Projects are unique, temporary structures that produce unique knowledge. For organisations to gain competitive advantage, this knowledge needs to be transferred effectively between projects. Knowledge transfer across projects is thus an important and decisive competitive factor. However, project teams typically focus on short-term project goals, and often fail to regard capturing and transferring project knowledge between projects as important for the long-term benefit of the organisation. This theoretical study argues that Project Management Offices (PMOs) play an important role by supporting and facilitating the flow of knowledge between projects. A conceptual framework depicting the role of PMOs in the transfer of knowledge between projects is presented here, while empirical results will be reported on in a sequel to this paper.
However, Project Management Offices (PMOs) are thought to be catalysts that moderate (support) and mediate (facilitate, coordinate, and control) the transfer of knowledge between various projects [8]. This paper argues that, without a formalised structure like a PMO that focuses on both the short-term (project efficiency, impact on the project team, and impact on customer [9]) and long-term (alignment of projects and organisation strategy, preparing for the future and business success [10]) objectives of project portfolio success, effective and efficient project knowledge transfer could be very difficult to achieve. Although PMOs fullfil this important integrative role, no study that models the role played by PMOs in the transfer of knowledge between projects could be found. This theoretical study (based on a literature survey) therefore explores the role played by PMOs in supporting and facilitating the flow of knowledge between projects, and presents a conceptual framework that depicts the role of PMOs in the transfer of knowledge between projects.

PMOs mediate and moderate the transfer of knowledge between projects by embedding accumulated knowledge from past project experiences into project management routines that are used across multiple projects in the organisation [11]. In as much as the ability to consolidate learning from previous projects is crucial, the problem in the practical environment is that project employees usually do not get the time to share, evaluate, align, and capture the knowledge before moving to the next project [12]. Their goals are project-specific and short-term in nature. PMOs mitigate the risk of losing project knowledge due to time constraints on the project teams. The overarching research question, therefore, is: “To what extent do PMOs moderate (support) and mediate (facilitate) the flow of knowledge between projects?”

1.1 Project Management Offices

The need to coordinate large, complex contracts that included many projects for a single large customer in the defence industry led to the birth of PMOs in the middle of the twentieth century [13]. Unger, Gemünden and Aubry [8] attributed the formation of PMOs to the challenges faced by project-based organisations (PBOs) in managing multiple projects as an integrated unit. Since then, the establishment of PMOs has increased steadily — an indication that many organisations believe that PMOs are central to attaining their goals and objectives [14]-[16]. A PMO (also known as a project support office [17], project office [18], project management centre of excellence [19], directorate of project management [20], [21] or project management unit) is an organisational focus-point for the project management function, and provides support, methods, procedures, systems, and policy for project management across the organisation [22]; it is an organisational entity with full-time personnel to provide and support managerial, administrative, training, consulting, and technical services for PBOs [19]; and it is a unit or department whose objectives are to assist and support project managers and facilitate good project management practices in a project organisation [23]. Their main functions and responsibilities include improving project management competency, implementing project management standards and methodologies, and providing support to project management teams and to portfolio management [23].

1.2 Objective of the study

The literature reviewed indicates a need for a model that simulates the facilitation and supporting role of PMOs in the transfer of knowledge between projects. This study thus seeks to fill this need by developing a conceptual framework that simulates the moderation (support) and mediation (facilitation) roles of PMOs in inter-project knowledge transfer. This would close the gap between short- and long-term project objectives in PBOs, since most project team members focus on the short-term goals of the project, and often fail to regard capturing and transferring of project knowledge across projects as a priority, or as bringing important long-term benefits to the organisation [7]. We believe that such a model could assist PBOs to maximise efficiency and thus gain a competitive advantage. This paper begins with a brief overview of a knowledge transfer framework, looks at an organisational model and uses it to develop a knowledge transfer framework that is spearheaded by the PMO, and lays out the context variables (characteristics of projects). Characteristics of knowledge generated and sent (independent variables), characteristics of knowledge received and used (dependent variables), and knowledge transfer elements (knowledge transfer infrastructure and processes) are discussed in sections three, four, and five respectively. In section six, the moderating and mediating roles of the PMO on the relationship between knowledge generated and sent and knowledge received and used are modelled. Three main propositions are then put forward, and a conceptual model is presented to help better understand the role of PMOs.
in the transfer of knowledge across projects. Finally, conclusions are drawn, and an avenue for further research is discussed.

2 KNOWLEDGE TRANSFER FRAMEWORK

Osterloh and Grand [24] defined a framework as an instrument to structure convoluted problems and a starting point for the development of alternatives for action. A knowledge transfer framework thus seeks to systemically structure knowledge transfer elements, their relationships, and the principles of how these elements interact [24]. Knowledge transfer infrastructure (people, tools, routines, and systems) and knowledge transfer processes (create, store, share, and use) are the main elements that drive knowledge transfer in organisations [4], [24]-[26]. The general objective of knowledge transfer management is to improve the systematic interaction of knowledge transfer infrastructure and processes within an organisation [24]; and PMOs play a significant role in the management, interaction, and integration of these elements and in ensuring the success of knowledge transfer across projects.

2.1 Organisational model

In a typical PBO with a PMO to direct projects, the PMO moderates and/or mediates the flow of knowledge between projects, as shown in Figure 1. Either (a) knowledge is transferred from one or more projects to the other(s) and the PMO moderates the process, or (b) project knowledge is transferred from project(s) to the PMO and then from the PMO to other projects. In the latter, the PMO acts like a knowledge repository; it manages the knowledge by determining what knowledge to transfer and when and how to transfer it to the respective project(s), depending on the needs of the receiving project(s).

![Figure 1: Project knowledge flow in a typical PBO with a PMO](image)

2.2 PMO’s role in the knowledge transfer framework

Similarly to the PBO with a PMO (Figure 1), PMOs play a coordination (resource allocation across projects), controlling (establishing and maintaining a sound knowledge base) and supporting (cultivating project management standards, improving knowledge transfer between projects and communication) role in the knowledge transfer framework [8]. They are responsible for the management of the whole knowledge transfer framework, which in turn improves the transfer of knowledge between projects. Based on the flow of knowledge in a typical PBO with a PMO (Figure 1), a knowledge transfer framework that is driven by the PMO has been established. Knowledge transfer revolves around the management of knowledge transfer infrastructure and processes [24]. To articulate the role of PMOs in the transfer of knowledge across projects, we established the characteristics of the knowledge generated and sent, the characteristics of the knowledge received and used, and the characteristics of the support and facilitation provided by the PMO, as shown in Figure 2. These characteristics are discussed in detail in sections three to five.
2.3 Demographic and contextual information

One of the common misconceptions about projects is that they are all the same, and that the same or similar tools can be used for all project activities [27]. Managing projects using this approach often leads to failure and/or disappointment, since projects are unique and thus vary in many ways [28]. It is important, therefore, to adopt a framework for categorising projects that addresses the case of projects that are temporary, that are part of an organisation and its culture, and that perform new tasks that have not been done before [28]. Characteristics of projects form an integral part of the demographic information in this research. To address differences among projects, we adopt Shenhar and Dvir’s [29] ‘diamond’ approach, which categorises projects according to four characteristics: novelty, technology, complexity, and pace. Although this is a broad classification, it is very important because it helps to differentiate projects, and specifies a set of rules and behaviours for each project type. Each dimension affects knowledge transfer in its own way [29]. Therefore, the investigation will consider the characteristics of projects to ensure that data collected from the same project types can be compared to avoid distorting the results. The demographics questionnaire will be based on this diamond model to ensure that the respondents choose the answer that best describes the project to which they are referring.

3KNOWLEDGE GENERATED AND SENT

3.1 Characteristics of knowledge generated and sent

Four characteristics of knowledge generated and sent (knowledge objects, knowledge articulability/tacitness or explicitness of knowledge, knowledge embeddedness, and knowledge complexity) have been identified.

3.1.1 Knowledge objects

Although Sokhanvar, Matthews and Yarlagadda [30] identified eight knowledge objects (project management, technical, procedural, costing, clients, legal and statutory, suppliers, and people), there are three main types of knowledge aspect: project management, technological, and entrepreneurial knowledge [7], [31], [32]. A case study conducted by Wei and Miraglia [32] indicates that new construction techniques (technological knowledge) and innovative project management methodologies (project management knowledge) represent the most important types of knowledge transferred and re-used from project to project in a Chinese construction firm. Due to the unique nature of projects [5], [6], particularly exploratory ones, there is usually a high degree of uncertainty and ambiguity about what knowledge to transfer [4]. Therefore, multiple types of knowledge are needed if improvements to organisational products and services are to be realised [33]. Ultimately, knowledge objects have a direct impact on the impact and usability of knowledge [7], [32].
3.1.2 Knowledge articulability or tacitness/explicitness

Knowledge articulability is the extent to which knowledge can be verbalised, put into perspective, and/or written [4]. It deals with the tacitness and explicitness of knowledge [34]. Tacit knowledge, which is unspoken and embedded in people’s experience, know-how and instinct [34], and is hard to teach and learn, is usually hard to articulate and hard to transfer. On the other hand, explicit knowledge is systematic and formal, expressed, can be formulated in sentences, has a universal character, and can be transferred through standardised procedures, and is therefore easy to articulate and transfer [34]-[38]. Organisations need to know the articulability of the knowledge they are dealing with before attempting to explore and exploit it, since different kinds of knowledge require different methodologies, techniques, mediums, and processes. The most difficult exercise faced by most organisations is to convert tacit knowledge into explicit knowledge, so that it can be stored and used in other projects and to gain competitive advantage over other competitors [33], [39]-[42]. Articulated knowledge is easily captured, stored, and shared with other recipients, as it is pragmatic and easily comprehended [34]. This notion proves that articulable knowledge can be more easily transferred than poorly articulated knowledge [4]. Moreover, less articulated knowledge is difficult to diffuse among an organisation’s employees; and this hinders knowledge usability and success in knowledge transfer. However, both tacit and explicit knowledge are crucial in the creation and re-use of knowledge, and contribute positively to projects’ success [35].

3.1.3 Knowledge embeddedness

Cummings and Teng [4] defined ‘embeddedness’ as a characteristic of knowledge that deals with the quality of being firmly and deeply entrenched, or fixed in place. According to Argote and Ingram [1] and Cummings and Teng [4], knowledge can be entrenched in individuals, processes, and tools or products, as well as in various sub-networks [34]. Knowledge embeddedness pre-exists and shapes the sharing of relationships between projects [43]. Hsiao, Tsai, Lee, Dun-hou and Lee [44] identified social aspects [45], technical aspects, and innovation as contexts in which knowledge can be embedded. The challenge to be tackled by project organisations is knowing the number of knowledge elements and the related sub-networks that need to be transferred, absorbed, tailored, and adopted by the receiver [4]. Knowledge embedded in people can sometimes be better transferred by transferring the individuals concerned, while knowledge embedded in tools is more readily transferred between units; and the success of knowledge embedded in organisational routines is determined by the transferability of meaning and value [4]. The survey results of Higuchi and Yamanaka [46] indicate that the key factor for effective tacit knowledge-sharing and long-term co-creation is basically related to embeddedness. The more embedded the knowledge, the more difficult it is to transfer; thus knowledge transfer success increases as knowledge embeddedness decreases [4].

3.1.4 Knowledge complexity

Knowledge complexity is a characteristic of knowledge that derives from the fact that either a large number of actors and activities are involved in a knowledge process, or neither inputs nor outputs of knowledge processes can be observed [47]. Knowledge complexity (the state of being intricate or convoluted) increases the complicatedness (not easy to unravel or solve) of knowledge transfer; creates unnecessary regular face-to-face interaction; and makes the sharing of knowledge between source and recipient difficult [48]. Thus knowledge complexity negatively affects the successful transfer of knowledge. The less complex the knowledge, the more successful the knowledge transfer. High levels of knowledge complexity lead to a low usability of knowledge by other projects or recipients [49].

4 KNOWLEDGE RECEIVED AND USED

4.1 Characteristics of knowledge received and used

The characteristics of knowledge received and used — knowledge usability and knowledge impact — determine whether the transferred knowledge is functional and practical, and whether it influences projects and their success. The characteristics of knowledge received are directly influenced by the characteristics of knowledge generated and sent [4], [7].

4.1.1 Extent of use of knowledge (knowledge usability)

Although it is widely accepted that projects are unique, temporary structures [5], [21], [30], [42], [50], [51] that provide little scope for routinised learning, Brady and Davies [52] argue that similar
categories of projects produce repeatable and predictable patterns of activities that can be transferred and used by current and future projects. Therefore, the usability of knowledge is largely dependent on the characteristics of knowledge generated and sent. Expected use (received and under consideration), conceptual use (know about it), instrumental use (apply it), and strategic use (teach, share, and improve own understanding) are the dimensions for knowledge use established by Van Waveren, Oerlemans and Pretorious [7]. When considering the usability of knowledge, one should relate it to the characteristics of knowledge generated and sent. The less complex, embedded, and tacit the knowledge, the greater the extent of knowledge use.

4.1.2 Impact of knowledge

Meadow and Yuan [7] outlined three kinds of knowledge impact: individual status level impact, individual usage level impact, and group level impact. However, for the impact of knowledge to be measurable, there needs to be a set of variables that have to be defined and benchmarked against the effects of knowledge received and used [7]. It is thus recommended that these variables be aligned with project and organisational goals. Shenhar, Dvir, Levy and Maltz [9] proposed five dimensions of knowledge impact: project efficiency (meeting time, cost, project specifications), benefit to the customer (customer satisfaction and meeting functional performance), impact on the team (satisfaction, retention, and personal growth), business success (commercial value, profits, and revenue), and preparing for the future (sustainability and growth). Reich, Gemino and Sauer [53] identified two main categories of knowledge impact: project management performance, and project performance. There is a direct link between the impact of transferred knowledge and the characteristics of knowledge generated and sent. The less complex, embedded, and tacit, and the more articulate the knowledge, the greater its impact.

4.2 Influence of knowledge generated and sent on knowledge received and used

As already alluded to, there is a direct relationship between characteristics of knowledge generated and sent and knowledge received and used, even in organisations without a PMO. The identified characteristics of knowledge generated and sent (type of knowledge, articulability or tacitness/explicitness of knowledge, knowledge embeddedness and complexity) have a direct influence on the extent of use and impact of use of knowledge transferred. However, since this research focuses mainly on the role of PMOs, this relationship falls outside the scope of the investigation, and so will not be explored.

5 KNOWLEDGE TRANSFER SUPPORT AND FACILITATION BY PMO

5.1 Knowledge transfer support and facilitation characteristics

Effective knowledge transfer management increases project performance [3], and PMOs play a supporting (moderating) and facilitating (mediating) role in the transfer of knowledge between projects [5], [11], [54]. These roles are largely dependent on two main variables: the available knowledge transfer infrastructure, and the knowledge transfer processes [25], [31], [49], [55]. Argote and Ingram [1] and Cummings and Teng [4] argue that knowledge is embedded in people, tools, routines and systems; therefore, knowledge transfer success depends on the effective management of the infrastructure and processes of knowledge transfer. Table 1 details the PMO’s role in the interaction of knowledge transfer infrastructure and processes in order for organisations to realise improved knowledge transfer between projects. It summarises what the PMO does to each knowledge transfer infrastructure to improve the respective knowledge transfer process. For example, the PMO rolls out appropriate and/or relevant information and communication technologies that support the creation and/or sourcing of knowledge. This results in improved characteristics of the knowledge generated and sent. These two knowledge transfer elements are interdependent; therefore, a balance between them has to be found if the effective and efficient transfer of knowledge between projects is to take place.
Table 1: Interaction of knowledge transfer infrastructure and processes

<table>
<thead>
<tr>
<th>Knowledge transfer processes</th>
<th>Create/Source</th>
<th>Store/Secure</th>
<th>Share/Disseminate/Align</th>
<th>Apply/Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems and tools (ICT)</td>
<td>Roll out appropriate technology that supports creation of knowledge</td>
<td>Provide systematic, safe, user-friendly, and continuous access to knowledge repositories</td>
<td>Provide technologically appropriate platforms and mediums for the effective sharing and dissemination of knowledge</td>
<td>Ensure that the right systems and tools are in place to facilitate effective application/use of knowledge</td>
</tr>
<tr>
<td>People (management &amp; employees)</td>
<td>Involve and motivate people, as they are the main drivers of knowledge creation through innovation, lessons learnt, R&amp;D programs, etc.</td>
<td>Encourage rigorous application of project management methodology to serve as storage of knowledge</td>
<td>Organise phase project review meetings, lessons learnt, conferences, expert networks, seminars, and other knowledge dissemination initiatives driven by people</td>
<td>Strategically position people to drive the knowledge use/application initiative for realisation of maximum benefit</td>
</tr>
<tr>
<td>Routines and processes (organisational culture and structure)</td>
<td>Instil and encourage organisational culture and structure that supports knowledge creation</td>
<td>Create routines and processes that make the storage of knowledge easy and effective</td>
<td>Create organisational culture and structure that encourage collaboration and trust to facilitate effective knowledge dissemination</td>
<td>Facilitate and support an organisational culture and structure that encourage effective use of knowledge</td>
</tr>
</tbody>
</table>

5.1.1 Knowledge transfer infrastructure

Gold, Malhotra and Segars [56] define ‘knowledge transfer infrastructure’ as the technical, structural, and cultural factors that enable the maximisation of social capital for knowledge transfer. It consists of information and communication technology (ICT), organisational culture and structure, and management and employees’ support [2], [35], [57]. Since knowledge transfer infrastructure is the backbone and fundamental enabler of effective knowledge transfer processes, PMOs manage knowledge transfer infrastructure very closely [18] for the overall success of knowledge transfer between projects. The success of various knowledge transfer mechanisms – social networking, formal training programmes, templates and checklists, intranet and shared network drives [50], project and phase reviews [23], a knowledge repository, expert consultants, brainstorming and mentoring programmes [3], [5] – is largely dependent on efficient knowledge transfer infrastructure. The more effective and efficient the knowledge transfer infrastructure, the stronger the capability of knowledge transfer mechanisms and processes [25]. PMOs assist in selecting the appropriate transfer mechanisms for the successful dissemination of project knowledge [58].

5.1.1.1 Systems and tools (ICT)

What technologies, techniques, and transfer mechanisms would be employed to facilitate smooth, sound and effective knowledge transfer processes? ICT is a critical factor and enabler in knowledge creation and transfer [56], [59] and comprises an element of the structural dimension [60], [61] that is needed to mobilise social capital for the creation of new knowledge through the integration of information and communication systems in an organisation [56]. ICT can support all forms of knowledge transfer [62]; and so a highly developed ICT infrastructure is essential for successful knowledge transfer [42]. Business intelligence, collaboration and distributed learning, knowledge discovery and mapping, opportunity generation, and security were identified by Gold et al. [56] as technological dimensions that are core to effective knowledge transfer. ICT supports knowledge transfer processes and contributes to improved organisational learning and performance by facilitating knowledge transfer processes. Thus ICT positively affects knowledge transfer process
capabilities [25], and PMOs play a major role in managing ICT to ensure that effective transfer mechanisms are put in place and are used to influence the characteristics of both knowledge generated and knowledge used.

5.1.1.2 Routines and processes

Organisational culture and structure form an important part of the routines and processes of PBOs. Organisational culture consists of collaboration, trust, and a learning culture [42], [63], [64]. Culture shapes assumptions about what knowledge is worth exchanging; defines the relationships between individual and organisational knowledge; and creates the context for the social interaction that determines how knowledge will be shared. It also shapes the processes by which new knowledge is created, legitimated, and distributed in an organisation [62]. Collaboration, trust, and a learning culture positively affect knowledge transfer process capabilities [25]. Better collaboration increases trust, and both lead to improved project performance [65]. ‘Organisational structure’ refers to the degree to which decision-making authority is shared in an organisation [25]. Decentralised structures facilitate knowledge sharing and collaboration [56], while high centralisation prevents interaction and frequency of communication, and reduces creativity, innovation, and the need to share ideas among individuals [64]. Therefore, decentralised organisational structures are more likely to support knowledge transfer processes than are centralised organisational structures [25]. Thus PMOs closely manage these important, yet tricky, knowledge transfer enablers to facilitate and support successful knowledge transfer.

5.1.1.3 People

People are the principal drivers of knowledge transfer [59], in that they facilitate and coordinate the integration of diverse knowledge assets and combine theoretical and practical knowledge for effective knowledge transfer. ‘People’ includes management and employees; and their buy-in and support of knowledge transfer is vital for successful knowledge transfer across projects. Successful knowledge transfer is mainly linked to people, because learning and sharing knowledge are social activities that take place between the organisation’s greatest asset – its people [64]. Support and backing from top management is crucial not only for knowledge transfer success, but also for overall project success. Top management has to create a highly conducive and supportive atmosphere in which to advance project knowledge transfer effectiveness and success [42]. The support of top management positively affects knowledge transfer process capabilities [25], and PMOs play a highly significant role in managing this knowledge transfer enabler.

5.1.2 Knowledge transfer processes

Knowledge transfer processes support and facilitate the effective and efficient transfer of knowledge between projects. The processes consist of knowledge creation and sourcing, compilation and transformation/alignment, dissemination/distribution/sharing, application and value realisation, and ensuring its availability to future users [31], [66]. Knowledge capture and transfer is also recognised by the Project Management Institute [5]. Knowledge transfer processes are interlinked; for example, the creation of organisational knowledge requires the sharing, integration, and dissemination of knowledge [56]. PMOs are regarded as a source of centralised integration and as a repository of knowledge that can be used to inform more effective and efficient project management [61]. They also play a significant role in the management of knowledge transfer processes.

5.1.2.1 Knowledge creation and sourcing

Knowledge creation can be interpreted as an interlinked and boundary-crossing process of knowledge sharing, knowledge integration, and knowledge generation [42]. It can include the development of new information and knowledge from raw data, but it also recombines and reorganises existing knowledge without necessarily creating completely new knowledge [48]. The uniqueness and temporariness of projects presents a huge opportunity to acquire new knowledge for individuals and for the organisation [50]. Technical specialists, innovators, R&D programs, lessons learnt programmes, and external sources are some of the knowledge sources identified by the Knowledge Research Institute [66]. In order to stay ahead of their competitors, organisations need continuously to innovate and develop or acquire knowledge that is difficult for competitors to copy [35], [39]. Nonaka [67] developed a framework of knowledge creation mechanisms that is based on tacit and explicit knowledge, and created four groups: socialisation (tacit to tacit), internalisation (explicit to tacit), externalisation (tacit to explicit), and combination (explicit to explicit). Strategic alliances are also a good example of creating knowledge through organisational learning of the alliances [68]. PMOs influence the knowledge creation and sourcing process, having identified the
characteristics of the required knowledge; and this makes the knowledge transfer process significantly effective as the appropriate knowledge is generated and transferred.

5.1.2.2 Knowledge storage and securing/protection

The main objective of storing knowledge is to provide systematic and continuous access to the organisation’s knowledge repositories [30]. A rigorous application of project management methodology makes the storage of knowledge habitual [63]. Documenting decisions and assumptions about resources, time, quality requirements, costs, etc., is a way to store and share knowledge [50]. Organisations store knowledge in the form of both tacit or explicit knowledge; and PMO leaders can overcome the challenges of storing knowledge by adopting the strategy of integrating knowledge use into the IT systems that support processes among knowledgeable workers. Knowledge protection is one of the important processes driven by PMOs that help organisations to keep and enjoy the competitive advantage that comes about as a result of their successful knowledge transfer processes. The processes are security- and compliance-oriented, and are designed to protect and safeguard knowledge from illegal or inappropriate use (even theft) by internal or external stakeholders [56]. Therefore, it would be pointless for organisations to innovate and create new and unique knowledge, yet fail to protect this knowledge, as competitors will pounce, and organisations may find themselves being victims of the failure to protect their knowledge.

5.1.2.3 Knowledge sharing/dissemination and alignment

Knowledge is only valuable if it is appropriate, accurate, accessible, and shared through appropriate mechanisms [62]. Therefore, effective knowledge transfer requires efficient systems, methods, protocols, and procedures. The challenge of knowledge transfer in the project environment is to capture the lessons learned (both positive and negative) on one project and to share them with other projects in order to increase efficiency and competitiveness [69]. Periodic closeout meetings (at the end of each project phase) and after-action reviews (immediately after an important event) are valuable for interrogating, learning, sharing, and disseminating knowledge to the project team and to the PMO [23]. Risks associated with new projects are reduced by the methodical remembering and documenting of project experiences [63]. There is a growing need in organisations effectively to put into practice knowledge transfer systems with the aim of going beyond limits for the purpose of disseminating vital knowledge throughout projects, teams, and organisations [70], and PMOs help to fulfil this need. Expert networks, educators/trainers, seminars, and conferences are some of the knowledge dissemination initiatives put in place by PMOs [66]. However, PMOs should guard against knowledge overload, and focus on disseminating knowledge that will add value to the projects and the organisation by incorporating knowledge into the project work-flow, process, template, and/or specification [71]. Knowledge alignment is one of the most important aspects of knowledge transfer: it deals with bringing the captured data into line so that it is used to the benefit of the recipient, appropriately, efficiently, and at the right place and time, since gathering, evaluating, classifying, and structuring information will not automatically result in successful knowledge transfer. PMOs help to align and use the correct knowledge in the right situations to enable the full value of the knowledge to be realised [56].

5.1.2.4 Knowledge application/use

Application, re-use, exploitation, capitalisation, and use of knowledge [24] involve making use of the acquired and stored knowledge. Surprisingly, very little has been documented or said about the outcomes of effective knowledge application and its implications and/or its contribution to knowledge transfer [56]. PMO leaders and project managers help to align knowledge strategies and tactics with the enterprise’s direction, facilitate and monitor knowledge transfer-related activities and programmes, and establish cross-functional teams and collaboration efforts [49].

5.2 Modulating influence of the PMO on the relationship between knowledge generated and sent and knowledge received and used

From the above narrative, it is clear that PMOs moderate (support) the relationship between knowledge generated and sent and knowledge received and used. They put knowledge transfer infrastructure and knowledge transfer processes in place that ensure that the appropriate knowledge is generated, stored, aligned, protected, transferred, received, and used by the receiving project; hence the first proposition:

Proposition 1: The PMO moderates the relationship between knowledge sent and knowledge received (flow of knowledge between projects).
Even without the existence of a PMO, there is a relationship between knowledge generated and sent and knowledge received and used. This relationship will not be explored further, as it falls outside the scope of the investigation.

5.3 Direct influence of characteristics of knowledge generated and sent on the PMO’s mediation role

Projects produce various knowledge characteristics. Not all knowledge produced by projects is useful or relevant [72]. The characteristics of knowledge generated and sent influence the PMO’s mediating (facilitation) role in the transfer of knowledge across projects. The PMO’s mediation function is determined, therefore, by the characteristics of the knowledge generated. For example, the PMO decodes less articulate and complicated knowledge to improve its transferability to other projects. PMOs may also decide to transfer an individual who holds the tacit knowledge [38], depending on the efforts required to decode the tacit knowledge in comparison with the time it would take to decode the tacit and complicated knowledge, and the costs involved. PMOs decide on the knowledge transfer mechanisms to be used to transfer knowledge effectively, based on the characteristics of the knowledge generated. Tacit knowledge require people, while explicit knowledge is best transferred through tools and systems [62], [70]. The above narrative supports the second proposition:

Proposition 2: The characteristics of knowledge generated and sent (knowledge objects, articulability or tacitness/explicitness of knowledge, knowledge embeddedness and complexity) influence the PMO’s mediation (facilitation) role.

5.4 Direct influence of PMO’s mediation role on knowledge received and used

The realisation of the desired characteristics of knowledge leads to improved knowledge transfer between projects [24]. The absorptive capacity of an organisation is key to ensuring knowledge transfer [73]. To avoid flooding receiving projects with huge volumes of knowledge that may not necessarily be useful to them, PMOs determine the characteristics of the knowledge received and used by ensuring that the appropriate knowledge is transmitted, and that this happens via appropriate mediums. They also help to develop the absorptive capabilities of the receiving projects, to ensure that the received knowledge is absorbed and used to full effect [52]. PMOs need to have the absorptive capacity to receive knowledge from the project(s) [71] in order to improve the quality and effectiveness of the knowledge received and used. In some instances, rather than transferring knowledge in explicit form, PMOs recommend the transfer of individuals who have the requisite knowledge [70] to the needy project. PMOs also conduct lessons learnt workshops to boost their knowledge repository and use documented project experiences in future projects. This leads to proposition 3.

Proposition 3: The PMO’s mediation role improves the use and impact of knowledge received.

6 CONCEPTUAL MODEL

To help answer the research question, a conceptual model is presented in Figure 3, and three propositions are put forward. The model suggests that the PMO moderates and mediates the transfer of knowledge between projects.
CONCLUSION AND DISCUSSION

Based on a literature survey, this paper has explored and presented a conceptual model of the role played by PMOs in the transfer of knowledge between projects, and has argued that, without a PMO, this role cannot be effectively and efficiently fulfilled. The model suggests that the PMO moderates and mediates the transfer of knowledge between projects. An overview of the characteristics of the knowledge generated and sent, the characteristics of the knowledge received and used, and the direct relationship between the two — as well as the influence of the PMO — has been presented. The paper has put forward three main propositions:

**Proposition 1:** The PMO moderates the relationship between knowledge sent and knowledge received (flow of knowledge between projects).

**Proposition 2:** The characteristics of knowledge generated and sent (knowledge objects, articulability or tacitness/explicitness of knowledge, knowledge embeddedness and complexity) influence the PMO’s mediation (facilitation) role.

**Proposition 3:** The PMO’s mediation role improves the use and impact of knowledge received.
These propositions will be further investigated and empirically tested in a number of PMOs as part of subsequent research studies.

This study has certain implications for the research into the practice of PMOs. The conceptual model seeks to close the gap between the short- and long-term objectives of projects in a project environment where most project team members focus on the short-term goals of the project, and often fail to see capturing and transferring project knowledge across projects as a priority, or as important for long-term benefits to the organisation [7]. The PMO creates a strong link between the characteristics of the knowledge generated and sent and the characteristics of the knowledge received and used, and ensures that the two are interlinked for maximum benefits and efficiency. No literature could be found on the role of PMOs in the transfer of knowledge between projects; hence the conclusion that there is a gap in the literature. For the practitioner involved in a PMO, this paper presents a framework of factors about knowledge transfer to consider. The planned empirical work should contribute further to the practice of PMOs.

The study has certain limitations. It does not compare the impact of knowledge transfer between PBOs with and without a PMO, but rather focuses on the role of PMOs in the transfer of knowledge across projects. The framework is only applicable to PBOs, and so should not be blindly applied to any organisation. For future studies, therefore, it is important to modify the model so that it can be applied to organisations in general.

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