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Knowledge transfers and project-based learning in large scale infrastructure development projects: an exploratory and comparative ex-post analysis

Abstract

In order to apprehend how state-owned enterprises (SOE) learn from and share working experience in large-scale infrastructure development projects, this research analyses the project-based knowledge transfer and learning that occurred in two complex infrastructure (PPP) projects. Using face-to-face interviews with both internal and external project participants, an ex-post comparative analysis is made of two large-scale Belgian rail infrastructure projects. The results indicate that transferring the public sector project teams from one project to another allows for inter-project learning to take place. The knowledge transfers from the project setting to the state-owned enterprise are mainly the transfer of individual and tacit knowledge focussing more on (inter-) personal and individual learning, than on organisational learning. The latter is caused by the limited perceived strategic value of the researched projects, because of their public-private partnership (PPP) finance structure. As such, project-based organisational learning for these large-scale infrastructure (LSI) projects, remains underdeveloped.

1. Introduction

Knowledge transfer (KT) and knowledge management (KM), as themes in academic literature and as organisational tools in practice have developed under the umbrella of process efficiency-enhancing measures that contribute to the effectiveness of operations on the one hand, and to innovation in terms of quality of competition on the other hand (Wiig, 1997; Gupta, Iyer and Aronson, 2000; North and Kumta, 2014; Armistead, 1999; Jafari, 2009; Nonaka, 1995). The aim for KT and KM is the creation of knowledge assets out of information and expertise, and turning this knowledge into a competitive advantage. The main challenge for KT and KM lies in installing organisational learning dynamics that are suited to the culture of an organisation and are based on a combination of people (competencies) and information systems (technology) (North and Kumta, 2014; Argote, 2013; Gupta, Iyer and Aronson, 2000)¹.

This knowledge-based challenge is also important in public sector organisations, since the introduction of New Public Management (NPM) and the adoption of private sector management methods in the public sector are also reflected in the adoption of knowledge management in state-owned enterprises (North and Kumta, 2014; Gill et al., 2010). Sceptics to this evolution and the implementation of NPM have argued that these sorts of tools cannot be imported from the private to the public sector, given that there is no market logic that would support their implementation (Flinders, 2010). Inversely, we can however wonder why knowledge and knowledge assets would not be important in the public sector.

Nevertheless, as societies develop, infrastructure development projects naturally grow in scale and complexity, thereby increasing the number of professionals involved in projects, also lengthening the project life cycles and generating complex interfaces (Chou and Yang, 2012; Gasik, 2011). This in turn impacts the types and quantities of project-related information that are generated, making them more fragmented and more complex. Consequently, all contemporary infrastructure (development) projects require substantial amounts of specific knowledge, whether (Carillo et al.,

2006) or not PPP constructs are used as a form of procurement. In Belgium, the initial design and execution phases of PPP projects are quite novel and several public contracting parties are under-experienced with PPP (Mazouz, Facal and Viola, 2008; Aerts et al., 2014). The future of PPP in Belgium, given the budgetary constraints and European requirements, is uncertain, yet the need for large-scale infrastructure development remains. Hence, considering PPPs as a separate type of projects with a specific structure may underestimate the potential value of project learning in these projects to LSI projects in general. The latter would clearly be a mistake given that PPPs are a subset or segment of the LSI project market, and given that the accumulation of LSI (PPP) knowledge contributes to the capacity of public sector organizations in terms of successfully initiating, implementing and completing the construction of increasingly complex types and structures of projects, irrespective of their financing nature (Carillo, et al., 2006). The latter is confirmed by Winch and Leiringer (2016) who recently underlined and identified the importance of owner project capabilities to ensure project success. They build on research demonstrating that project capabilities are essential to obtain competitive advantage for a project-based firm providing infrastructure assets (Brady and Davies, 2004 and Davies and Brady, 2000). Winch and Leiringer (2016) argue that, complementary to the suppliers of assets, "strong owners" can also achieve higher performance on major infrastructure projects if they develop project coordination capabilities. Moreover, these 'owner capabilities' should be dynamic (Helfat, et al 2007; and Winter 2003), and as such extend their resource-base, because these particular project-related resources are usually not the core business of the owners (Winch and Leiringer, 2016), i.e. the public sector entities. Building these capabilities can be done through internal learning or external acquiring via for example consultants, with the risk of losing long-term owner capability (Flowers, 2007) for the latter.

LSI projects in general and large scale PPP projects in particular involve large capital expenditures and are characterized by great operational complexity. This creates severe consequences when mistakes are made based on a lack of experience and or information (Marshall, Prusak and Shpilberg, 1997). Therefore, even though the literature on LSI (PPP) projects expresses a potential

to raise efficiency, this is largely dependent on the ability of public and private sector actors to act and perform with sufficient knowledge and expertise.

However, project management literature on the development of project knowledge and capabilities is particularly focused on one side of the project market, namely the contractor or supplier side (Brady and Davies, 2004; and Davies and Brady, 2000). The focus in management literature, in this sense, has been on the value of knowledge management for private sector actors (Grant, 1996; Barney, 1996) that are involved in for example PPP projects (Kwawu, Elhag and Ballal, 2010), with less attention for the importance of KM and organisational learning in public sector entities (Carillo, et al., 2006). When the issue has been addressed, it has mostly been done in a normative or prescriptive manner, rather than a pragmatic, realist, descriptive ex-post manner (Robinson et al., 2010).

In sum, it is relevant to study whether for large-scale infrastructure investments, knowledge is actually accumulated, disseminated, transferred and reused intra- and inter-organisation wise, in and between public sector organisations involved in these projects. The focus of the current research is therefore on the transfer of information or knowledge from and between the temporary project-environments back to a permanent public organisation, which in this case is a state-owned enterprise (SOE). More specifically, this paper provides an ex-post evaluation of two complex long-term infrastructure projects developed in light of the expansion and improvement of the Belgian railway system. The two cases, initiated by the same organisation, shed light on the extent and means employed to further organisational learning in a state-owned enterprise, through project-based knowledge management and transfer from one project to the next.

The paper is set up as follows; first the research design and the research methods are introduced. Afterwards the results of the study are discussed. In a final stage, a discussion of the implications towards future research is presented, whilst also offering a final conclusion.

2. Research perspective and framework

2.1 A state-owned enterprise perspective

Hodge et al. (2010) point out that the LSI - and in particular also the PPP - discourse and evaluation space is filled with many different interest groups, stakeholders and actors all with their own bounded perspectives (Hodge, Greve and Boardman, 2010; De Schepper, Doods and Haezendonck, 2014). Governments and/or involved public and semi-public entities hold a clear stake in these sorts of elaborate and complex projects, with potentially high political, societal and financial costs and societal backlash, when projects derail or do not live up to their expectations (Hodge, Greve and Boardman, 2010). The latter is however highly likely, given that government failure in terms of policy delivery, strategy, project organisation and needs identification can lead to poor procurement incentives, lack of coordination, lack of skill, and lack of information (Yuan et al., 2009).

In a state-owned enterprise (SOE) that operates in a (semi-) competitive environment, it is expected that this lack of project coordination capacity is less prevalent, since such enterprises are assumed to have substantial say in the development of strategic (knowledge) assets. Hence this research approach opts to confront the issue of ex-post project evaluation from the perspective of a SOE.

The primary focus is therefore on how a public sector actor, in this case an autonomous state-owned enterprise, manages its large-scale project-related knowledge. Moreover, the design is also sensitive towards the notion that the studied projects are based on the idea of bundled infrastructure arrangements (Hodge, Greve and Boardman, 2010). This means that a project will run through a set of predefined phases before reaching completion. Finally, the research also includes several internal as well as external direct stakeholder opinions, in order to enhance the accuracy of the findings.

2.2 Public private partnership as a case context

The focus of our research is on Long-Term Infrastructure Contracts or LTICs (Hodge, 2010). The LTIC type of partnership can involve the design, construction, financing and maintenance (and possibly even the exploitation) of public infrastructure, or a public facility by the private sector, under a long-term contract (Hodge, Greve and Boardman, 2010).

Both cases examined in this paper started out as conventionally financed at the feasibility study level, and at some later stage in their project life-cycle the PPP arrangement was imposed by the Federal Government on the project owner (on the SOE, in this case the Belgian Railway Infrastructure manager). The rise of PPP in Belgium at the end of the 1990s and beginning of 2000, in particular in the Flemish region, mostly coincided with the deregulation of the rail market at the end of 2004, splitting the historical monopoly in a state-owned holding company, and two separate state-owned enterprises (SOEs) of which one is responsible for the transport service (passengers and cargo), and another is responsible for infrastructure management, and network operation and access. In the case of the Railway Infrastructure Manager, this led to a strategic plan strongly focused on structural improvements on the level of project delivery for network expansion projects. Furthermore, the strong past growth in passenger transport and expected future growth of rail cargo transport in Belgium, coupled to increasing congestion and resulting delays, led to the identification of a list of LSI projects (most of them already under study since the 1990s) to be implemented at shorter notice. The most known examples are the 2nd rail access to the port of Antwerp, a new North-South Junction under the city centre of Brussels and the reactivation of the Iron Rhine. Therefore, the 'imposed' use of PPP was not only considered as a lever on the level of generating the necessary funds (and thus imposed by the government), but was quickly identified by the executive management as a competence enhancing tool to reduce lead times for future project delivery in general. In particular, as, besides the 2 projects under consideration in this study, it was very likely that other projects following the same approach were to be implemented, but then potentially benefitting from a stronger organization at the level of the SOE. Hence, along the way, both projects under investigation in this study were not only regarded as important drivers for internal change generating spill-over to the whole organization, but also as a source of knowledge /knowledge base, facilitating the implementation of the longer-term infrastructure plan by the SOE, whether by PPP or via traditional tender procedures (TPP). However, the economic crisis and resulting budgetary cuts have led to a shelving of these projects, as the Federal Government following its 2014 government declaration seeks to cut 3 billion euro at the Belgian Railways (transport service provider and infrastructure manager combined).

Therefore, we believe the only differentiating element of PPP projects from a learning point of view is the management of the asset through its life-cycle; however, the data presented in this paper are related to the design and construction phases of two projects, and we do not focus on the knowledge transfer during the operational phase. In addition, an important aspect of complex stakeholder management, or for example the experience and skills for negotiating with many actors, is not only linked to PPP, but counts for all LSI projects. Hence, the PPP structure of both cases can be merely considered contextual for this research, and do not necessarily imply that our results would be limited to this specific type of LSI projects.

2.3 A comparative approach to knowledge transfer and management in LSI project environments

Projects, due to their nature as temporary types of organisational forms, act as environments wherein knowledge that is relevant to the involved permanent organisations can only be created briefly (Prencipe and Tell, 2001; Schindler and Eppler, 2003; Bakker et al., 2011). Project-initiators and project team-members work on a project for some time and then move on. Individually they learn, but that knowledge/those lessons remain with them, and are not necessarily absorbed by the involved permanent organisation(s). Hence, the assumption is that permanent organisations, in both the public and private sector, would develop knowledge transfer mechanisms and programs that aim at capturing the vital project-based learning that occurs in these projects, as the knowledge can only be captured briefly. Given that LSIPs may only occur sporadically, they do still open up (financial) opportunities, and it therefore stands to reason that organisations might try to maximise their ability to form knowledge assets in this matter.

For public sector organisations in particular, several drivers, listed in table 1, explain why these actors might develop knowledge assets in LSI project delivery. These drivers include the increased complexity experienced in large-scale (mega) projects (Chou and Yang, 2012; Geraldi, Maylor and Williams, 2011), the novelty of specific structures such as PPP and all of its derivatives, and the

implementation of continuous improvement and innovation in large-scale infrastructure development projects (Larson, 1997). There are however, also barriers to managing knowledge in these types of projects. The main idea here is that knowledge transfer is not a copy-paste undertaking and does require investments to be made (Szulanski, 2000). In other words, organisations have to weigh the cost of transferring and managing knowledge gained and captured in project environments against the potential benefits to be obtained, i.e. the strategic value of the transferred knowledge.

INSERT Table 1 Drivers and barriers to KM in LSI projects

The failure to manage knowledge, as the result of a lack of process, strategic value or other barriers, means that for the remaining phases of a project, or for future endeavours, the development of crucial business insights is absent at the organisation level.

From a societal viewpoint, the importance of knowledge creation and knowledge gathering in LSI projects should also be underlined. It is crucial to figure out whether and how public entities gather and pass on knowledge that is needed, in order for future employees and generations to be sufficiently informed on the origins, specificities and histories of a certain LSI project, especially given the need for the mobilisation of public funds and public resources in the development of these projects.

Consequently, the research at hand uses a two-step research design. The analysis starts with an ex-post project analysis for both projects, thereby focussing on the project-based learning that is found under these conditions, in a state-owned enterprise involved in LSI projects. In a second step, the knowledge base and management culture found at the state-owned enterprise is assessed. The combination of the forgoing elements will allow for a general conclusion on the way a particular state-owned enterprise manages its project knowledge gained through participation in LSI projects. Moreover, this two-step approach might explain why a particular knowledge management approach is used under these conditions.

The focus in terms of types of knowledge to be transferred is on tacit and explicit knowledge, which

resides with the LSI project participants. Since the research is set up as an ex-post evaluation of both projects, it stands to reason that the focus in terms of transferable knowledge will be on lessons that were learned during these two projects.

3. Research method

3.1 Case-study research

The paper employs a comparative case study design (Bryman, 2008). The main research question is: do public sector entities manage their strategic knowledge gained through large-scale project participation, and what is the reasoning behind the retrieved approach?

The case-study research method is most fitting for this research framework, as it allows for the study of managerial action within a single organization and across different organisations, and due to its capacity to capture and encompass elements of complex social problems (Yin, 2013). Therefore, to fully capture the perspective of the participants active within the state-owned enterprise (or SOE), we also included the perspective of several private sector project participants as a means of strengthening the validity of the complex situation described by the participants from the SOE. This comparison and confrontation of the different perspectives led to a more detailed and valid picture of how the actual process of managing these projects and the knowledge gained in these projects unfolded.

The drawback linked to case-study research design originates from the limited extent to which a case study can be used as a basis for generalization towards the full population of LSI projects, given the specific context in which the research takes place (Bryman, 2008; Hair et al., 2011). However, in our case, we rather seek for analytical generalization, and given the nature of both case studies (in particular the full access to a large sample of respondents for two LSI projects within the same organization), the identification of new research themes and research questions in the broader context of knowledge transfer and inter-project learning, and the moderating and mediating variables leading thereto. Furthermore, the research insights lead to the formulation of broader

managerial and policy recommendations on the level of organizational features conducive for knowledge transfer and organizational learning, such as the impact of corporate culture and the appropriate tools and structures for knowledge management.

3.2 Semi-structured, face to face interviews, feedback and panel sessions

Given the complexity and ambiguity related to the research-topic, preference in this research approach is given to a flexible research strategy. This is a three-stage research strategy.

First, interviews were conducted with people who were directly involved in one or both of the LSI projects under study. Then, feedback sessions were held in face-to-face meetings with the CEO and CFO of the principal or state-owned enterprise. Finally, a panel discussion was held with representatives of seven of the direct stakeholders, in which the findings of the study were presented and several crucial topics were (re-) addressed.

3.2.1 Semi-structured, face-to-face interviews

The first part of the research strategy is based on interviews that use a semi-structured questionnaire approach (Bryman, 2008; Hair et al., 2011). Hence both open as well as closed questions were listed. The closed questions had a 7-point Likert response scale, which ranged from total disagreement with a statement to total or full agreement with a statement. The descriptive part of the analysis presented in this paper provides ex-post project evaluations based on input received through open questions and that is gained through the panel-session that was held in May 2015. Questions probing the organisational culture at the permanent organisation or the perceived added value of knowledge management in these LSI projects employed a 7-point Likert scale.

The interviews were done in a face-to-face manner, arranged through facilitation by the top-level management, i.e. the CEO and CFO at the SOE (the Belgian railway infrastructure manager). The executive management provided a list of 48 potential respondents. Out of these 48 respondents, 40 people were prioritised² and contacted. 30 respondents were found willing to participate in the

² The prioritisation was based on the availability of the respondents, as some of the listed respondents, had already retired, left the organisation, or were unavailable due to other circumstances.

study. The interviews were conducted over a period of 3 months, from May until July 2014. The list shown in table 2 presents the main occupations of the respondents and the dates when the interviews were held. These respondents were all directly involved in one or both of the LSI projects, and all hold mid- to top-level positions within their respective organisations.

INSERT Table 2 Interviewees, background and participation in the research

In relation to the actual participation of the respondents, a division can be made for the internal and external stakeholders and their involvement in Project 1, Project 2 or both. Internal refers to employees that acted on behalf of the SOE; external refers to private sector participants that were also involved in the projects (such as consultants, contractors or engineers).

For Project 1, 23 respondents specified to have taken part in the project, 17 of them internal stakeholders and 6 of them external stakeholders. For Project 2, 26 respondents specified to have taken part in the project at some point. This set of respondents consisted out of 19 internal stakeholders and 7 external stakeholders. This means that 7 respondents did not participate in the Project 1 and 4 respondents did not participate in the Project 2. All others participated in both projects.

Respondents were also asked to specify if and in which of the 11 phases, distinguished by Robinson et al. (2001), they participated in one or both of the projects. These phases were then clustered into 6 groups of which 5 groups were included in the analysis. The final phase, i.e. the transfer phase, was not included in the analysis as participation in this phase at the time of the study was impossible. The transfer back of the projects happens at the end of the contract, which for these cases is 35 years after the projects are commissioned and operational. The reduction of the phases into 6 groups was done in order to be able to present the findings in an orderly fashion. A presentation of the actual phases included in each phase cluster can be found in table 3. The completed phases are indicated in light grey, the non-completed phases are indicated in darker grey³.

INSERT Table 3 Project phase clustering

³ A slight nuance has to be made however, the construction phase, for the Project 2 will end in December 2014, whilst the exploitation and maintenance of the Project 1 is currently already underway.

The actual participation of the respondents in each of the projects is shown in the figure below. The figure reveals that several, if not most of the respondents participated in more than one phase during the project.

INSERT Figure 1 Phase-dependent participation in the LTIC projects

3.2.2 Feedback with the executive management

In November 2014 a research report was composed and delivered to the CEO and CFO of the project owner, i.e. the state-owned enterprise. Both, the CEO as well as the CFO were able to provide feedback on the findings through two separate feedback meetings. Based on the insights gathered in these two feedback moments, the choice was made to have an additional session in which several directly involved project participants would receive the findings of the research and would also be able to discuss these findings.

3.2.3 Panel discussion and presentation of the findings

Table 2 shows which of the respondents also acted as a panel-member in the second step of the research. Those highlighted in light grey participated in the follow-up session. This follow-up panel session was held in May 2015. During a 4 hours long debate, the role of knowledge management in the public sector, for this particular SOE and the added value of knowledge transfer in LSIPs such as PPP projects was debated after the panel-members had been informed on the findings of the preliminary study. Hence, the panel discussion augmented the level of detail of the preliminary findings and served as final validation of the results.

3.3 Case-selection

The selected cases are both the PPP parts of larger rail infrastructure development programs. The main features of both projects are summed up in table 4.

INSERT Table 4 Case descriptions

The main motivation for the construction of Project 1 is the accessibility of the Brussels airport. The project connects several Belgian and European cities with Belgium's main airport, via rail. The construction itself occurred without interrupting the air traffic, whilst tunnelling under the airport's main runway, and foresaw in the construction of a completely renewed train station.

Project 2 consists out of a 16-kilometre long rail project, which provides a direct rail link for freight transport between the port facilities on the left and right banks of the river Scheldt. The PPP part of the project consists out of two tunnel tubes, sitting up to 40 meters under the river which are 6 kilometres long, 8 meters wide and made using concrete casting. These transport facilities form the longest railway tunnels ever created in Belgium. The implementation of this part of the project consisted out of several activities, amongst which are the construction of railway beds, the renovation and modifications to an existing piece of tunnel, and the construction of an access tunnel between the different tunnels.

Both PPP parts of these projects, are set-up according to the logic of an LTIC, in this case a design, build, finance and transfer (DBFT) and design, build, finance, maintenance (DBFM) structure, where the private investment entity was backed by a large debt-equity leverage provided through a group of financial institutions and governmental entities. The actual construction activities were delegated to private construction consortia comprising several construction companies, all with prior experience within Belgium.

In functional terms, these projects represent the achievement of similar goals. Next to facilitating the flow of goods and passengers, and consequently economic activity, the aim is to enlarge the rail capacity and speed up the Belgian rail network's adoption of 21st century rail safety and technology. Hence, these cases are relevant given their contributions to economic welfare in the region and their financial implications for coming generations. They are of scientific importance due to their specific organisational nature. We do however acknowledge the existence of differences between the cases in terms of financial, organizational and operational structures, as well as referring to the differences in the composition of the flow of goods and geographical impact region associated with these projects.

4. Results

The results section of the paper begins with an ex-post project appraisal, which allows for lessons learned to be made explicit, thereby highlighting the actual project-based knowledge transfer. This assessment is complemented by a study of the shift in the LSI knowledge base at the SOE as a result of the SOE's participation in both projects. In developing sufficient context for the research, substantial effort was also directed towards establishing which knowledge management culture and perceived need for KM existed at the SOE. To this end, an overall assessment of the knowledge management culture found at the SOE was made. Based on these three assessments the research evaluates the impact project-based knowledge transfer and learning has had for the state-owned autonomous enterprise in these cases.

4.1 Project based knowledge transfer and learning, an ex-post comparison

Respondents were asked to provide their insights through open-ended questions, followed by the creation of several answer categories through inductive coding. The results presented in table 4 summarise the strong and weak points of both projects and focuses on the top 5 delays, wins and problems that were mentioned by respondents in both projects. As such, the table is in itself an explicit knowledge transfer that can serve the public sector and the project owner in the following phases of both projects, or in other projects. A distinction between internal and external points of view is also made, given the ex-post comparison approach and the fact that this may decrease the chance of having respondent bias.

4.1.1 Delays in the projects

In terms of communalities retrieved in both projects, when looking at the delays that occurred, the research finds that the technical acceptance procedure is an element that is raised by external stakeholders in both cases. On this topic one of the external stakeholders mentioned: “... *In terms of technical validation, the same is true. The public enterprise has a number of internal stakeholders, which means that different entry points exist. A dedicated LSI (PPP) project team might be a useful tool in order to lower the number of entry points for technical validation, hence speeding up the validation process.*” (Respondent 29, 7/7/14). During the panel discussion that took place on the 4th

of May 2015 respondents also indicated the following: *“We need to re-evaluate the sequence in the negotiation stage of the projects. There is a clear need for dialogue and inter-personal contact, even in non-PPP LSI projects. As such we (project owners) would be able to develop a level playing field even before price discussions arise. ... We do however hold on to the notion of reference designs, as working without reference designs would make the whole endeavour much too heavy for our private sector counterparts. As we need to limit the number of possible directions in which the project may develop/evolve.”* (Panel discussion, 4/5/2015).

Internal stakeholders, in their reported grievances, therefore focus on the primary phases of the PPP projects by highlighting the troublesome negotiations in the tendering phases of the projects and relatedly, towards drawing up the tender specifications.

In the panel discussion, respondents indicated that the sequence in terms of the negotiations is crucial, as this may be the main cause for the delays retrieved in the negotiation phases. In order to obtain the highest possible level of project quality bidding parties would need to provide their ideal solutions or ideal bids from which, through repeated consultation, a pre-set level of quality would be obtained. In doing so, a level playing field is created amongst the bidding parties. Only then should negotiations start on the price and finance methods. A second element that is crucial in accelerating the negotiation in these types of projects, is working with a reference design, as this enables bidders to start from the same starting point. Total freedom in project conception and design was evaluated as unworkable, as this invokes unnecessary negotiations on an insurmountable large range of issues.

The external stakeholders also saw that the technical acceptance procedure was a source of delay: *“One must make a choice between technical and functional requirements. If one prefers functional requirements, then the test and control methods should also be designed and ready. ... Hence, one can redeem the expectations linked to the project.”*, (Respondent 29, 7/7/14), and: *“Purely functional requirements allow the contractor to become creative within the framework delivered by the project owner. Hence the contractor can solve problems faster and more efficiently and improve the execution of the works, which is mutually beneficial.”* (Respondent 19, 23/06/2014), *“If the*

project owner wishes to use functional demands, then he or she also needs to realise that functional demands need to be properly developed. Only when this is done, will proper monitoring be possible when the project reaches its execution phases.” (Respondent 27, 2/072014). These remarks indicate that the project owner was still adapting to working with a new set of requirements, i.e. functional rather than technical requirements.

The implementation of payments linked to the work packages is also seen as a delay in Project 1. Here it seems that the magnitude of the work packages also influenced the control the public entity had over the project. The smaller work packages used in Project 1 caused more payment issues, but kept the project within the foreseen timeframe. Whilst the larger work packages put in place in Project 2 increased the needed effort to evaluate their completion, thereby allowing the project to slightly exceed the foreseen timeframe: *“In terms of the work package composition and monitoring, a hybrid approach needs to be developed. ... Hence the contractor has sufficient leeway to optimise the execution of the works, whilst the project owner can still monitor the progress, as long as the financing curve/timing is not altered.”* (Panel discussion, 4/5/2015).

Larger work packages are therefore seen to increase the time needed to complete a project, yet lower the transaction costs. Smaller packages conversely, tend to provide more control and are therefore easier to monitor, yet increase the monitoring transaction cost at the public side/project owner side of the project. During the panel discussion respondents therefore suggested that a hybrid monitoring and control procedure needed to be developed. This would entail including a contractual provision that allows contractors to rearrange work packages and milestones as long as this does not affect the cash flow of the project or alters the pre-financing structure. As such the contractors would have sufficient flexibility in the arrangement of the works, whilst the consortium owners would not run into liquidity issues, whilst key milestones can still be monitored by the project owner or initiator.

4.1.2 Problems in the projects

Regarding elements that caused problems for both projects, the research finds that these projects were reported to be quite troublesome. Which is not that remarkable, as these projects present complex project environments that include several stakeholders, with different backgrounds and objectives.

This has led to the observation that particularly for the integration of the maintenance phase in the project life cycle, both internal and external stakeholders, active in both projects, report that this is an issue that should be improved (and has been improved) as a consequence of the SOE's participation in these two projects: *"We were disappointed that we were not involved in the projects' design and execution phases. As such we would have been able to represent the interest of the teams and contractors that would need to perform and provide the maintenance for both projects, as well as point towards the need for particular provisions that are needed to perform the maintenance properly."* (Respondents 11 & 12, 11/06/2014). During the panel discussion this issue was raised again: *"In terms of knowledge management and transfer we simply have to admit to the fact that certain knowledge does not exist yet. At this point in time, we do not know what, for example in terms of maintenance, the consequences of the chosen approach will be in 25 to 35 years. It is after the fact that we will be able to present lessons learned and in turn aim to make our approach in these large scale projects more robust."* (Panel discussion, 4/5/2015). As such a clear lack of life-cycle integration is ascertained, which is assumed to be one of the main features of a PPP, or in this case LTIC project and also points to another crucial element. At the moment of the research too little information and experience on long term project maintenance was available to benchmark the approach against or to go to as a means of best practice. Hence the pioneering role of this SOE should also be underlined, yet this also implies that public sector entities have in the past often neglected to calculate the cost of and find procedural methods to cope with long term infrastructure maintenance.

Next to this, the risk transfer leads to prolonged discussions that often, according to certain internal stakeholders, lead to mitigating measures in order to accommodate the private sector actors. In the

same strand of reasoning, the fact that the transfer is mainly focussed on insurable risks is a matter of some frustration at the internal stakeholder side: *“In the future we need to invest in proper mechanisms to transfer risk from one party to the other. It is important that we overcome this stalemate or deadlock and as such allow ourselves to come to actual cooperation instead of passing the hot potato around until it reaches the least informed party.”* (Respondent 21, 26/06/2014)

For Project 1 particularly, an added difficulty is the fact that the financial and construction partners were attracted through separate tenders, meaning that these private sector actors were joined together after having tendered the contract separately: *“At the one hand we (the project owner) are convinced that the first project would have been more expensive if the financing and construction partners had been in a consortium before the start of the negotiations. The rationale behind this being that a pre-existing consortium would have never been price-optimal. The best (cheapest) team of engineers, the best (cheapest) contractor(s) and the best (cheapest) financier(s) will almost never be part of the same consortium. Using separated tenders, we were able to select the best for all three parties, making this a win-win-win for us. On the other hand, using separate tenders does however increase the managing and transaction costs for us, in comparison to when we would have selected or opted to use a consortium, since the project owner has to mediate the interaction between the partners due to the fact that the consortium partners do not remedy issues internally, i.e. within the consortium.”* (Panel discussion, 4/05/2014). Consequently, conflict arose when the tender, which was developed as a traditional procurement project, was presented to the financial partners of the project. However, as there were more checks and balances, due to the separation between client, contractors and financial partners, the overall project process did actually resemble a PPP project-process with tight control over the three main project management goals. On the other hand, the fact that the parties were forced to cooperate allowed the private partners to become more opportunistic in their approach, hence leading to more conflict, whilst at the same time creating more potential for the project owner to learn from this process.

A main insight within Project 2 is that the project functioned according to the logic of a traditional

infrastructure procurement project, and that the arbitration procedure that was added to the process as a means of conflict resolution, ultimately did not add much value. The tender that was created was developed with a particular type of consortium in mind. As such, the private parties involved in the project would come to the table with one voice. Hence, due to the inclusion of the financial, technical and construction partners in the same consortium, the project process resembled a traditional procurement project approach; even though the tender was developed in order to serve an integrated consortium, i.e. serve a PPP project logic. The latter being a direct lesson learned from the first project, where several issues were encountered as a result of the usage of separated tenders.

Finally, the political dynamics at play in these two projects also substantially diverge. Put differently, the end users in the Project 1 are constituent voters for which the project has visibility through direct use. The second project facilitates a flow of goods (mainly containers), which is far less visible for constituent voters, and therefore has less of an impact on the formation of the public's opinion on the success and fulfilment of the expectations related to this particular project.

INSERT Table 5 Project comparison: project management success and opportunism

4.1.3 Wins in the projects

The results indicate that one of the main reported wins signalled by both internal as well as external stakeholders is the on-time delivery. The fact that the tunnelling risk was shifted towards the private party is also seen as an important facilitator in these projects. A somewhat less important advantage is the ability of the private sector partners to provide plans for the circulation of traffic during the construction phases of the project, thereby lowering the nuisance or negative impact associated with the project, as perceived by third parties.

INSERT Table 6 Ex-post project appraisal summary

4.2 Project-based learning, a knowledge base perspective

A shift in the knowledge base, due to project-based learning was assessed through asking the respondents whether or not they knew what a PPP project process would entail at the start of each project. As such the results indicate that the clarity of the project process, was largely unclear to

internal stakeholders at the start of the Project 1. Hence the majority of internal stakeholders that participated in the study indicate that they tend to, or do not agree with the statement that to them the project process was clear at the beginning of Project 1. When compared to the 'Clarity internal' category for the second project, the results indicate that more respondents indicate that the (PPP) project process was clear to them at the start of the second project. This finding is a first indication of the fact that the participation in the first project did affect the knowledge base present at the permanent organisation, in this case expressed through the knowledge held in individual knowledge retention bins.

INSERT Figure 2 Knowledge base assessment: process clarity

As a result, since the project process was clearer at the beginning of the second project, this would indicate that a learning process was able to develop, allowing internal stakeholders to start the second project feeling more secure over what would follow. However, as Project 1 was set-up according to the logic of a DBFT project and Project 2 was set-up according to the logic of a DBFM project, the internal stakeholders possessed more knowledge on what was to follow, at the start of the second project, due to a deliberate strategic choice allowing internal stakeholders to approach the project from a more traditional perspective.

Hence the shift in process clarity is fully explained through the experience that was gained in the first project, yet largely relates to the pre-existing knowledge base already present at the permanent organisation, i.e. pre-existing knowledge on how to perform a TPP or traditional procurement project. Nonetheless, since the project team that worked on Project 1, also worked on Project 2, knowledge was transferred between projects as people gained experience with this kind of LSI projects in Project 1 and were able to re-use this knowledge in Project 2: *"In these cases most of the initial team was transferred to the second project. As a result, the knowledge that was developed in the first project was largely transferred to the second project. We do however feel that using explicit knowledge transfer tools to do so, would not add much value and also feel that our involvement in the maintenance of both projects will allow us to develop a feedback loop throughout the life-cycle of both projects, therefore allowing us to capture learnings thereafter."*

(Panel discussion, 4/05/2014). The latter is clear in our findings of the initial study as well where knowledge on the inclusion of penalty clauses for instance or the stringency of the financial models used in these projects was clearly present and retrieved in both projects. In sum the findings therefore indicate that once the project owner, through its project team, knew what they knew, i.e. established a knowledge base; they were able to exploit this knowledge base in order to make a strategic choice in the design of the second project's framework and structure.

INSERT Figure 3 Knowledge base assessment: resources & competencies

Next to increased project knowledge, an expansion in organisational capacity from the first project to the second project is confirmed in the findings related to the presence of sufficient competencies and experience at the start of both projects. For the first project these elements were evaluated as being insufficient. This is represented in figure 3 in which the largest part of respondents tends to, to fully agrees with the statement that the permanent organisation possessed sufficient experience and competencies at the start of the second project. Again this shift in competency and experience, to some extent is seen as the result of prior knowledge gained through participation in Project 1. When addressing the matter further during the panel discussion, respondents did indicate that the project was set-up according to a TPP structure. Hence confirming the conscious choice to use a more traditional approach.

4.3 Strategic value as the main driver for organisational learning

When looking at the value attributed to the knowledge transfer that is found in these cases, the comparative results indicate that respondents feel motivated to share their findings and hence support the transfer of knowledge towards the permanent organisation. This is presented in the findings by a situation in which more than 50 % of the internal stakeholders indicate that they were motivated to share their experience gained in the projects with the permanent organisation.

It is however apparent that explicit knowledge transfer-tools, e.g. the formulation of lessons learned, are not fully utilised at the internal stakeholder side in both projects as more than 60 % of the internal stakeholder respondents indicate that they did not focus on lessons learned in either project (more than 80% of respondents reported this to be the case for project 1).

Therefore, permanent follow-up of the projects was not observed, and is not codified and/or structured in order to lead to the creation of organisational memory in the form of, e.g. a documentation centre. The latter is confirmed in table 7, where an overview is given of the importance of knowledge transfer tools that were used either individually by participants of the projects, or tools that were used at the project level.

INSERT Table 7 Knowledge transfer tools: individual use and project-level use (across cases)

The results shown above indicate that the most important knowledge transfer tools at the individual level are on the job training, reporting to a superior and personal documentation. These are not integrative transfer tools that promote the sharing of explicit information, across departments and within the larger organisation, which would allow for the development of organisational knowledge. These tools do not have a codifying or explicit component, nor are they collectively stored and/or shared. These modes of transfer allow for mainly interpersonal knowledge transfer to occur, and are therefore well suited towards short-term knowledge storage in the organisation's individual knowledge retention bins.

At the project level, the institutionalised form of knowledge-transfer during the project, in the form of monthly-organised executive meetings, is seen as the primary tool for knowledge sharing during an LTIC project. Lessons learned are reported as a means of knowledge transfer during the project; yet the scores retrieved are rather high and would therefore imply a division amongst the respondents related to the importance of these tools. Furthermore, the answer categories did not differentiate for lessons learned through traditional or PPP project participation. Hence, it is possible that the lessons learned that are referred to are lessons learned that were or are developed in traditional procurement projects.

The main explicit knowledge dynamic that was identified in Project 1 is a learning to contract dynamic, as reported by Mayer and Argyres (2004). This dynamic develops when organisations learn to contract with each other through repeated interaction, irrespective of changing products, or relationships (Mayer and Argyres, 2004). The contract defines the work packages and provides stipulations on the project specificities and therefore serves as a repository for knowledge about

how to govern the collaboration. The interviews also point out that a further developed documentation centre could have aided the interpretation of the contract, and could have served as a tool for knowledge to be transferred in explicit form during the project's implementation. Another, yet not explicit knowledge transfer that originated from the project environment is one where occasional individual efforts, aimed at implementing project processes that resemble the PPP method, are now applied in the core business of the SOE. As such, through Schumpeterian entrepreneurial imitative innovation (Schumpeter, 1934; Ihrig, 2011), individuals try to transfer the tacit knowledge gained in project environments to the permanent organisation, in an effort to improve the organisation's daily business processes.

These initial findings therefore clarify that these project organisations did not place much emphasis on the explicit transfer during the projects. To explain these findings, questions were included in the questionnaire that aimed at assessing the corporate culture and in establishing whether or not the corporate culture at the SOE is attuned to the creation of organisational memory. Strikingly, the majority of respondents reports that overall, the SOE does have a corporate culture that encourages more or less the creation of lessons learned and best practices, as can be seen in figure 4.

INSERT Figure 4 Corporate knowledge management culture

Hence the question remains why, if the organisation is adapted to the formation or creation of lessons learned and best practices, this does not happen during the LTIC projects.

Literature on project-based learning would suggest that the temporary nature of the LTIC project organisation does not allow knowledge sedimentation, and that project managers that are involved in several or sequential projects, do not find the time to codify their knowledge or put their lessons learned on paper, due to the short amount of time that is given between projects (Bakker et al., 2011). However, this seems counterintuitive in these cases, as the culture is seen as attuned to performing such tasks and the duration in which partners have to cooperate in these cases is sufficiently long, hence allowing for knowledge sedimentation even in the project environment.

Consequently, the fact that little or no explicit knowledge transfer took place during and after these projects needs a different explanation. As a result, during the panel discussion, participants were asked why knowledge transfer from the project environment to the permanent organisation was not important in these two projects.

Respondents stated that this lack of strategic importance had several causes.

First of all, at the origin of the initiation of these PPP project structures, lies a political choice. The strategic decision-making therefore does not originate from within the SOE. Imposing a PPP finance structure may have brought the SOE project managers out of their comfort zone and made them assume these projects to be very different to conventionally procured LSI projects. Hence, in terms of strategic value and in the attainment of the organisation's strategic objectives, these projects represent low frequency, high intensity type projects that may only arise every 5 to 10 years for this particular organisation. The latter is nicely represented in the following quote: *“PPP is just a means to an end, in a given and temporary political and economic system. There are no lessons to be learned from a PPP project, as what we do in these projects, is exactly the same as what we do in non-PPP projects. The only difference is the accessibility in terms of the financing of the project, which makes that the deadlines and budgets in these types of projects are better respected. The biggest problem in a PPP project is in the asymmetrical power relations, which are imposed on us by the government. We as infrastructure manager have the status of an autonomous state-owned enterprise, yet we cannot autonomously decide which investments need to be pursued in order to obtain our organisation's strategic goals. This puts us in a very challenging position.”*

(Respondent 25, 2/07/14)

The value of creating an inclusive explicit knowledge transfer is therefore not perceived as aiding the individual project manager, nor the organisation, since investing in knowledge that captures the essence of the participation of the organisation in these projects is resource, time and people dependent, i.e. entails making extra costs.

Additionally, respondents indicate that new PPP projects in Belgium are not very likely, and additional debt-based project finance mechanisms are to be avoided in the near future, thereby lowering the need to capture knowledge - if assumed typical for this type only - that was gained in these types of settings.

Furthermore, respondents indicate that these knowledge transfer-facilitating investments would be made if PPP projects were to follow in the future. During the research, such a situation seemed unlikely. According to the respondents, a crucial factor is the project pipeline as expressed in an encompassing infrastructure- and investment policy, as such explicating the strategic direction and importance of PPP in the future. Such a policy is largely non-existent in Belgium, thereby making it harder to make sound or informed strategic knowledge investment in PPP at the organisation level.

Additionally, issues of flawed knowledge transfers or flaws in the knowledge that is transferred are also raised as psychological barriers that limit the extent of the knowledge transfer. Simply put, justification for extensive investments in LSI knowledge at the organisation level are not easily found.

Finally, as the permanent organisation is involved in the maintenance phase of Project 1, this means that maintenance related feedback becomes available during the project. This serves as a feedback loop on how the project is doing, therefore lowering the need to follow-up on the projects at the organisation level. Here, a clear 'silo' method of thinking is retrieved in which the underlying logic stipulates that the maintenance knowledge should be kept in the maintenance department.

An element that also permeates from the findings is related to the attraction of external knowledge through the employment of external consultants. This activity lowers the need for knowledge creation internally, yet does not allow for knowledge sedimentation at the organisation level. A crucial matter raised in the panel discussion is linked to the out-sourcing of certain aspects of LSI projects and relates to the need for public sector organisations to manage their project knowledge internally, rather than having a centrally coordinated government service that manages all LSI and

PPP related matters in cooperation with the respective public sector project initiators or developers. Given that LSI and certainly PPP knowledge may have little value at the organisation level in public sector organisations, the proposition is made to manage this knowledge through an overarching endeavour, including both TPP and PPP public sector knowledge.

On the topic of such inter-organisational knowledge transfers of LSI related knowledge between public sector organisations, respondents indicated that LSI knowledge is vastly complex and characterised by incomplete information. Hence the transfer of in these cases PPP-related knowledge between public sector entities is currently realised through a more tacit or inter-personal manner, as structuring this type of knowledge transfer was seen as difficult to achieve.

5. Conclusion

For the two LTIC projects studied in this paper, the results in terms of LSI related knowledge management indicate that the focus of the state-owned enterprise, is not on the creation and consequent capturing of explicit, organisation-level and collective knowledge. Knowledge is mainly managed by people and is therefore treated as a tacit and individual concept. There seems to be little attention for the creation or expansion of the existing organisational project management knowledge base, in explicit terms. Yet, in the second project, the pre-existing project management knowledge base, related to traditional procurement methods, was exploited and applied in the new project setting, hence highlighting a dynamic response to change. In terms of adapting to new project management skills and knowledge, the organisation struggled with deciding on what new knowledge should be kept, which elements of the traditional approach should be unlearned and what elements could be perceived as additions to the pre-existing organisational knowledge base. This is related to the fact that mechanisms used to convert tacit knowledge into explicit knowledge were not a priority during the projects. It is also related to a corporate culture that cannot attribute much importance to the knowledge management and transfer in LSI projects, as the perceived costs related to doing so are perceived to outweigh the direct strategic benefits. Given the low frequency with which this type of project is demanded from the organisation. The former elements lead to the

conclusion that SOEs with particular strategic objectives and often limited or short term high intensity exposure to these types of LSI projects do learn during these projects, develop skills and related project management knowledge, yet that the transference of explicit knowledge to the permanent organisation is difficult due to the need for additional and unjustifiable investments and/or a lack of perceived alignment with the core strategic objectives of such organisations.

Whether state-owned enterprises should manage LSI and even PPP related knowledge internally (at an alleged bureaucratic cost for themselves), remains to be researched further, eventually coming to an actual cost-benefit analysis. From the results retrieved in this research, it is easily derived that LSI participants feel that such knowledge should be managed externally. A specialised cross-policy level government body, and/or a community of practitioners, or another form of knowledge management outsourcing can serve this purpose. Future research should therefore address this issue of efficiency in managing knowledge gained through the participation of different types of public sector organisations in for example LTIC projects and how this can be done if little or no explicit knowledge is being transferred during LSI projects such as the ones studied here.

6. Discussion and future research

6.1 Ex-ante vs. ex-post analysis of knowledge transfer

The research presented in this paper has tackled the issue of project-based learning and knowledge management at the public side of two PPP projects from an ex-post perspective. Lessons learned are distilled and the process of knowledge transfer for LSI projects is studied. However, as public sector entities may have to enter into LSI projects without extensive prior knowledge, it is interesting to study how the ex-ante knowledge transfer would work and whether public sector entities try to obtain knowledge on the project process in an ex-ante manner. Even more so, the channels, tools and processes used in this effort prove to be quite revealing in this process, therefore requiring further scrutiny.

6.2 Inter-project learning in the public sector

Given the temporary nature of projects in general, not specifically for PPP projects, the matter of inter-project learning remains quite troublesome. The latter is however related to the overall fitness of the inter-organisational knowledge transfer system that exists for project-based knowledge at the public sector side in any given region or nation. Coming to a more inclusive approach in any public sector, will unavoidably also entail creating communities of practice and in establishing communication channels that allow for sedimentary knowledge to be transferred. Ultimately, the governmental capacity or ability to successfully initiate, implement and monitor projects will therefore, at least in terms of effective and efficient employment of resources, necessitate the transfer of knowledge from one project to the next. Future research will therefore want to focus on the structure and building blocks needed for governments and public sector organisations (such as state-owned enterprises) world-wide to develop key knowledge resources when it comes to project initiation, implementation and monitoring.

6.3 Corporate culture in an autonomous state-owned enterprise

Given that the projects, in both cases, are signalled as being successful in project management terms, it seems that the permanent organisation stands to improve its project management through the implementation of simulated PPP project structures on the traditional procurement projects that the organisation is involved in. This is however not feasible without having an effect on the orientation of employees in terms of their approach towards inclusivity in their project management. The question therefore is, how to structure such a re-orientation. An inclusive project management approach can only mature in an institutional environment that is conducive to its further development, i.e. sensitive to organisational learning. The incidence of PPP-types of LSI projects presents a window of opportunity and has the potential to have a disruptive innovative effect, when lessons learned are indeed fostered. The institutionalisation of an integrative project management approach may however be better supported by a slow path dependent institutional change that lets employees adapt gradually to the new approach. Future research may therefore address the matter of project management reorientation and how this is affected by the occurrence of windows of

opportunity and gradual institutional change in the event of LSI projects.

6.4 The strategic importance of PPP at the public side

The observation that the sedimentation of PPP project knowledge is not a priority for a state-owned enterprise that otherwise is moderately committed to investing in its knowledge resources, signals a lack of strategic or long-term importance of the PPP mechanism for this particular SOE. Therefore, on a larger scale, the strategic importance of the PPP mechanism should be evaluated. In order to ascertain whether other public actors find the mechanism to be important, and whether or not PPP knowledge is shared and stored across state-owned enterprises, in light of the long-term duration of the contracts and their potential ramifications. However, it is apparently difficult to capture and disseminate PPP related knowledge within a single organisation, as PPP knowledge would not necessarily strengthen the LSI knowledge base, and it is doubtful that sufficient resources and competency are being allocated in order to develop tools that allow for knowledge created in LTIC projects all over Belgium to be articulated, captured, organised and distributed by a knowledge coordination centre. Based on these elements, we argue that the inter-organisational flow of LSI relevant knowledge should, at the public side, be addressed as this can provide insight into the public sector's absorptive capacity in the field of LSI and in particular also PPP projects developed in Belgium or in any region, nation or state for that matter.

6.5 Strong project ownership and the development of dynamic capabilities

As was stated in the introduction, Winch and Leiringer (2016) have argued that strong owners can achieve higher performance on major infrastructure projects if they have and develop project coordination capabilities. The latter also became clear in the cases that were studied here, as the project owners felt that they were better equipped to tackle the second project, given their increased experience with this type of project, and expansion of their knowledge base.

The challenge in LSI projects clearly lies in learning from these projects (Brady and Davies, 2004), as they are no business as usual endeavours and are often highly specific, and, as such, it is not obvious for owners to engage in endogenous inter-project learning (Winch and Leiringer, 2016). The problem however is that in order for capacity to be built, experience is needed and project

owners need to be able to assess their own strengths and weaknesses in terms of project initiation, implementation and monitoring. Hence either the project owner needs to develop a knowledge base which can then be exploited further or which can serve as a basis against which new knowledge can be evaluated and explored. The alternative is that an external knowledge base is used, which in turn makes the project owner strategically vulnerable, as an overreliance on external expertise may prove to be unreliable or insufficiently suited to serve the interests of the project owner.

A more logical approach would therefore be to develop a large body of knowledge on the management of LSI projects, which can then serve different project owners.

The latter however also warrants some caution and this for two reasons. On the one hand, the development of a body of knowledge and the description of core competencies in relation to LSI project coordination at the public sector side may invoke a competency trap through which an overreliance on standardised methods and procedures may lead to a lack of innovation and may reduce flexibility. Hence the body of knowledge as well as the competencies need to be of a dynamic nature, that is, able to adapt to environmental change and suited to serve the project owner in case changes occur in the project ecology. On the other hand, methods need to be developed and or applied that allow project owners to differentiate the vital or crucial knowledge and or competencies from the general and or less important knowledge and competencies. Otherwise the endeavours of creating a usable body of knowledge will lead to an overabundance of information that will become unworkable.

Further research can therefore look into several elements. There is the make or buy decision related to the LSI project coordination body of knowledge or knowledge base and the drivers of either choice. Alternatively, researchers may also look into the core competencies that need to be developed to be able to identify and use such a body of knowledge. This also means that research will need to look into the development of methods that allow for the differentiation of vital knowledge from non-vital knowledge. In turn also influencing the dynamics of project coordination capacity, and creating the need to identify the drivers, barriers and pitfalls when project owners are confronted with changes in their environment.

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Figure 2 Phase-dependent participation in the LTIC projects

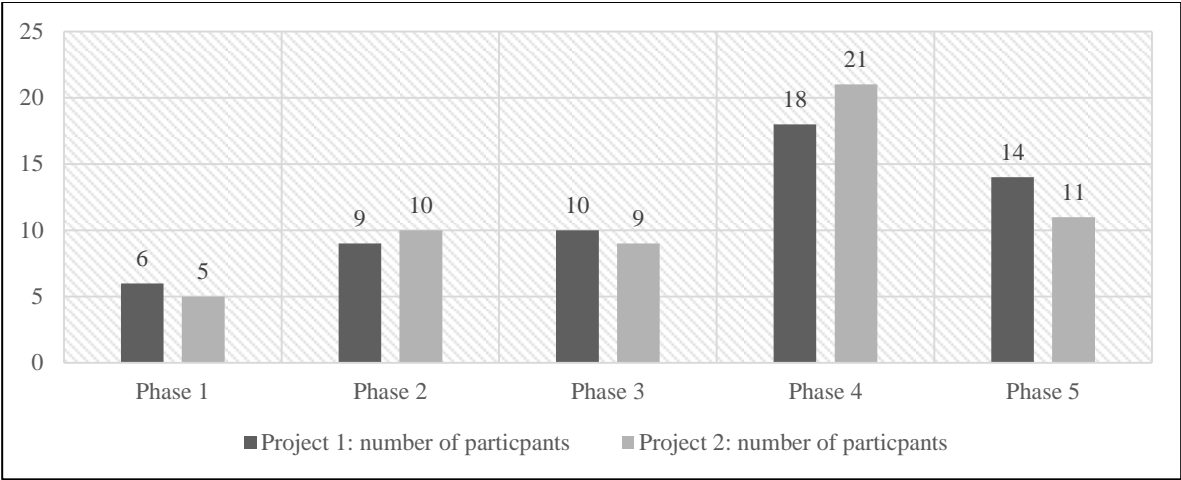


Figure 2 PPP knowledge base assessment: process clarity

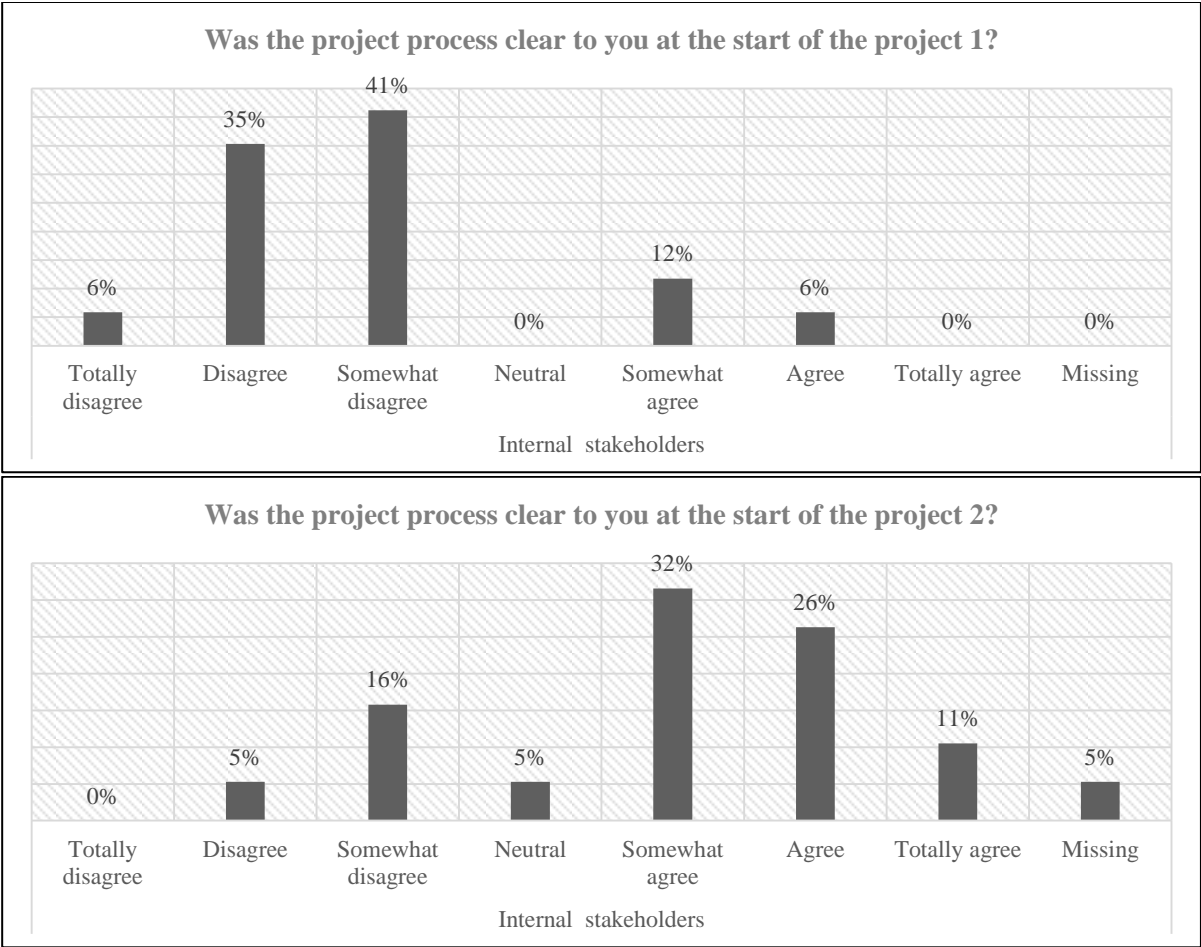


Figure 3 PPP knowledge base assessment: resources & competencies

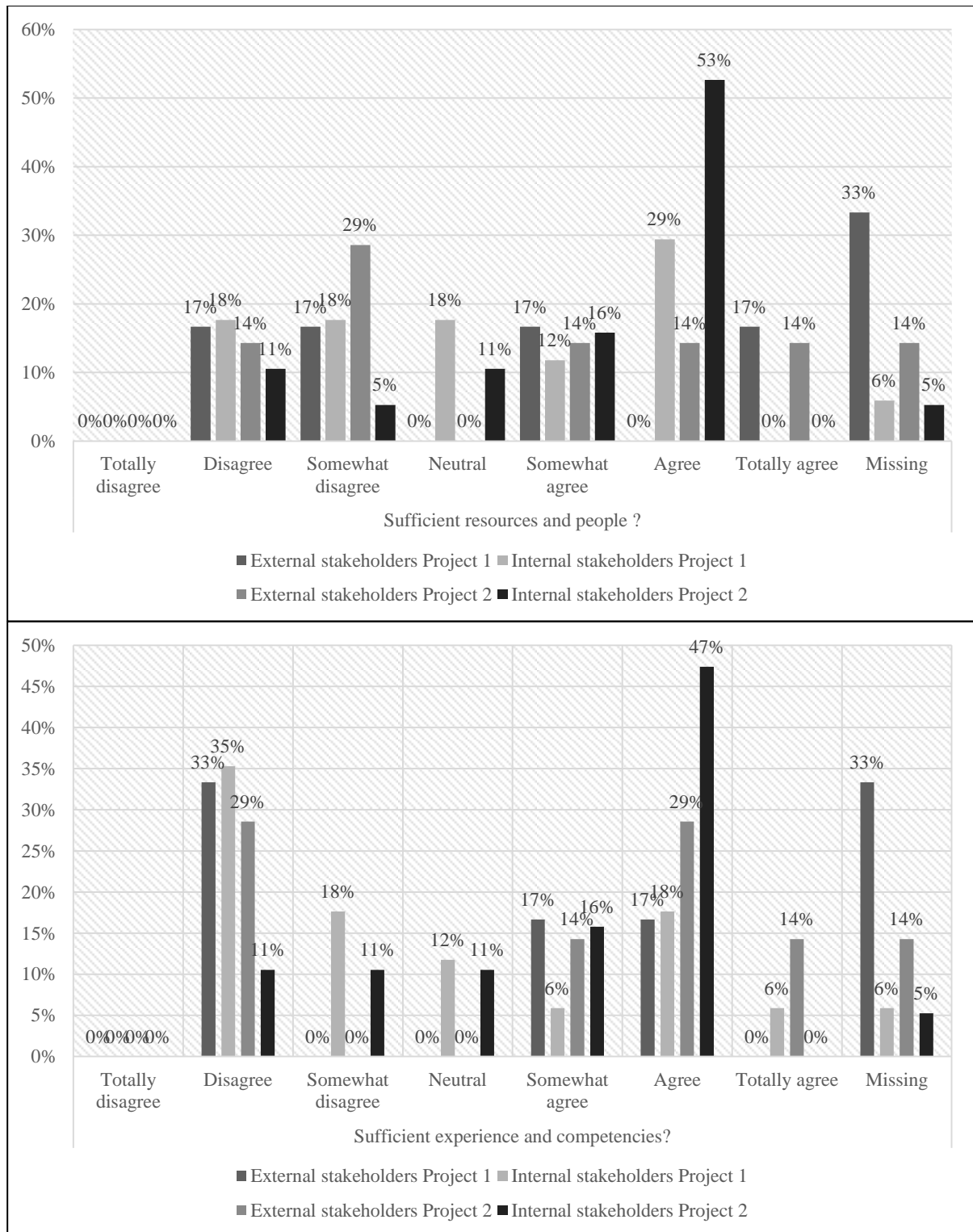


Figure 4 Corporate knowledge management culture

