not only to champion initiatives but also to keep top management informed (see Shi, Markoczy and Dess, 2009). Since this role is generally involved with suggesting new insights to top management, it is more oriented towards prospective than retrospective learning, trying to generate new standards for future use (see Julian, 2008).

PMO managers, as any middle level managers at this brokering archetype, perform two key functions of initiative championing and status reporting (see Shi, Markoczy and Dess, 2009). Each of these functions requires a different boundary technique. On the one hand, championing initiatives requires more interactive boundary techniques (e.g. informal meetings and communication) in order to promote higher management confidence in the proposed strategies. This entails focal PMO managers to have superior networking and interpersonal skills to perform their linkage and exchange function more successfully (see table 1). On the other hand, status reporting requires more systematic boundary techniques (e.g. reports writing, emails updates, and formal meetings) in order to keep higher management informed. The latter techniques require focal PMO managers to have IT and knowledge synthesis skills in order to perform their knowledge management function more effectively (see table 1). Like bottom-up gatekeepers, this brokering role does not require focal PMO managers to have significant liminality competence as they broker their group interaction with top managers as outsiders (see Borg and Söderlund, 2015).

Bottom-up representative is expected follow *tertius iungens* as a bridging strategy in order to allow top management access to the origins of initiative when

required. This is mainly to promote top management confidence in the initiatives by ensuring that they are subject to collective verification (see Shi, Markoczy and Dess, 2009). As such, bottom-up representatives are likely to close the gap between peer PMO managers and top management especially when top management requires more confidence to approve or proceed with a new strategy.

3.2 Horizontal Knowledge Brokering Transactions

This includes three types of transactions (see figure 3). First, cross-project knowledge flow where PMO managers broker the transactions between two independent projects. This type of brokers is usually known as liaison (see Gould and Fernandez, 1989). Second, intra-project knowledge flow interventions where PMO managers broker particular transactions within project boundaries. Brokers mediating knowledge flow transactions between intra-group outsiders are known as cosmopolitans (see Gould and Fernandez, 1989). Finally, PMO managers mediating roles within the PMO through facilitating horizontal cross-project knowledge flow process. PMO managers thereby seek to elicit and assess projects' knowledge with an intention of reusing it in other ongoing projects. However, sometimes PMO managers may transfer specific knowledge to other projects with a goal of verifying the viability of that knowledge before suggesting it as a strategic initiative before top managers (see Shi, Markoczy and Dess, 2009). Horizontal liaison operations involve prospective learning since fresh projects' knowledge is mobilized to be used in other ongoing projects (see Julian, 2008).

Since knowledge flow from projects is inherently problematic (see Swan, Scarbrough and Newell, 2010; Zhao, Zuo and Deng, 2015), PMO managers may require more social impact over project managers knowledge sharing attitudes. This can be achieved through boundary encounters processes, such as interactive and collaborative meetings and communications (Pemsel & Wiewiora, 2013; Star & Griesemer, 1989). Therefore, horizontal liaisons need to have more interpersonal and networking competence in their linkage and exchange operations with project managers (see

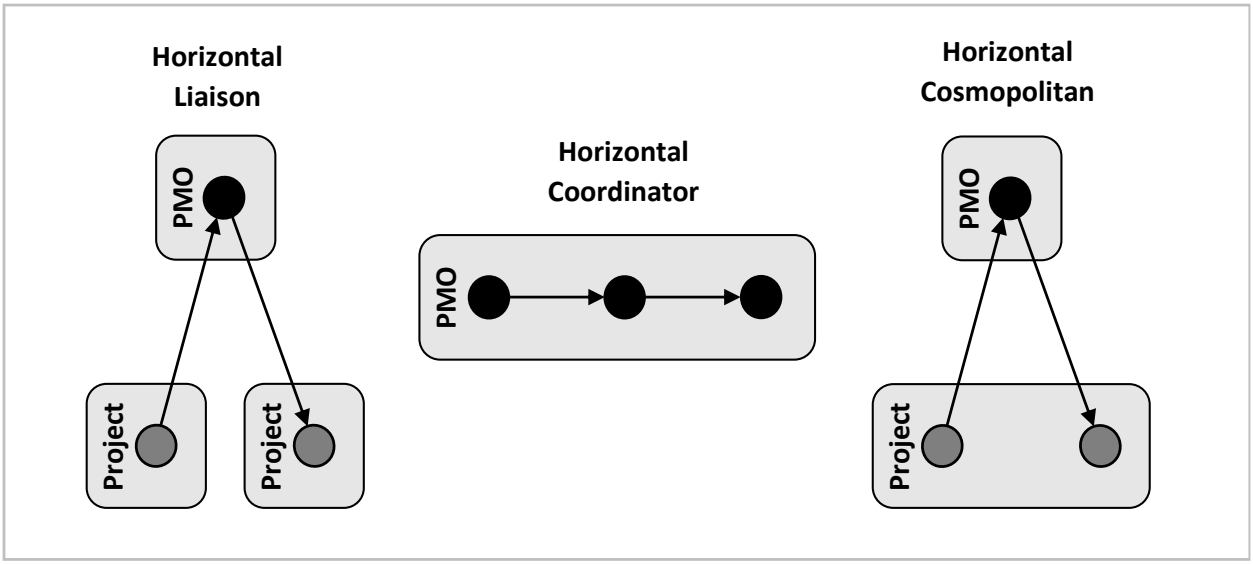

Fig. 3 Graphical Representations to Horizontal Knowledge Brokering Transactions

per sue. This type of brokers is known as coordinators (see Gould and Fernandez, 1989). Each of these three brokering roles to be discussed with more detailed synthesis as follows:

3.2.1 Horizontal Liaison

This brokering role involves PMO managers linking project managers operating at different projects

table 1). In addition, moving back and forth between projects usually requires more linkage and exchange skills in terms of mediation and negotiation (see table 1).

In order to have more effective cross-project knowledge share transactions, PMO managers in this role need to develop their knowledge management skills necessary to evaluate and communicate knowledge (see table 1). In addition, operating between two independent bodies of knowledge is expected to

leave focal PMO managers with role ambiguity and role conflict (see Stamper and Johlke, 2003). As a result, PMO managers need to develop their liminality competence to ease such role tensions (see Borg and Söderlund, 2015).

In terms of the bridging strategy, whether horizonal liaisons adopt *tertius iungens* or *tertius gaudens* is somewhat dependent on the extent to which the relationship between mediated projects is perceived as competitive versus cooperative (see Hansen, Mors and Løvås, 2005; Chiambaretto, Massé and Mirc, 2019). However, competition may be more likely as project managers are more concerned about the achievement of their projects' objectives (see Pemsel and Wiewiora, 2013). This in turn gives more likelihood to *tertius gaudens* as a bridging strategy.

3.2.2 Horizontal Cosmopolitan

This role denotes PMO managers' interventions to facilitate intra-project knowledge flow when required. Julian (2008) holds that PMO leaders not only broker knowledge flow from and into projects, but also within the projects. This is especially the case when PMO managers, as middle level managers, monitor the implementation of a new strategy or emerging know-how (see Shi, Markoczy and Dess, 2009). This includes mediating knowledge flow between project managers and other project bodies, such as team managers and project support. Learning orientation of this brokering role can be both prospective and retrospective, as it involves monitoring the application of knowledge extracted from previous experience as well as monitoring the emergence of new knowledge (see Julian, 2008).

The operations of this brokering archetype require more interactive boundary techniques in order to closely monitor the implementation of a new strategy (see Star and Griesemer, 1989; Pemsel and Wiewiora, 2013). As a result, focal PMO managers need to develop their skills in teaching and mentoring as part of their capacity building function (see Eriksson and Leiringer, 2015). In addition, relational boundary techniques by their very nature require those in such brokering roles to have superior networking and interpersonal skills as part of their linkage and exchange function (see table 1). Finally, role ambiguity and role tensions are more likely due to the fact that focal PMO managers in such roles are mediating the interactions between outsiders (see Borg and Söderlund, 2015). The bridging strategy that is more likely to be used by horizontal cosmopolitans is *tertius iungens*. This is because of the main objective of this brokering role in reaching a consensus over the implementation of new strategy or know-how.

3.2.3 Horizontal Coordinator

This brokering role involves PMO managers facilitating internal transactions with their peer group within the PMO. The main objective of horizontal coordinator is to ensure that emerging strategic initiatives are thoroughly debated within the PMO before championing it before top managers (see Shi, Markoczy and Dess, 2009) through bottom-up representative role. Since this role is more involved with the process of developing new strategic initiatives, its learning orientation is more prospective aim at exploit knowledge for future use (see Julian, 2008).

Since the transactions of this brokering role are completely internal, the need for more relational boundary techniques, such as informal communication and meetings, may be of crucial importance (see Star and Griesemer, 1989; Pemsel and Wiewiora, 2013). As such, networking and interpersonal skills are key for more effective linkage and exchange function to focal PMO managers (see table 1). Moreover, operating in the heart of the process of developing strategic alternatives may also means that horizontal coordinators need to develop their knowledge evaluation and integration skills (see table 1). Finally, internal transactions may also mean that focal PMO managers prefer to adopt *tertius iungens* (i.e. bridging the gap between mediated parties) as a bridging strategy. Adopting this strategy not only boosts the speed of communication, but also add to the quality of debate and in turn the output initiatives (Shi, Markoczy and Dess, 2009).

3.3 Top-down Knowledge Brokering Transactions

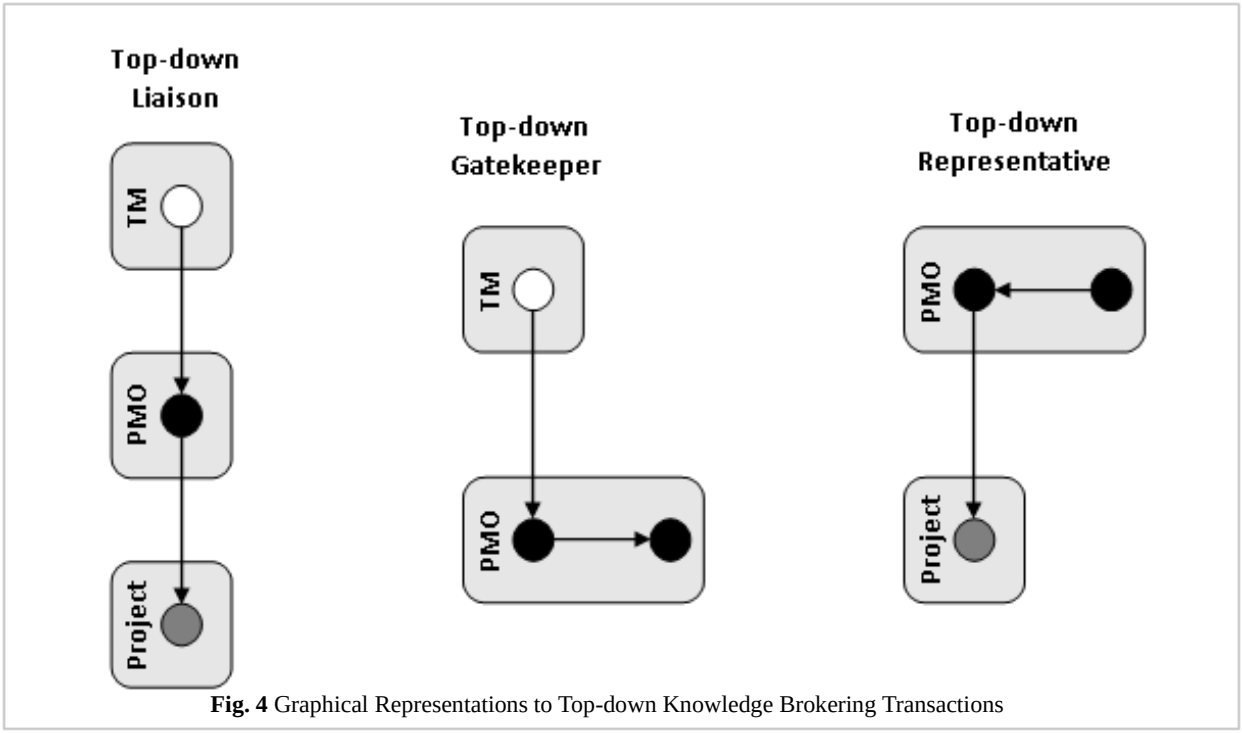

Fig. 4 Graphical Representations to Top-down Knowledge Brokering Transactions

This type of transactions can be classified into three distinct categorizes (see figure 4). First, top management level down to project level knowledge flow transaction mediated by a focal PMO manager. This type of brokering role is known as liaison as the focal PMO manager needs to mediate the transaction between two outsiders from two different groups (see Gould and Fernandez, 1989). Second, top management level to PMO level transaction mediated by a focal PMO manager. Since such focal PMO managers control top management knowledge flow to their PMO team, they can be recognized as gatekeeps (see Gould and Fernandez, 1989). Finally, PMO level down to project level knowledge flow transaction brokered by a focal PMO manager. The latter role is known as representative since such brokers represent their group interest before another group (see Gould and Fernandez, 1989).

3.3.1 Top-down Liaison

This brokering role involves PMO managers mediating knowledge flow transactions between top management and project level. The main objective behind this type brokering roles is to facilitate the process of strategy implementation (Shi, Markoczy and Dess, 2009). As such, corporate strategy imposed by top level management is cascaded down to project level by focal PMO managers. Since strategy enforcement often originates from former projects' experience to support the implementation of current projects, learning orientation associated with this brokering archetype is then more retrospective (see Julian, 2008).

This type of brokering requires both relational as well as systematic boundary techniques in communicating new strategy to project level (Pemsel & Wiewiora, 2013; Star & Griesemer, 1989). On the one hand, explicit know-how, which the project team can readily master or acquire (Goffin & Koners, 2011; Polanyi, 1966), can be sent through written plans. This means that focal PMO managers need to have better competence in terms of IT and tailoring skills in order to effectively communicate the new strategies at project level. On the other hand, tacit knowledge that is difficult to shared rather than direct interaction (Goffin & Koners, 2011; Polanyi, 1966). This entails PMO managers acting such roles to have superior interpersonal, networking, mentoring, and teaching skills to communicate imposed strategy in more effective and interactive manners (see table 1). In addition, operating between two independent external groups means that top-down liaisons need to develop their mediation and negotiation skills as part of their linkage and exchange function. Likewise, liminality competence is more important to focal PMO managers to mitigate role tensions (Kislov, Wilson and Boaden, 2017) stemming from the fact of brokering two external bodies of knowledge (see Borg and Söderlund, 2015). The bridging strategy used by top-down liaisons is more

likely to be *tertius iungens* in order to promote top managers' confidence through allowing them to closely monitor strategy implementation.

3.3.2 Top-down Gatekeeper

This brokering role denotes the top-down knowledge flow transaction manipulated by focal PMO managers between top managers and PMO team. This role acts as a shield against immature and developing strategies imposed by top managers (Shi, Markoczy and Dess, 2009). In this way, focal PMO managers are expected to filter out the most promising aspects to their peers in PMO team to be translated and tailored to facilitate delegation and implementation at project level. Learning orientation of this brokering archetype is therefore more retrospective than prospective since it involves top-down strategy enforcement that is usually informed by past project experience (see Julian, 2008).

Top-down gatekeepers are more likely to adopt more systematic boundary techniques in their gatekeeping role (see Star and Griesemer, 1989; Pemsel and Wiewiora, 2013). This entails focal PMO managers to have significant knowledge evaluation skills to filter out the most promising strategy aspects to be transferred to their peers in PMO team (see table 1). In addition, this brokering archetype is less prone to role tensions since it is not solely dealing with outsiders meaning that owning liminality competence is not essential for effective performance of such PMO managers (see Borg and Söderlund, 2015).

In terms of the bridging strategy, focal PMO managers acting this role is more likely to follow *tertius gaudens*. This is mainly to shield some top managers' emergent and developing strategies expected from affecting ongoing PMO efforts to suggest strategic alternatives (Shi, Markoczy and Dess, 2009). In this way, better levels of strategic flexibility can be maintained through governing the interaction between strategy development and enforcement of PMO team and top managers respectively.

3.3.3 Top-down Representative

This brokering role involves the top-down knowledge flow transaction mediated by focal PMO managers between PMO team and project managers. Such brokering role is pivotal not only to PMO function in strategy translation (Hobbs & Aubry, 2007), but also in retrieving PBO repositories to provide projects with required training and mentoring (see Julian, 2008; Eriksson and Leiringer, 2015). Thus, learning orientation of this brokering role is more retrospective since it involves using previous knowledge (see Julian, 2008).

Top-down representative is more likely to use more relational boundary techniques, such as informal meetings and communications (Pemsel & Wiewiora, 2013; Star & Griesemer, 1989). This means that such PMO managers requires more interpersonal and networking skills (see table 1) not only to stimulate their peers' knowledge share behavior, but also project managers readiness to apply that knowledge. This in turn requires focal PMO managers to have better training and mentoring skills as part of their capacity building function (see Eriksson and Leiringer, 2015). Another key knowledge management skill needed for effective knowledge transmission as part of representative brokering is IT skills (see table 1). However, this brokering archetype does not require having significant liminality skills since its transactions are not wholly external (see Borg and Söderlund, 2015).

Unlike gatekeeper archetype, representative brokers are more focused on enhancing the quality of information flow rather than its control (Gould & Fernandez, 1989; Shi et al., 2009). This means that focal PMO managers acting this role is more likely to follow *tertius iungens* as a bridging strategy. Hence, direct interactions between peer PMO managers and project managers are accessible when required.

4 Discussion

Extant literature on PMO knowledge brokering roles does not offer in-depth synthesis to the determinants of each brokering role in mediating various knowledge flow transactions. Building on Gould and Fernandez's (1989) brokering typology and its extension by Shi, Markoczy and Dess (2009),, we identify three key categories of knowledge flow transactions each of which is mediated by three distinct archetypes of knowledge brokering roles. First, bottom-up transactions from lower to higher power bodies of knowledge. This includes the flow of knowledge coming from projects up to PMO and top management levels. Second, horizontal knowledge flow transactions within and between same level bodies of knowledge. This includes inter-project, intra-project and intra-PMO knowledge flow transactions. Finally, top-down transactions from higher to lower-level bodies of knowledge. This in-

cludes knowledge flow from higher management down to PMO and project levels. Our study is unique in defining all potential knowledge brokering roles the PMO act to enhance PBOs' knowledge exploration, exploitation, and synchronization.

The categorization presented in this study highlights a number of theoretical findings. At bottom-up knowledge brokering level, it has been found that PMOs' knowledge brokering roles significantly contribute to the process of prospective learning through ensuring that projects' knowledge is elicited, evaluated and integrated to inform decision making at higher management level. This can clearly be seen in the strategic determinants of this type of knowledge flow transactions where PMO managers acting as gatekeepers work to establish a firm PMO knowledge base.

Table 2 Summary of the Theoretical Framework

Bottom-up Knowledge Brokering Transactions						
Brokering Archetype	**Mediated Parties**	**Strategic Objectives**	**Learning Orientation**	**Operational Techniques**	**Required Competence**	**Bridging Strategy**
Bottom-up Liaison	Projects and Top Management	Championing strategic alternatives	Prospective	Relational (e.g. interactive meetings and communication)	Interpersonal, networking, evaluation, integration and liminality	Tertius iungens (close the gap)
Bottom-up Gatekeeper	Projects and PMO	Building knowledge base	Prospective	Relational (e.g. interactive meetings and communication)	Interpersonal, networking, evaluation and integration	Tertius gaudens (fill the gap)
Bottom-up Representative	PMO and Top Management	Build a powerful platform to champion initiatives and report on projects' performance	Prospective	Relational & systematic	Interpersonal, networking, IT, integration	Tertius gaudens (fill the gap)
Horizontal Knowledge Brokering Transactions						
Brokering Archetype	**Mediated Parties**	**Strategic Objectives**	**Learning Orientation**	**Operational Techniques**	**Required Competence**	**Bridging Strategy**
Horizontal Liaison	Inter-project	Verify or develop projects' knowledge	Prospective	Relational (e.g. interactive meetings and communication)	Interpersonal, networking, evaluation, integration, mediation, negotiation and liminality	Tertius gaudens (fill the gap)
Horizontal Cosmopolitan	Intra-project	Monitoring strategy implementation and knowledge emergence	Prospective & Retrospective	Relational (e.g. interactive meetings and communication)	Teaching, mentoring, networking, interpersonal, and liminality	Tertius iungens (close the gap)
Horizontal Coordinator	Intra-PMO	Knowledge integration	Prospective	Relational (e.g. interactive meetings and communication)	Interpersonal, networking, evaluation, and integration	Tertius iungens (close the gap)
Top-down Knowledge Brokering Transactions						
Brokering Archetype	**Mediated Parties**	**Strategic Objectives**	**Learning Orientation**	**Operational Techniques**	**Required Competence**	**Bridging Strategy**
Top-down Liaison	Top Management and Projects	Strategy implementation	Retrospective	Relational & systematic	Interpersonal, networking, IT, tailoring, teaching, mentoring, mediation, negotiation, liminality	Tertius iungens (close the gap)
Top-down Gatekeeper	Top Management and PMO	Shield immature strategies, strategy translation	Retrospective	Relational & systematic	Interpersonal, networking, IT, and tailoring,	Tertius iungens (close the gap)
Top-down Representative	PMO and Projects	Training and mentoring	Retrospective	Relational (e.g. interactive meetings and communication)	Interpersonal, networking, teaching, mentoring, and IT	Tertius iungens (close the gap)

This constitutes a platform from which PMO managers acting as representatives to champion strategic alternatives before higher management (see table 2). This is also evident in bottom-up liaison role whereby focal PMO managers directly leverage projects' knowledge in championing initiatives process. Another key finding at this level denotes the specific individual

qualities necessary to focal PMO managers to perform their knowledge brokering roles in an effective manner. This includes interpersonal and networking skills crucial to PMO managers acting as gatekeepers and liaisons to elicit knowledge from project managers, who are more obsessed with the achievement of their projects than sharing knowledge (see Pemsel and Wiewiora, 2013). In addition, knowledge evaluation and integration skills necessary for PMO managers acting as gatekeepers and liaisons in their efforts to develop new strategic initiatives (see table 2).

At horizontal knowledge brokering level, it has been noticed that prospective learning was generally supported. That is, PMO managers acting these roles have been found to be more focused on developing and integrating projects knowledge. In terms of the personal characteristics, role tensions were expected to be experienced by PMO managers acting as liaisons and cosmopolitans due to their totally external transactions (see Stamper and Johlke, 2003). This highlights Borg and Söderlund's (2015) call to acquire liminality competence in the face of role ambiguity and role conflict resulted from dealing with outsiders (see table 2).

At top-down knowledge brokering level, it has been found that PMOs' knowledge brokering roles contribute to the process of retrospective learning through retrieving and adapting previous projects' knowledge to facilitate the accomplishment of PBO-wide objectives through projects. This can clearly be seen in the strategic determinants of PMO managers acting as representatives, who try to ensure that previous projects' lessons are adapted to the needs of ongoing projects (see table 2). Similarly, PMO managers acting as liaisons and gatekeepers participate to the process of strategy implementation that in essence represents a form of exploitative learning (see Brady and Davies, 2004; Eriksson and Leiringer, 2015). Another key finding at this level involves the personal attributes PMO managers need to own to effectively perform top-down knowledge brokering roles. This comprises teaching and mentoring skills key to PMO managers acting as liaisons and representatives to help project teams to implement enforced strategies and adapt previous knowledge (see table 2).

In general, all of the nine knowledge brokering roles identified at this study required more relational boundary techniques to perform knowledge flow transactions in an effective manner. This highlights the tacit nature of knowledge that in most cases cannot be transferred rather than direct interaction (see Desouza and Evaristo, 2006). This finding is in line with previous contributions advocating the use of more interactive operational techniques to effectively elicit projects' knowledge (e.g. Wiewiora *et al.*, 2014; Hartmann and Dorée, 2015). This finding is significantly reflected in the individual attributes PMO managers need to have to perform the knowledge brokering role in an effective manner. That is, in all of the introduced roles, interpersonal and networking skills were highly crucial specially to stimulate project managers knowledge sharing behavior (see table 2).

5 Conclusions

The aim of this paper was to introduce a theoretical understanding on how PMO managers broker knowledge flow transactions within and between the three PBO levels (i.e. projects, PMO and top management). Following a literature-based methodology, a theoretical framework has been developed identifying strategic, operational, individual and structural determinants of each knowledge brokering role played by PMO managers at three different levels of knowledge brokering transactions (see table 2).

This theoretical model in turn stimulates a number of key conclusions. First, PMOs' knowledge brokering function has powerful potentials to effectively govern PBOs' knowledge by balancing bottom-up explorative knowledge flow with top-down exploitative knowledge flow. In other words, providing higher management with continuous feedforward to inform decision making that in turn reacts in more enhanced feedback in the form of new strategies. This is especially key to provide a fertile ground to innovation where the ideas and perspectives of those at operational levels are encouraged though proper elicitation, mobilization, and exploitation. In so doing, the proposed network of knowledge brokering roles plays a crucial role maintaining continuous organizational improvement iteratively and continuously.

Secondly, knowledge brokering is a multifaceted construct that cannot be predicted without defining the direction of knowledge flow and the characteristics of mediated entities. This highlights the widespread oversimplification seen in previous studies in treating knowledge brokering roles as a single-faceted construct. In this way, each knowledge brokering role played by PMO managers has been defined with a specific set of determinants necessary for more optimal levels of knowledge brokering performance at PBOs.

This study contributes to the literature of knowledge management in the context of PBOs by presenting a conceptual model to the network of knowledge brokering roles played by PMO managers. This model presents in-depth synthesis on how each knowledge flow transaction needs to be mediated by PMO managers. Prior research has, however, considered PMO knowledge brokering functions as a single-faceted construct. This paper also contributes to PMO literature by explaining and emphasizing PMOs' knowledge brokering roles necessary to perform each knowledge flow transaction.

There are also practical implications to the theoretical framework developed in this study. First, PBOs need to understand the dynamism behind PMO knowledge brokering roles in terms of knowledge flow direction and the characteristics of mediated parties. This in turn helps organizations to plan necessary actions to enhance knowledge exploration and exploitation necessary to their growth and maturity. Second, identifying the most needed individual attributes to every knowledge brokering role is key to PBOs to have better quality and quality skills needed at PMO divisions. That is, human resources management in PBOs is expected to have more informed decisions in hiring, delegating and upskilling PMO managers.

However, some limitations do appear in this research. That is, this conceptual study was based on previous theoretical models and evidence that are not solely developed or conducted in project-based setting. This is mainly attributed to the scant literature published on PMOs' knowledge brokering roles. Therefore, future research needs to closely observe knowledge brokering roles of PMO managers and precisely identify the determinants of performing each role in more effective manner. In addition, conceptual studies do not offer hypothesis testing which means that future studies need to examine the emerging elements of the theoretical model.

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