

A Case of Obstructing Conditions in Knowledge Flow Dynamics

Lina Lo
Nova Southeastern University
lina_lo@ymail.com

Abstract

Knowledge flows unevenly throughout an organization and the problem is that the fundamental dynamics of these flows are still not well characterized in theoretical and computational models. This study built on existing work—knowledge-flow theory, need knowledge generation, and the critical success factors for enterprise resource planning implementation—to examine the multi-dimensional knowledge-flow phenomenon in context, and used the case study methodology for knowledge-flow theory building. The research question was two-pronged: how can need knowledge and its flow across stakeholders within an organization be explained using a multidimensional knowledge-flow model and how can Nissen’s five-dimensional knowledge-flow model be validated using a real-life immersion case? This case study suggests enabling need knowledge determinants and obstructing conditions are in play in determining the path of need knowledge flow. These two research artifacts should be considered together to provide a fresh research avenue towards better understanding of knowledge flow dynamics.

1. Introduction

Knowledge is a sustainable advantage for an organization and knowledge assets can increase value with use [1]. However, knowledge flows unevenly across people, organizations, places, and time, and knowledge may not be equally valuable or needed throughout its flow [2], [3], [4], [5], [6], [36] and are particularly pronounced in complex organizations and enterprises [6]. Initiatives such as enterprise resource planning (ERP) implementation projects exemplify uneven knowledge flows. The problem is that the fundamental dynamics of these flows are still not well characterized in theoretical and computational models [7], [8], [4]. Lin et al. noted that the “research approach of dealing with KM [knowledge management] issues often fails to grasp, especially, the issues of knowledge flow” [8, p. 629]. Nissen portrayed the state of KM

research as mostly of a descriptive nature and put forth that the next generation of KM research should move toward measurement, explanation, and prediction: “Learning from failure can provide important lessons, but such provision depends critically upon knowing what causes failure (e.g. preconditions) and learning how it can be prevented” [4, p. 236]. Nissen highlighted the importance of identifying and distinguishing “the contextual factors that affect the efficacy of various knowledge flow processes” and encouraged researchers “to immerse themselves in operational organizations in the field and to investigate how people as individuals, in groups, in organizations, and in even larger collectivities know and learn” [4, p. 236].

1.1. Multidimensional knowledge flow

Nissen developed a five-dimensional (5D) knowledge-flow model to better understand the dynamics of knowledge flow by characterizing a particular knowledge in four dimensions—reach, explicitness, life cycle, and time—and qualifies the efficacy in achieving a knowledge-based action in the fifth dimension, the power dimension [4]. This 5D model can be visualized on a Cartesian coordinate system. The reach dimension is plotted along the horizontal x-axis representing the different levels of socialization from individual to group to organization, and beyond. The explicitness dimension is the vertical y-axis from tacit at the bottom of the axis and upwards to explicit. The life-cycle dimension is represented by the z-axis that comes out of the page progressing from knowledge creation to organizing, formalizing, sharing, applying, and refining. The fourth or time dimension is the flow time represented by an arrowed vector or line graph that relates the three dimensions on the x-, y-, z-axes. The thickness of the arrow represents the magnitude of the flow-time: fast flows are thick vectors and slow flows are thinner vectors. The fifth or power dimension is not captured in the coordinate system. This dimension qualifies how powerful a knowledge-based action is, given the values of the other four dimensions.

1.2. Need knowledge

Pourzolfaghar et al. developed a technique to capture required (or need) knowledge of two different types of experts (or stakeholders) during the architectural conceptual-design phase of a green-building project to improve knowledge flow among these two different sets of stakeholders based on an earlier four-dimensional knowledge-flow theoretical framework proposed by Nissen [6], [2], [9]. Pourzolfaghar et al. found that knowledge flows along the critical paths of workflows that contribute positively to organizational performance [6], as posited by Nissen [4], [9]. Pourzolfaghar et al. concluded that “knowledge flows should be planned and managed like workflows” [6, p. 75]. Kaiser, Fordinal, and Kragulj furthered the concept of required or need knowledge, independent of the work by Pourzolfaghar et al., and built a theoretical framework to capture (create and discover) need (or required) knowledge in an organization for the generation of innovative products and services [10]. Kaiser et al. integrated the theory of needs into the theory of knowledge-based organizations. The premise was that needs are “requirements to be met for the individual’s well-being and the organization’s sustainable existence” [10, p. 3501]. Kaiser et al. showed that their model was successful in discovering and generating need knowledge in large organizations in a short time frame. Pourzolfaghar et al. and Kaiser et al. reinforced Jennex’s description of KM as “getting the right knowledge to the right people at the right time” [11, p. 52]. It follows that it is more efficient for an organization to focus on need knowledge and move that through the knowledge flow for the relevant stakeholders.

1.3. KM in ERP

KM has long been used to enhance ERP implementation [12], [13], [14] and to explain some of the difficulties in realizing ERP projects and benefits [15], [16], [17], [18], [19]. Nour and Mouakket proposed a framework of critical success factors (CSFs) for ERP implementation in three dimensions: (a) six fundamental stakeholders (end users, top management, information-systems department, project team, organization, and vendor), (b) three major phases of an ERP project life cycle (pre-implementation, main implementation, and post-implementation), and (c) five different roles each stakeholder may play during each ERP-implementation phase (consultation, participation, fulfillment, authorization, and support) [20].

Given the problem is that knowledge flows unevenly and are still not well described theoretically or computationally, the goal of the research was to validate and extend Nissen’s 5D model using a real-life ERP initiative as a case to better understand the uneven

flow of knowledge through an organization. This case study built on existing work—knowledge-flow theory, need knowledge generation, and CSFs for ERP implementation—to present a theoretical framework to characterize knowledge-flow patterns by addressing a two-pronged research question: (i) *how can need knowledge and its flow across stakeholders in an organization over time be explained using a multidimensional knowledge-flow model and (ii) how can Nissen’s (2014) 5D knowledge-flow model be validated using a real-life immersion case?* The premise was that by explaining real-life need knowledge flows using Nissen’s model, which would address the first prong of the research question, Nissen’s model would be validated, which would address the second prong of the research question. Furthermore, by incorporating need knowledge and stakeholders into the knowledge-flow model, the goal of the study would be achieved.

International financial institutions (IFIs) such as the European Investment Bank, The World Bank, and Asian Development Bank provide financing and technical advisory support to developing countries. One of these initiatives, referred to as the Reforming the Public Financial Management Project or REPFMP, was signed between a developing country and one of these IFIs in 2004 with the goal to reform the country’s public financial management system with an ERP system as the core of this initiative. It took 11 years for the resulting ERP system to become operational in 2015. REPFMP is the first ERP implementation in this country aiming to enhance government efficiency and effectiveness in the comprehensive management of public resources. The REPFMP initiative, with its multitude of stakeholders and corresponding implementation complexities, presented a rich environment for better understanding knowledge-flow dynamics, while enabling stakeholders “to translate theory into practice and inform practice with theory” [4, p. 235].

2. Theoretical framework development

2.1. Review of literature

The review of the literature aimed to present the research trends in KM, focusing on knowledge flows, and to establish ERP implementation as an appropriate laboratory to study the multidimensionality of knowledge flow. Accordingly, the literature review was built on two research streams: KM and ERP implementation (see Figure 1). Under KM, the state of KM research was organized along Nissen’s five knowledge-flow dimensions: reach, explicitness, life cycle, time, and power. The literature review addressed

the second research stream by establishing ERP implementation as an appropriate laboratory to study the multidimensionality of knowledge flow. This segment of the review started with the CSF of ERP implementation and the role of KM in its successful implementation and ended with a discussion of ERP implementation in the public sector or in developing countries: that is, the specific setting of the real-life case for this study.

The prevailing body of literature in knowledge-flow dynamics is descriptive in nature [4], supporting Serenko and Dumay’s conclusion that KM is maturing as a discipline and empirical studies will help the discipline progress [21]. [22], [23]. Studies on the multidimensionality of the knowledge-flow phenomena have been limited to only a couple of dimensions at a time, with the reach dimension garnering the greatest attention. The literature review also demonstrated that ERP implementation in the public sector and in developing countries offered a relatively untapped environment to study the uneven flow of knowledge using Nissen’s 5D model.

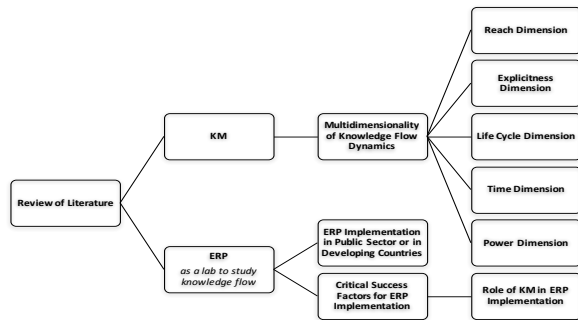


Figure 1: Strategy for the review of the literature

Some researchers have attempted to build conceptual knowledge-flow theory. Lin et al. identified a number of factors or determinants—transfer, source, receiver, and flow context—that affected knowledge flow, and proposed a hybrid model that included a triangulation scheme to illustrate the multidirectional nature of and adaptive interactions among the determinants of knowledge flow [8]. Kim et al. developed a tool based on social-network analysis to trace organizational knowledge paths to identify where and how knowledge flows and stops [7].

Pourzolfaghar et al. used Nissen’s multidimensional knowledge-flow model as the background theory for their study of need knowledge and its movement between experts to avoid rework due to ineffective KM [6]. Pourzolfaghar et al. extended an activity-based architectural design framework

developed by Macmillan, Steele, Austin, Kirby, and Spence [24], merging the theory of knowledge flow with the theory of architectural design. Their work further demonstrated the linkages between knowledge flow and workflows and the multidimensionality of knowledge flow in high-performing organizations. However, there are usually multiple stakeholders participating in a complex project such as the building project described by Pourzolfaghar et al., but they focused on explicating only mechanical and electrical need knowledge and the related flows among mechanical and electrical engineers during the architectural conceptual-design phase of a green-building project in Malaysia.

Kaiser et al. focused on needs and knowledge about needs in organizations and developed a framework for the creation and discovery of need knowledge grounded in abductive reasoning, which is a process that “relies on observations to stimulate possible hypotheses” with “an appeal to instinct” [10, p. 3501]. Kaiser et al. then applied the framework to a large project in Austria to create a catalog of needs for Austrian bakers, who role-played in the study as four different sets of stakeholders: customers, owners or chiefs of bakeries, employees of bakeries, and the Austrian Federal Economic Chamber, the institution that initiated the project. Contributions of the Kaiser et al. study are twofold: (a) integrating the theory of needs into the theory of knowledge-based firms, and (b) using abductive reasoning in the generation of need knowledge. However, they applied the framework developed and described in the study to only one case and at a snapshot moment during a workshop setting.

The studies by Kaiser et al. [10] and Pourzolfaghar et al. [6] presented a new process of need-knowledge explication through innovative merging of disciplines with limited empirical work to validate the generalizability of the approaches across organizations and industries. Both groups of researchers focused on tacit knowledge and only hinted at the multidimensionality of knowledge-flow dynamics in organizations. Both used instances outside the realms of information systems, the traditional domain of KM. Taken together, along with Nissen’s 5D knowledge-flow model [4] and Nour and Mouakket’s ERP CSF classification framework [20], both with limited real-life applications, quite a blank canvas emerged for further elaboration, especially in information-systems research. In this context, the main research gap is the lack of empirical work to explain the multidimensional knowledge-flow phenomena in context.

The REPFMP initiative provided fertile ground for this study of multidimensional knowledge-flow phenomena. REPFMP took 6 years from conception to the beginning of ERP-system implementation, with 4.5

years spent on procurement, resulting in a total project life of well over a decade. Although the lifetime of REPFMP is not an anomaly among the 87 implementations studied by Dener et al. [25], REPFMP took longer than the average time to gain traction. Dener et al. noted that effective FMIS (ERP) design and implementation required contextual and country-specific solutions, echoing Nissen's assertion of a "contextual factors" requirement in knowledge-flow processes [4].

Poon and Yu considered procurement an important pre-implementation component of ERP adoption and studied practices in Hong Kong and Australia [26]. Negi and Bansal cited that the two most crucial and expensive knowledge phases in a successful ERP implementation lifecycle were requirements engineering and configuration [27]. These are the pre-implementation stages of an ERP implementation, and the pre-implementation phase is a pivotal moment in an ERP project [28], [25]. This study concentrated on the pre-implementation phase of an ERP-implementation lifecycle.

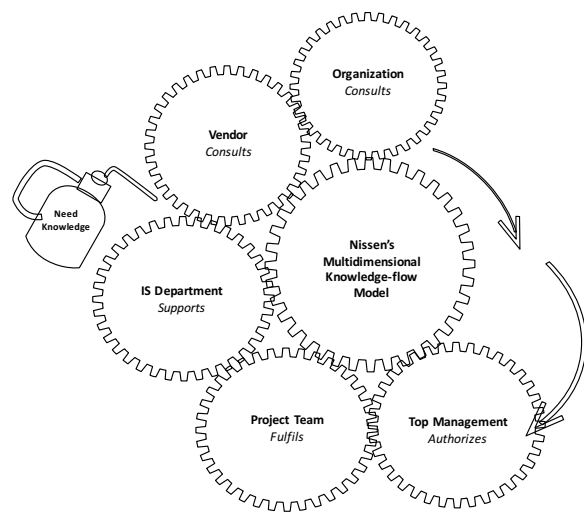


Figure 2: Framework linking data to theoretical propositions

2.2. Theoretical framework

This study extended Nissen's 5D knowledge-flow model [4] as the theoretical framework to explain the flow of need knowledge described by Kaiser et al. [10] across Nour and Mouakket's stakeholder groups of an ERP project [20]. Hanisch, Lindner, Mueller, and Wald linked knowledge to project life-cycle stating that different types of knowledge were needed during the different stages of a project life-cycle [30], providing

the basis to connect Kaiser et al.'s need knowledge to Nour and Mouakket's CSF framework (see Figure 2).

3. Methodology

3.1. The design

The research was an explanatory single-case study as described in Yin [31] to understand the phenomenon of knowledge-flow dynamics across all different stakeholder groups over the pre-implementation period of a real-life ERP implementation. Accordingly, the five research design components were as follows:

1. Research question: How can need knowledge and its flow across different stakeholders in an organization over time be explained using a multidimensional knowledge-flow model? and How can Nissen's 5D knowledge-flow model [4] be validated using a real-life immersion case?
2. Research proposition: First, the study validated Nissen's proposed 5D knowledge-flow model [4], which has limited empirical work, by considering the multidimensional aspects of knowledge flow in a real-life ERP project. Second, the research adopted five of the six stakeholder groups defined by Nour and Mouakket [20], thereby expanding on Pourzolfaghar et al.'s work with only two stakeholder groups [6]. Third, the proposed study was longitudinal to cover the multiyear (2004–2009) pre-implementation phase of an ERP initiative, departing from the work of Pourzolfaghar et al. [6] and Kaiser et al. [10], who considered relatively shorter time horizons.
3. Unit of analysis: The unit of analysis was a team of individuals representing the five stakeholder groups—top management, information systems department, project team, organization, and vendor—involved in the pre-implementation phase of ERP implementation under the REPFMP initiative.
4. Linking data to the proposition: This study used three sources of data—project-related documentation, archival records, and interviews—to capture uneven flow of need knowledge through an organization. These different sources of evidence facilitated triangulation of the collected data. Data analysis relied on linking data on flows of need knowledge across the five different stakeholders through an organization to the proposition that need knowledge flows can be explained by Nissen's multidimensional knowledge-flow model [4] (see Figure 2).
5. Criteria for interpreting data: The data-analysis strategy adopted for the study followed the theoretical propositions espoused in the five dimensions in Nissen's multidimensional

knowledge-flow model [4], the concept of need knowledge advocated in Kaiser et al. [10] and Pourzolfaghar et al. [6], and the three critical-success-factor dimensions in Nour and Mouakket's ERP successful-implementation framework [20]. These theoretical propositions together became the criteria to guide the data-analysis process to explain the multidimensionality and unevenness of need knowledge flows across five stakeholder groups during the pre-implementation phase of an ERP project.

3.2. The case

The IFI-financed REPFMP was the studied case. The core goal of REPFMP was to implement an ERP information system to support the finance ministry of the country's public financial-management processes that included budget planning, execution, and reporting. These budget planning and treasury information systems are generally referred to as FMIS in the IFI and the broader development aid communities. REPFMP was to be the first FMIS implementation for the central government to enhance efficiency, governance, integrity, and transparency of management of public resources.

One of the IFIs agreed to finance the REPFMP in 2003, and the US\$60 million loan agreement was signed in December 2004. The core, almost 90% of the entire loan, was the implementation of an ERP information system specifically to manage budget planning, execution, and reporting. The REPFMP spanned 12 years starting in 2003 when the initial concept of the project took root. It officially closed in December 2015 with the ERP system officially launched in April 2015.

Based on the experiences of 87 World Bank FMIS implementations over 25 years, 55 completed and 32 ongoing projects, Dener et al. found that total duration of completed projects was 7.9 years on average, ranging from 3.6 years in Afghanistan to 13.4 years in Malawi [25]. Duration of the preparation (pre-loan signing) phase of the 87 implementations averaged 16 months, the effectiveness period (from loan signing to disbursement loan fund) at 6 months, and the procurement of FMIS systems among completed projects took 2.2 years. Taken together, the average duration of pre-implementation, from conception through to the beginning of system implementation of World Bank-financed FMIS projects took about 4 years. The REPFMP took 6 years, with 4.5 years spent on procurement.

3.3. The data

This case study utilized three sources of evidence: project-related documentation (semi-annual progress reports, a midterm evaluation, and monitoring mission reports), internal archival records (e-mails, formal correspondence, legal documents, and minutes of meetings), and open-ended interviews. Before the interview part of the data-collection process, the researcher collected and reviewed project-related documentation (obtained through project team members), and screened the internal archival records filed online in the IFI's REPFMP project portal covering the period from December 2004 to July 2009. The researcher assembled all ERP procurement-related items from the project-related documentation and archival records to build a chronology of events that delayed the procurement process and those that eventually led toward contract signing in July 2009. The actual chronology of 4.5 years of empirical events occurred during the ERP procurement period was then benchmarked against the planned chronology scheduled to take only 14 months.

Once data from all three sources of evidence were collected, the logic model data-analysis technique was used for explanation building. This logic-model framework was used as the preliminary analytic technique to tie together the chronology of events ("what happened") and initial explanatory propositions ("why it happened"). The logic model data-analysis technique was appropriate at this point as the goal was, following Yin's protocol [31], to match empirically observed events to theoretically predicted events.

4. Results

This case study focused on the pre-implementation phase of an ERP project. The need knowledge is accordingly in the procurement domain. Gaining procurement knowledge would facilitate and accelerate the acquisition of the ERP information system needed to improve the efficiency and effectiveness of the finance ministry's public financial management. The desired knowledge flow for the ministry would inevitably be for procurement knowledge to flow quickly, directly, and with high power.

4.1. Need knowledge determinants

Nissen postulated that organizations in general lack processes to support direct, quick, and powerful knowledge flow, resulting in obstructions along the knowledge-flow path [4]. The logic model described by Yin [31] was constructed as a tool to understand these knowledge-flow obstructions by deriving the cause-effect results chain. Figure 3 depicts the results structure of this case study.

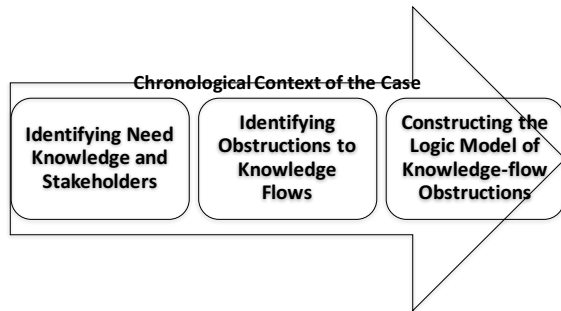


Figure 3: Toward a logic model of knowledge-flow obstruction

Lo introduced the concept of three need knowledge determinants—*intrinsic*, *extrinsic*, and *catalytic*—that enable knowledge-flow advancement [32]. For this case study, procurement was considered *intrinsic* need knowledge that is basic, general, procedural, how-to, domain-based knowledge, without which no procurement process could emerge. *Extrinsic* need knowledge refers to technical and subject-matter- or industry-specific knowledge such as IT and ERP-related knowledge for this case study. All processes in an organization require some subject-matter- or industry-specific knowledge. *Catalytic* need knowledge is the authorizing environment to advance knowledge flow to the next point in space or time. Without the catalytic knowledge to authorize procurement-process advancement, as evidenced in this case study, the procurement knowledge loop would be incomplete.

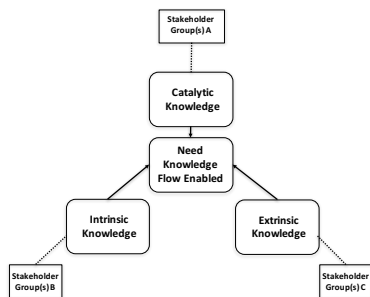


Figure 4: Need knowledge determinants in knowledge flow

Catalytic knowledge enables Nonaka’s *Ba* [33], or what Kaiser et al. referred to a “special kind of *Ba*,” a “time-space-nexus” of “shared space” necessary to complete the need knowledge-flow loop [10]. Furthermore, different stakeholders possessed different types of need knowledge, and presence, or absence, of all three types of need knowledge determined completion of a knowledge-flow loop (see Figure 4). For this case study, completing the knowledge-flow

loop would mean advancing to the next stage of the procurement process.

4.2. Obstructing conditions

This paper presents results pertaining to causes of knowledge-flow obstructions. The government’s first progress report in March 2006 stated that “insufficient training on and understanding of procurement” was one of the main reasons for slow progress. The report suggested one of the measures to speed up procurement was “providing adequate training for team members to carry out their responsibilities.” Insufficient training resulted in staff not able to perform duties, which in turn contributed to resisting doing the work. Lack of procurement training or inadequate training, discussed earlier in this chapter, was consistently mentioned in the first four government’ progress reports and echoed by all stakeholder groups. Being “not able” to perform a knowledge-based action (performing the procurement) resulted in resisting the action, noted in the upper left corner of Figure 5.

One member of the government project-team stakeholder group pointed out they experienced “not a lot of support from outside of the directorate-general of treasury” and that within the directorate-general of treasury, only the director general and a few involved in the planning and design of the project were supportive. One project-team member prefaced the interview with the statement that the government had a certain unwillingness to adopt a ready-made ERP system, with some officials considering custom building a system. The third government’s progress report, dated April 2007, stated that the consultancy team, which was engaged by the government to assist the government to evaluate the bid proposals, “highlighted that it would be too risky to undertake in-house development due to limited IT capability within the ministry.” Representatives of the IS department stakeholder group stated that even the directorate-general of treasury, where the FMIS was to be hosted, had strong opposition to the project with one of the senior officials opposing the approach because an ongoing initiative to transform the operations of the branch offices of the directorate-general of treasury across the country might conflict with the new system. Another perspective of this unwillingness to embrace the ERP was brought about by a project-team member who described a reluctance to change, and in the directorate-general of treasury, some believed that “everything was good already and rejected new things automatically.” Recorded in the government’s third progress report dated April 2007 was that

At the level of [project implementation units], one cannot expect middle management and staff to align their interests automatically with a project espousing transparency, control and accountability, or one that promises automation efficiency gains that could be perceived as a threat to jobs.

This “not willing” sentiment can be seen as rooted in certain self-interests to resist gaining new knowledge, which in turn adds another cause for the resistance condition in the logic model for knowledge-flow obstructions in Figure 5.

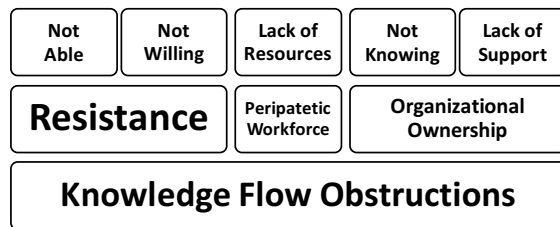


Figure 5: Logic model framework to better understand causes for knowledge-flow obstructions

The government’s March 2006 report stated “inadequate human resources and full-time staff” as another reason for slow progress. The need for dedicated full-time staff to work on the REPFMP was mentioned as a recommendation in the IFI’s first monitoring mission report conducted in June 2016. The lack of dedicated staff to implement the REPFMP project was due partly to the ongoing ministerial organizational restructuring discussed in the third report. The fourth IFI mission report for the February–March 2007 mission also stated that, “While new structural unit was established that afforded full-time staff, existing counterpart team members might not be reappointed to the new structural unit.” The fallout of the reassignment was that those trained might not be able to use their newly gained knowledge and a new set of project-team members would need to be trained. As discussed in previous sections, dedicated resources were lacking throughout the pre-implementation phase of the REPFMP and the structural unit was not in place until after the FMIS implementation contract was signed. The lack of resources contributed to the peripatetic workforce as another condition for the knowledge-flow obstructions depicted in Figure 5.

At a Steering Committee meeting for the REPFMP project conducted during the reporting period, the government’s first progress report in March 2006 cited that the minister would “take a lead in ensuring successful implementation of the [project].” The ERP

system was to be implemented at the directorate-general of treasury even though the system would have supported the entire ministry. One project-team member pointed out that the ongoing reorganization of the ministry entailed the splitting of one unit into two—the directorate-general of treasury and the directorate-general of budget—and with the split, “officials who were previously involved in project preparation were reassigned.”

The IS-department stakeholder group noted that officials of directorate-general of budget were “dissenting groups.” This ownership sentiment extended across the organization, observed by the top-management stakeholder group who said that there was no “public awareness campaign” to inform those outside the main implementing unit. Part of this awareness campaign was designed to be addressed by the change management and communications consultancy the government would procure under the REPFMP project, as stipulated in the project-consideration document. Almost all IFI mission reports listed the procurement of this consultancy as a priority. This consultancy was to be in place at the start of the project during the pre-implementation phase of the FMIS, but this did not happen until after the contract for the FMIS implementation consultancy was signed.

The sixth government’s progress report, dated November 2008, stated that “change management consultancy was not considered to be urgent till January 2010 when the FMIS was to be piloted.” One member of the top-management stakeholder group said support was “not so good ... better in the third year” and that improving support of stakeholders would empower the community of the finance ministry. The result was that most people across the ministry did not know much about the REPFMP project, as summed up by a member of the project-team stakeholder group, indicating that not all units knew the purpose of the FMIS. “Not knowing” about the purpose of the FMIS underlay the “lack of support” for the REPFMP project as a whole. These two interrelated but distinct causes contributed to the organizational-ownership condition for knowledge-flow obstructions, as depicted in the right corner of Figure 5.

4.3. Hierarchy of knowledge-flow obstructions

Using the logic-model data-analysis technique described by Yin [31], and triangulating data collected, five factors are depicted in Figure 5: not able, not willing, lack of resources, not knowing, and lack of support. These five contribute to three conditions for knowledge-flow obstructions: resistance, peripatetic workforce, and organizational ownership. The five factors at the top level of the figure are basic or raw elements resulting in the three conditions—resistance,

peripatetic workforce, and organizational ownership—represented in the second level of Figure 5 that cause knowledge-flow obstructions.

Further analysis to clarify the links between the two levels of the cause–effect chain—not able and not willing—are grouped as contributing to the resistance condition toward knowledge-flow obstruction. Lack of dedicated resources results in a peripatetic workforce to advance a knowledge-based action, which in turn contributes to knowledge-flow obstruction. Not knowing and lack of support together reflect an ownership condition that could result in the narrow stakeholder base needed for organizational commitment to effect a knowledge-based action. These three conditions—resistance, peripatetic workforce, and organizational ownership—together provided an undesirable outcome of procurement delays in the studied case, and resulted in the phenomenon of knowledge-flow obstructions.

5. Conclusions and summary

5.1. Archetypical knowledge-flow patterns

For an organization to rapidly gain and directly apply new knowledge—completing the knowledge-flow loop across the organization—Nissen (2014) suggested that the knowledge would need to stay on the tacit-knowledge plane, or the bottom plane in the three-dimensional Cartesian coordinate system used to represent Nissen’s 5D knowledge-flow model. As organizations in general lack processes to support direct, quick, and powerful knowledge flow, obstruction often exists along the knowledge-flow path [4]. Nissen postulated two archetypical 5D knowledge-flow patterns that most organizations routinely employ as classic processes [4]. Further, multiple permutations are possible for these archetypical knowledge-flow patterns and the “5D space enables one to understand, visualize and analyze every knowledge flow in any comprehensible organization” [4, p. 81]. Nissen’s two archetypical 5D knowledge-flow patterns were adopted to explain need knowledge-flow patterns of this case study.

Following Nissen’s designation, Knowledge-flow 1 is a low-powered flow. For this case study, Knowledge-Flow 1 is characterized by procurement knowledge (intrinsic need knowledge) first learned explicitly by the project-team stakeholder group through procurement training sessions, and ERP knowledge (extrinsic need knowledge), gained as inputs from the vendor and IS-department stakeholder groups. Knowledge continued to flow, converting from explicit (learning) to tacit (applying) knowledge on the explicitness dimension along the vertical y-axis of the

Cartesian coordinate system described above, but flowing slowly from learning to applying (finalizing bids evaluation) on the life-cycle dimension along the z-axis that comes out of the page. The knowledge-flow loop was then completed quickly and powerfully, once catalytic need knowledge was acquired from the organization and top-management stakeholder groups, oscillating on the reach dimension along the x-axis, providing the authorizing environment for the project-team stakeholder group to complete the knowledge-flow loop by awarding the system-implementation contract. This knowledge-flow path took a circuitous 4.5 years and mostly on low power, meaning the knowledge-based action was weak.

The slow flow time and low-powered flow before the inflow of catalytic knowledge could be attributed to the three knowledge-flow obstructing conditions identified in this case study as resistance, peripatetic workforce, and organizational ownership. Throughout both stages of the bidding process, resistance, a sense of not able to process the procurement and being unwilling to embrace the ERP system, seemed to be the dominant obstructing condition among government stakeholder groups. A peripatetic workforce available to work on the procurement activities and the lack of commitment across stakeholder groups throughout the organization comprised the other two conditions that obstructed knowledge-flow advancement. Despite numerous structured training sessions delivered by the IFI to the government project team, the IFI and government project teams felt they did not really have the need knowledge to finalize the procurement process. It took, eventually, an anonymous letter to the president of the IFI at its headquarters, alleging corrupt practice by the government project team to trigger organizational intervention by the finance ministry and the IFI, the former to demand assurance from government senior staff of no wrongdoing and the latter to conduct an investigation of IFI’s internal-procurement practice, to generate catalytic need knowledge, thereby explicitly resetting the forward motion to complete the knowledge-flow loop. Tacit knowledge (intrinsic need knowledge such as general-procurement process and extrinsic need knowledge, ERP-related) is dilute, slow-moving, and less powerful than explicit knowledge (catalytic need knowledge in the form of IFI’s investigative report) in this knowledge-flow pattern.

Knowledge-flow 2 is high powered and associated primarily with tacit knowledge (catalytic need knowledge) acquired by an individual, who applies the knowledge and shares it with a small group of people through personal interactions, and across an organization through delegation or staff assignments. Tacit-knowledge conversion is slow in general, but

once acquired is powerful, direct, and fast. During the second-stage bidding process, the embattled government procurement team dug in, insisting that only one bidder was qualified to win. It was the minister, representing the organization stakeholder group, who called for a review of the benefits and relevance of the ERP system to change the mindset of all stakeholder groups. By the time the bid opening took place, the relevance review was completed, reaffirming the relevance of the FMIS project. The minister then announced to all senior officers (directors-general level) that the FMIS was critical to the ministry and should be implemented quickly, and the focus was to process the procurement. This was the catalytic need knowledge that was high powered, and moved fast and directly across the organization, enabling a knowledge-based action to complete the knowledge-flow loop.

The above discussion employed Nissen's 5D knowledge-flow model that espouses two archetypical knowledge flows to address the first prong of the research question by providing an explanation of how need knowledge flows across stakeholders in an organization over time. The explanation also addresses the second prong of the research question and merges two concepts identified in this case study: three need knowledge determinants—*intrinsic, extrinsic, and catalytic*—that enable knowledge flow and three obstructing conditions—*resistance, peripatetic workforce, and organizational ownership*—that hinder knowledge flow.

5.2. Limitations

The amount of data embedded in the project-related documentation and archival records, although mostly factual, stating "what happened" with minimal critical analysis on "why it happened," could have benefited from using some content-analysis software for more systematic and comprehensive data mining to better categorize factors that affected the flow of need knowledge across stakeholder groups. In this study, "why it happened" was mostly addressed by interviews based on individual memories almost a decade old, with details likely to be selectively edited or otherwise corrupted by more recent events. However, with the successful launching of the FMIS and smooth operation of the system since 2015, interviewees seemed to be open and able to be critical in discussing their individual and organizational weaknesses. Furthermore, the explication of the three enabling need knowledge determinants and three obstructing conditions was grounded in established research streams. These two research artifacts of enabling need knowledge determinants and obstructing conditions

can be considered analytic generalizations for knowledge-flow phenomena in an organization.

5.3. Future work

This case study introduces a framework to explain knowledge-flow dynamics using a multidimensional knowledge-flow model. Future work should focus on application aspects of the 5D knowledge flow, stakeholder dynamics, and associated need knowledge in the design of enterprise-wide initiatives. Given the lengthy procurements of most IFI-financed reform projects, future work could examine procurement as a profession, not unlike the audit profession discussed by Nguyen and Kohda [34]. Nguyen and Kohda introduced a 3-E model of wisdom determinants that encompassed the epistemic virtue, ethical virtue, and enabling virtue required in wise decision making in the audit profession. A procurement-evaluation process, accordingly, could be considered to explore the role of wisdom in judgment during the procurement-evaluation process and could potentially alleviate obstructing conditions. Furthermore, applying Kaiser's three-step theory wave to learn from an envisioned future as a prerequisite for any major enterprise-wide project could contribute to more sustainable transformative initiatives for organizations [35].

6. References

- [1] Davenport, T.H., and L. Prusak, *Working knowledge: How organizations manage what they know*, Harvard Business School Press, Boston, MA, 2000.
- [2] M.E. Nissen, "An extended model of knowledge-flow dynamics", *Communications of the Association for Information Systems*, vol. 8, 2002, pp. 251-266.
- [3] M.E. Nissen, "Dynamic knowledge patterns to inform design: A field study of knowledge stocks and flows in an extreme organization", *Journal of Management Information Systems*, vol. 22, no. 3, 2006, pp. 225-263.
- [4] M.E. Nissen, *Harnessing dynamic knowledge principles in the technology-driven world*, IRM Press, Hershey, PA, 2014.
- [5] I. Nonaka, I., "A dynamic theory of organizational knowledge creation", *Organization Science*, vol. 5, 1994, pp. 14-37.
- [6] Z. Pourzolfaghar, Z., R. Ibrahim, R. Abdullah, N.M. Adam, and A.A.A. Ali, "Improving dynamic knowledge movements with a knowledge-based framework during conceptual design of a green building project", *International Journal of Knowledge Management*, vol. 9, 2013, pp. 62-79.
- [7] Y. Kim, Y.S. Hau, S. Song, and G. Ghim, "Trailing organizational knowledge paths through social network lens: Integrating the multiple industry cases", *Journal of Knowledge Management*, vol. 18, 2013, pp. 38-51.
- [8] C. Lin, J. Wu, and H. Tsai, "A hybrid approach to knowledge flow", *Industrial Management & Data Systems*, vol. 113, 2013, pp. 628-646.

- [9] M.E. Nissen, *Harnessing knowledge dynamics: Principled organizational knowledge and learning*, IRM Press, Hershey, PA, 2006.
- [10] A. Kaiser, B. Fordinal, and F. Kragulj, "Creation of need knowledge in organizations: An abductive framework", in 47th Hawaii International Conference on System Science Proceedings, 2014, pp. 3499–3508, Institute of Electrical and Electronics Engineers Computer Society, Los Alamitos, CA.
- [11] M.E. Jennex, "Impacts from using knowledge: A longitudinal study from a nuclear power plant", *International Journal of Knowledge Management*, vol. 4, 2008, pp. 51–64.
- [12] P. Liu, "Empirical study on influence of critical success factors on ERP knowledge management on management performance in high-tech industries in Taiwan", *Expert Systems with Applications*, vol. 38, 2011, pp. 10696–10704
- [13] T.C. McGinnis and Z. Huang, "Rethinking ERP success: A new perspective from knowledge management and continuous improvement", *Information & Management*, vol. 44, 2007, pp. 626–634.
- [14] D.E. O'Leary, "Knowledge management across the enterprise resource planning systems life cycle", *International Journal of Accounting Information Systems*, vol. 3, 2002, pp. 99–110.
- [15] Y. Guo, Y. Feng, and C. Wang, "The impact mechanism of organizational culture on ERP assimilation: A multi-case study", in 47th Hawaii International Conference on System Science Proceedings, 2014, pp. 4044–4053, Institute of Electrical and Electronics Engineers Computer Society, Los Alamitos, CA.
- [16] M.C. Jones, M. Cline, and S. Ryan, "Exploring knowledge sharing in ERP implementation: An organizational culture framework", *Decision Support Systems*, vol. 41, 2006, pp. 411–434.
- [17] R. Palanisamy, "Organizational culture and knowledge management in ERP implementation: An empirical study", *The Journal of Computer Information Systems*, vol. 48, no. 2, 2008, pp. 100–120.
- [18] R. Vandaie, "The role of organizational knowledge management in successful ERP implementation projects", *Knowledge-Based Systems*, vol. 21, 2008, pp. 920–926.
- [19] E.T.G. Wang, C.C. Lin, J.J. Jiang, and G. Klein, "Improving enterprise resource planning (ERP) fit to organizational process through knowledge transfer", *International Journal of Information Management*, vol. 27, 2007, pp. 200–212.
- [20] M.A. Nour and S. Mouakket, "A classification framework of critical success factors for ERP systems implementation: A multi-stakeholder perspective", *International Journal of Enterprise Information Systems*, vol. 7, no. 1, 2011, pp. 56–71.
- [21] A. Serenko, and J. Dumay, "Citation classis published in knowledge management journals. Part I: articles and their characteristics", *Journal of Knowledge Management*, vol. 19, 2015, pp. 401–431.
- [22] A. Serenko, and J. Dumay, "Citation classis published in knowledge management journals. Part II: studying research trends and discovering the Goggle Scholar Effect", *Journal of Knowledge Management*, vol. 19, 2015, pp. 1335–1355.
- [23] A. Serenko, and J. Dumay, "Citation classis published in knowledge management journals. Part III: Author survey", *Journal of Knowledge Management*, vol. 21, 2017, pp. 330–354.
- [24] S. Macmillan, J. Steel, S. Austin, P. Kirby, and R. Spence, R. "Development and verification of a generic framework for conceptual design", *Design Studies*, vol. 22, 2001, pp. 169–191.
- [25] C. Dener, J.A. Watkins, and W.L. Dorotinsky, *Financial management information systems: 25 years of World Bank experience on what works and what doesn't*, The World Bank, Washington, DC, 2011.
- [26] P. Poon and Y.T. Yu, "Investigating ERP systems procurement practice: Hong Kong and Australian experiences", *Information and Software Technology*, vol. 52, 2010, pp. 1011–1022.
- [27] T. Negi, and V. Bansal, "A methodology to bridge information gap in ERP implementation life cycle", *International Journal of Enterprise Information Systems*, vol. 9, no. 2, 2013, pp. 70–82.
- [28] J. Dawson and J. Owens, "Critical success factors in the chartering phase: A case study of an ERP implementation", *International Journal of Enterprise Information Systems*, vol. 4, no. 3, 2008, pp. 9–24.
- [29] B. Hanisch, F. Lindner, A. Mueller, and A. Wald, "Knowledge management in project environments", *Journal of Knowledge Management*, vol. 13, no. 4, 2009, pp. 148–160.
- [30] R.K. Yin, *Case study research: Design and methods*, 5th ed., Sage, Thousand Oaks, CA, 2014.
- [31] L. Lo, "Understanding knowledge flow dynamics during the pre-implementation phase of an enterprise resource planning project", in 51st Hawaii International Conference on System Science Proceedings, 2018, pp. 4400–4409, Institute of Electrical and Electronics Engineers Computer Society, Los Alamitos, CA.
- [32] I. Nonaka, R. Toyama, and N. Konno, "SECI, *Ba* and leadership: A unified model of dynamic knowledge creation" *Long Range Planning*, vol. 33, 2000, pp. 5–34.
- [33] L. Nguyen, and Y. Kohda, "Toward a model of wisdom determinants in the auditing profession", in 50th Hawaii International Conference on System Science Proceedings, 2017, pp. 4604–4613, Institute of Electrical and Electronics Engineers Computer Society, Los Alamitos, CA.
- [34] A. Kaiser, "Towards a knowledge-based theory of developing sustainable visions: The theory wave", in 50th Hawaii International Conference on System Science Proceedings, 2017, pp. 4496–4504, Institute of Electrical and Electronics Engineers Computer Society, Los Alamitos, CA.
- [35] M. R. Hass, and M. T. Hansen, "When using knowledge can hurt performance: The value of organizational capabilities in a management consulting company", *Strategic Management Journal*, vol. 26, 2005, pp. 1–24.