A Survey of Knowledge Coordination Issues in Business Process Management

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In an era of knowledge economy, knowledge coordination has become an important topic for process-oriented management fields, such as project management and supply chain management. However, the concept of knowledge coordination has remained somewhat ambiguous. We first identify the elements of knowledge coordination. Then, we develop a theoretical framework analyzing knowledge coordination issues in business process management and investigating the interrelations among knowledge coordination mechanisms and coordination benefits/outcomes. The framework classifies knowledge coordination issues into three categories: administrative coordination issues, process coordination issues, and measurement issues of coordination effects, and proposes that knowledge process coordination mediates the positive relationship of knowledge administrative coordination with performance outcomes.

INTRODUCTION

A business process is a coordinated and logically sequenced set of work activities and associated resources that produces something of value to the customer (Hammer, 2014). In the era of knowledge economy, a business process in process-oriented management fields, such as project management and supply chain management, has a knowledge dimension (Davenport, 2014). That is, in the course of a work, which could be project-based, or organized along a supply chain, there are flows of knowledge among processors that use the knowledge to generate additional knowledge and / apply the Knowledge to produce goods and services for internal assimilation, for emission into the environment, or for both. Therefore, how to coordinate knowledge management in a business process has emerged as an important topic that deserves investigation (El Sawy and Josefek, 2003; Rosemann and vom Brocke, 2010).

Knowledge coordination involves the management of dependencies among process activities such that knowledge can be developed and leveraged in each and ultimately integrated across all (Massey et al., 2002). Coordination of knowledge processors and activities is a non-trivial task involving a variety of issues. However, the theoretical base for understanding knowledge coordination issues in business process management is still fragmented (Harmon, 2014; Van Wijk et al., 2008). A comprehensive understanding of these issues is needed to embody the knowledge base regarding the role of knowledge coordination in business process management.

Taking this opportunity, this paper explores the concept and dimensions of knowledge coordination in the course of developing a framework that describes major knowledge coordination issues confronting today's business process management. Researchers can use this framework in designing their studies of knowledge coordination, and practitioners can ponder on this framework as they strive for fresh insights into what it takes to realize effective knowledge coordination.

The remainder of this paper contains three sections. We start with a discussion of what knowledge coordination is. Then, we develop a framework to identify and categorize knowledge coordination issues in business process management. This paper concludes with a discussion of theoretical and practical contributions.

KNOWLEDGE COORDINATION

According to the theory of coordination (Malone and Crowston, 1994), coordination is defined as managing dependencies among activities. Holsapple and Whinston (1996) point out that coordination aims to harmonize activities in an organization by ensuring that proper resources are brought to bear at appropriate times and that they adequately relate to each other as activities unfold.

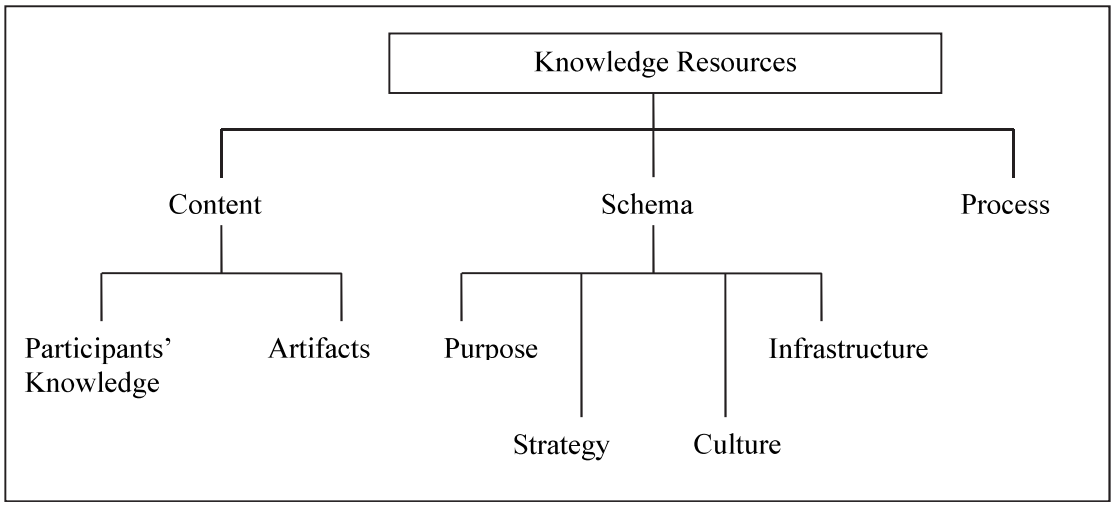
Built on the work of Malone and Crowston (1994) and Holsapple and Whinston (1996), Massey et al. (2002) define knowledge coordination as the management of dependencies among process activities such that knowledge can be developed and leveraged in each and ultimately integrated across all. This definition suggests that knowledge coordination involves three major components: knowledge resources, dependencies and knowledge coordination mechanisms. Dependencies arise from resources that are related to multiple activities. Knowledge coordination mechanisms are used to manage dependencies. Next, we discuss each component of knowledge coordination in details.

Knowledge resources. Holsapple and Joshi (2003) present knowledge resource taxonomy for classifying an organization's knowledge resources. However, this taxonomy takes a relatively static view on knowledge resources by considering knowledge more as object and capability, while the dynamic view on knowledge creation in a business process is not included. As shown in Figure 1, we extend their study by adding another component, namely process, to the original two components (i.e., schema and content knowledge resources), as the representation of the knowledge resources created in a dynamic business process.

Content resources are comprised of participants and artifacts. Participants include employees, customers, suppliers, partners, consultants and computer systems. A knowledge artifact is an object that conveys or holds usable representations of knowledge. Knowledge embodiment in an artifact can be explicit, tacit or implicit in nature. Common examples of knowledge artifacts are video training tapes, books, memos etc. The distinction between participants' knowledge and artifacts lies in the presence of absence of knowledge processing abilities. Participants have knowledge manipulation skills/competencies that allow them to process their own repositories of knowledge; artifacts have no such skills.

The taxonomy of Holsapple and Joshi (2003) identifies four schematic resources: culture, infrastructure, purpose and strategy. An organization's values, principals, norms, unwritten rules, and procedures comprise its cultural knowledge resource. Infrastructure is the knowledge that structures participants in terms of the roles that have been defined for participants to fill, the relationships among those roles, and regulations that govern the use of roles and relationships (Holsapple and Luo, 2002). Purpose is the schematic knowledge resource that defines an organization's reason for existence. It indicates an organization's mission, vision, objectives and goals. Strategy is the schematic knowledge resource that defines what to do to achieve organizational purpose in an effective manner.

FIGURE 1
TAXONOMY FOR KNOWLEDGE RESOURCES

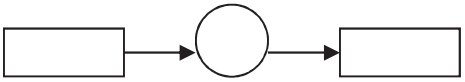
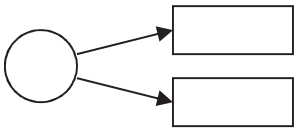
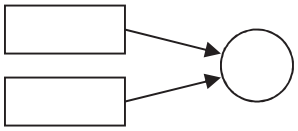
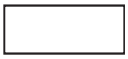


Process knowledge is context dependent, emerging from patterned interactions and practices in particular situations. This type of knowledge resource is emergent because answers or solutions are not prescribed but are generated through interactions (Faraj and Sproull, 2000). The classification of knowledge resources as content and scheme views knowledge as object and capability respectively. Knowledge as object is a static, repository-oriented view of knowledge that is easily contextualized, and it is seen as a pattern of information that produces insight. Knowledge as capability treats knowledge as a competence that is leveraged to execute processes. Knowledge as process is a view that centers on the creation and sharing of knowledge in a particular business process.

Activity dependencies in business processes. As shown in Table 1, there are three basic types of dependencies among activities: flow, sharing, and fit (Malone et al., 1999; Zlotkin, 1995).

Flow arises when one activity produces a resource that is used by another activity. Flow dependencies can be viewed as a combination of three kinds of constraints: prerequisites constraints (an item must be produced before it can be used), accessibility constraints (an item that is produced must be made available for use), and usability constraints (an item that is produced should be usable by the activity that uses it). Loosely speaking, managing these three types of constraints amounts to having the right thing (usability), in the right place (accessibility), at the right time (prerequisite). Sharing dependencies occur when multiple activities all use the same resource. Fit dependencies arise when multiple activities collectively produce a single resource. The three types of dependencies are elementary. Other dependencies can be the specializations or combinations of the three.

TABLE 1
ELEMENTARY DEPENDENCIES

Flow Prerequisite ("right time"), Accessibility ("right place"), Usability ("right thing")	
Sharing	
Fit	
Key:  Resource  Activity	

Knowledge coordination mechanisms. Some researchers have tried to classify major coordination mechanisms. The representative studies are summarized in Table 2.

As suggested by Table 2, the classification of coordination mechanisms can be based on resource types (e.g., tangible economic resource or intangible knowledge resource) (Faraj and sproull, 2000), task types (e.g., routine or non-routine tasks) (Gittell, 2002; March and Simon, 1958), or coordination goals (e.g., learning or adaptation) (Gosain et al., 2004).

In line with our definition of knowledge coordination indicates that the purpose of knowledge coordination is to use knowledge resources, generate knowledge and integrate knowledge across activities that depend on each other in a business process, we classify the mechanisms for knowledge coordination into the following two categories: knowledge administrative coordination and knowledge process coordination. By appropriately understanding knowledge resources needed and available for each activity involved in a business process, knowledge administrative coordination structures and controls processes to leverage knowledge resources. By managing activity dependencies (i.e., flow, sharing, and fit), knowledge process coordination generates and integrates knowledge across interrelated activities in a business process. This classification is also consistent with our conceptualization of knowledge resources, which combine both the static view (schema knowledge and content knowledge) and the dynamic view (the process knowledge).

TABLE 2
SUMMARY OF COORDINATION MECHANISMS IDENTIFIED IN THE LITERATURE

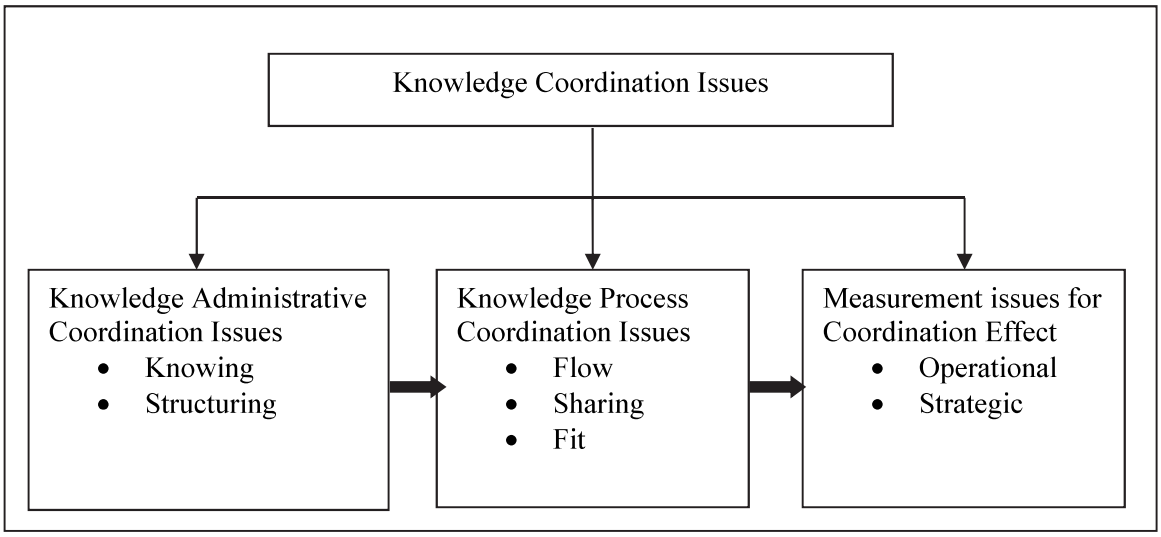
Research	Coordination mechanisms
March and Simon, 1958	1. Coordination by plan: coordination is achieved by pre-established schedules 2.Coordination by feedback: coordination is achieved by transmission of new information
Faraj and Sproull, 2000	1. Administrative coordination: the management of tangible and economic resource dependencies 2. Expertise coordination: the management of knowledge and skill dependencies
Gittell, 2002	1. Formal coordination mechanism: range from low bandwidth (work routines) to high bandwidth (boundary spanners and team meetings) 2. Relational coordination: coordination is facilitated by communication and relationships among participants
Gosain et al., 2004	1. Advance structuring: coordination is achieved by structuring information flows and interconnected processes 2. Dynamic adjustment: coordination is achieved through learning and adaptation

A FRAMEWORK OF KNOWLEDGE COORDINATION ISSUES

Over the past several decades, the economy has rapidly shifted from its traditional industrial base to a knowledge-based global economy. Knowledge coordination is imperative in process-oriented management fields, such as project management and supply chain management. In the field of project management, understanding how project teams effectively coordinate knowledge in business processes is a subject of growing importance (Ben-Menahem et al., 2016). For supply chain management, the coordination of knowledge about inventory status, logistic status, and production status is the elementary management practice, which leads to the achievement of operational benefits (Basu and Kumar, 2002; Lee et al., 1997). Recent studies have also shown that knowledge coordination contributes to agility and adaptability, which are dynamic capabilities required during supply chain process execution to meet emerging circumstances (e.g., Gosain et al., 2004; Handfield et al., 2015). Acknowledging the beneficial impact of knowledge coordination, based on our conceptualization of knowledge coordination, we develop a research framework to explore knowledge coordination issues in business process management, which advance new research topics for scholars to investigate and guide practitioners to achieve effective knowledge coordination.

As presented in Figure 2, this framework centers on the two primary knowledge- coordination mechanisms discussed in previous section, and the measurement of coordination effects in business process management. Knowledge administrative coordination issues and process coordination issues anchor on coordination execution, while measurement issues of coordination effects focus on the evaluation of coordination outcomes. Administrative coordination issues are classified into two categories: knowing, and structuring. Process coordination issues are identified in line with the three basic knowledge dependency patterns: flow, share and fit. Effect measurement issues involve both operational and strategic aspects. In addition, this framework depicts the linkages between coordination mechanisms and outcomes.

FIGURE 2
A FRAMEWORK FOR KNOWLEDGE COORDINATION ISSUES



Knowledge Administrative Coordination Issues

Knowledge administrative coordination is a re-planned coordination, a structuring coordination, aiming to harmonize activities that use available resources. It involves two dimensions: knowing and structuring.

Knowing. To manage dependencies, the organization must know the resources. Resource knowing is a function of (1) the extent an organization *understands* and *values* the resources, (2) the *accessibility* of the knowledge resources, and (3) the potential *costs* incurred in using that resource.

Understand. A baseline condition for turning to and using knowledge resources is awareness of their existence. The more an organization understands its knowledge resources, the more effective and efficient the organization knows how to use them in business processes management.

Value. With many options of knowledge resources, the organization must evaluate the knowledge resources in relation to the business process the organization is attempting to implement. The alignment or compatibility between different types of knowledge resources is another issue an organization must consider in valuing. For example, the decision to use customers' knowledge must be aligned with the business goal of the organization.

Access. The knowledge resource is helpful only if they are accessible. Because we rarely, if ever, make full informed decisions but rather satisfice (March and Simon, 1958), access alone may dictate whether and how knowledge resources are used. Three factors are associated with access issues: the use of advanced communications technology, the expending of personal relational energy, and culture (Borgatti and Cross, 2003).

Cost. There are costs involved in using knowledge resources. The extent to which an organization uses certain type of knowledge resource is a negative function of the costs that organization believes will incur. However, how to determine the cost of knowledge resources is a big issue facing the organization.

The case of Nortel networks (Massey et al., 2002) is a good example to illustrate our concept of knowing. From 1994 through 2000, Nortel Networks transformed itself from a technology-focused company to an opportunity-focused company by redesigning its new product development (NPD) process such that time to market was significantly reduced. By 2000, Nortel had become a profitable, innovative leader in the telecommunications industry.

In late 1994, to reengineer its NPD process, a task force comprised of representatives from engineering, business planning and marketing was formed. The initial task was to understand where its

idea resources originated. Nortel's existing NPD process at that time was customer-driven. Customer requests contributed to the extensions in functionality to existing products and services. However, after a survey of its employees to canvas for new ideas, Nortel found the internal pool of new ideas from employees was quite large.

Next, the task force evaluated if the use of employee knowledge resources could be aligned with the business strategy. The conclusion was that a completely customer-responsive approach to product development would not produce new product or service innovation with the move toward increased competition and industry deregulation.

However, Nortel didn't have a formal way in the existing process to capitalize on employee-generated ideas. Realizing that the utilization of its employees' knowledge assets would bring more benefits than costs, the executive sponsors issued a mandate to the task force to develop a knowledge management tool (an IS-based solution) to gain timely access to its employee knowledge resources.

Structuring. Organization design theory suggests coordination can be achieved through a formal coordination structuring, ranging from low bandwidth to high bandwidth (March and Simon, 1958). *Work routines* have low bandwidth, while *boundary spanners* and *team meetings* have high bandwidth (Gittell, 2002).

Work routines. Routines facilitate activity coordination by pre-specifying the tasks to be performed and the sequence to perform them. By using routines to codify best practices, local expertise can be transformed into organizational expertise, and therefore into potential sources of competitive advantage (Nelson & Winter, 1981). It is important for the organization to find the best way to structure the work routines in business processes.

For example, Gittell (1998) described how clinical pathways replaced protocols and became work routines for care provider groups in health settings. Before clinical pathways, routines in healthcare settings had long existed in the form of protocols, which varied from team to team. Clinical pathways combined protocols used by different members of the care provider team into a single document, outlining the tasks to be completed and decisions to be made by each function, and the sequence in which they are to be. Clinical pathways have been increasingly used for coordinating work processes in healthcare settings (Bohmer, 1998).

Boundary spanners. Boundary spanners are knowledge participants who know how to integrate work activities that cross functional boundaries. Project managers are a common form of boundary spanner in product development settings (Clark and Wheelwright, 1992). Knowledge management system is also a form of boundary spanner. In the Nortel case, an IS-based KM tool was developed to integrate the NPD processes.

In addition to the types of boundary spanners to use, how to evaluate the quality of boundary spanners is another issue. We propose that good boundary spanners should have deep coordination-related knowledge. According to Gosain et al. (2004), the construct of coordination-related knowledge consists of three dimensions: the knowledge of participants, memory of experience relevant to a given change situation, and the understanding of causal linkages between a change in the process and the effect it has on the outcome.

Team meeting. Team meetings give participants the opportunity to coordinate activities directly with one another. According to organization design theory, team meetings increase performance of interdependent work processes by facilitating interaction among participants and are increasingly effective under conditions of high uncertainty. Regarding team meeting, organizations need to address such issues as how to motivate participants to share in team meetings, who will be the attendants, the way to organize team meetings, and so on.

Knowledge Process Coordination Issues

As opposed to knowledge administrative coordination, which engages structured and prescribed mechanisms that either facilitate interaction among knowledge participants or reduce the need for it, knowledge process coordination represents the process of interaction itself, whose success is determined

by processors using, generating and integrating knowledge across activities. Knowledge process coordination consists of socially shared cognitive processes that develop and evolve to meet the demands of knowledge dependencies in the form of flow, sharing, and fit.

Flow. Flow refers to that the knowledge resource produced by an activity is used by another activity (Zlotkin, 1995). Flow has three constraints, prerequisite (*right time*), accessibility (*right place*) and usability (*right knowledge*). Releasing the hidden profile of knowledge processors behind activities, we view flow in knowledge process coordination as that a knowledge processor delivers the right knowledge produced or acquired by him to another processor in need (right place) at the right time.

Right time. It is not sufficient to acquire or produce the right knowledge and deliver it to where it is needed; Knowledge processors need to develop ways by which knowledge is brought to bear on the problem in a timely manner.

Right place. Knowledge processors can recognize when and where certain knowledge is needed. If knowledge processors cannot recognize the need for knowledge resources for a specific task/activity, then it might not be brought to bear even though it might be available.

Right knowledge. Knowledge processors can either acquire the knowledge from where it is located or produce the knowledge needed. Either way, knowledge processors need to deliver the right knowledge to the recipient. To guarantee the knowledge is 'right', knowledge processors should govern the quality of his piece of knowledge. Knowledge quality has two dimensions: knowledge validity and knowledge utility (Holsapple and Whinston, 1996). Validity is concerned with accuracy, consistency and certainty, while utility is concerned with clarity, meaning, relevance and importance.

Knowledge processors can use transactive memory to coordinate knowledge flow. A transactive memory exists when people in close relationships use other people as memory storage locations (Wegner, 1995), meaning that people can rely on others to process and encode knowledge that is related to their area of expertise and deliver to them at the right time. The development of transactive memory has been shown to lead to higher work group performance (Liang et al., 1995; Moreland et al., 1999). There is some evidence in the literature showing that the use of transactive memory also to group levels, such as project teams and supply chain partners. For example, in a case described by Subramani (2004), a supplier of a manufacturer for women's clothing is used by its retailer as the transactive memory for knowledge regarding customer tastes as well as product and market characteristics. As a result, the retailer reduced the level of markdowns, improved their margins on the product line, and reinforced the high-end image of the supplier's products.

Based on the above discussion, two major issues regarding knowledge coordination for flow process arise: (1) How to help knowledge processors to acquire or produce the right knowledge, to know where it is needed, and to bring it to place at the right time? (2) How to develop transactive memory systems among knowledge processors in a business process? Some studies have investigated the linkage between training and the development of transactive memory systems (Liang et al., 1995; Moreland et al., 1998). What are other drivers for transactive memory systems?

Sharing and fit. Sharing occurs when multiple knowledge processors share the same knowledge resources. Fit arises when multiple knowledge participants collectively produce a single knowledge resource. *Communication* and *shared goals* among knowledge participants are critical to achieve effective sharing and fit. Knowledge participants need communicate with each other in a frequent, accurate, timeliness and problem-solving way to determine how to allocate resources among each other or how to integrate own piece of work together. Shared goal encourages knowledge participants to value the contribution of others, to consider avoiding dysfunctional conflicts in resource sharing, and to act with respect to the overall fitting process.

The coordination of knowledge dependencies in the form of sharing and fit enacts a "collective mind". Weik and Roberts (1993) propose that collective mind begins with individual know-how and actions, emerges from the ongoing activity stream and is manifested by the process of heedful interrelating. Knowledge processors come to understand how their individual knowledge and activities

influence each other and link together through communicating and goal congruence forming. Then they can respond as a complete system to meet situational demands even though the complexity of the task is beyond the cognitive capabilities of individual participant.

Use the example in the study of Subramani (2004) to illustrate coordination for sharing and fit. The retailer shared its sales and return reports with the supplier through frequent, accurate, and timeliness communication so that the supplier could customize its designs according to customer tastes in different regions. The shared goal of enhancing supply chain performance enabled them to work together to create region-level profiles and even store-level merchandise forecasts for their products.

The share and fit process coordination incurs two major issues for organizations: (1) How to enhance the communication among knowledge processors? (2) How to facilitate goal congruence among knowledge processors?

Measurement Issues for Knowledge Coordination Effect

For knowledge coordination to become a recognized value contributor, methods for measuring the effect of knowledge coordination must be developed to promote accountability. However, measuring the effect of knowledge coordination is currently not an established management practices (Conway, 2003; Kanawattanachai and Yoo, 2007).

Many studies have devoted to investigating the value of knowledge coordination, including qualitative and quantitative methods. However, these studies share something in common, that is, they view knowledge coordination effect either from operational level or from strategic level. To date, few studies have examined the combined operational and strategic benefits of knowledge coordination.

Operational benefits. Benefits at the operational level come from gains of operation efficiency, such as lowered transaction and production costs, which are achieved through knowledge coordination across activities. Since different business processes have different operation efficiency gains, organizations need to find proper metrics to measure the effect of knowledge coordination on operation efficiency for each particular process.

Strategic benefits. Benefits at this level are created through organizations' positioning themselves to take advantage of opportunities arising in new markets, such as new products and services (which come from understanding the competition and market needs), new processes to make, assemble or deliver products and services (process innovation), new ways to organize in making, assembling, or delivering products (organizational innovation) (Malhotra et al., 2005), a richer understanding of the partner and nuances of the exchange, and the ability to recognize and respond to changes in the relationship. Again, the major issue facing an organization here is to choose the proper metrics to use.

All the issues discussed above are summarized in Table 3. Each issue can be a topic for both researcher and practitioners to address.

TABLE 3
KNOWLEDGE COORDINATION ISSUES IN BUSINESS PROCESS MANAGEMENT

Categories	Issue Examples
Knowledge administrative coordination issues	
Knowing	
Understand	What knowledge resources do we (as an organization) have?
	What knowledge resources are needed for a particular business process?
Value	How do we evaluate the compatibility among different types of knowledge resources?
Access	How do we gain access to needed knowledge resources? Through IS, social network, culture influence, or other channels?
Cost	How to determine the cost of knowledge resources?
Structuring	
Work routines	How to find the best way to structure the work routines in business processes?
Boundary spanners	How to use boundary spanners? (e.g., how to balance the usage of different types of boundary spanners? For example, the interaction between IS-based boundary spanner and people-based boundary spanner?)
	How to evaluate the quality of boundary spanners?
Team meeting	How to motivate participants to share knowledge in team meetings?
	What is the best way to organize team meetings? (e.g., virtual meeting?)
Knowledge process coordination issues	
Flow	How to help the right knowledge processors to acquire or produce the right knowledge, know where it is needed and bring it to the right place at the right time?
	How to develop transactive memory systems among knowledge processors in a business process?
Share	How can organizations enhance frequent, accurate, timeliness and problem-solving communication among knowledge processors?
Fit	How can organizations facilitate goal congruence among knowledge processors?
Knowledge coordination effect evaluation issues	
Operational effects	How to choose the proper metrics to measure the effect of knowledge coordination on operational gains?
Strategic effects	How to choose the proper metrics to measure the effect of knowledge coordination on strategic gains?

Linkage between Knowledge Coordination Mechanisms and Outcomes

A review of the literature suggests that there have been very few studies on how different knowledge coordination mechanisms work together to enhance performance outcomes in business process management. In addition, much of the current research related to knowledge coordination has greatly focused on the effect of knowledge administrative coordination mechanisms, such as the development of standardized routines, and the use of boundary spanners (e.g., IT), and team meetings (e.g., Argote and Spektor, 2011; Gosain et al., 2004; Malhotra et al., 2005). Although formal administrative coordination mechanisms structure and initiate knowledge coordination, knowledge processers and the dynamics in the process influence how well organizations can leverage knowledge coordination to obtain benefits (Ben-Manaham et al., 2016; Faraj and Sproull, 2000; Massey et al., 2002). Specifically, while knowledge administrative mechanisms provide a formal structure for organizations or teams to coordinate knowledge

dependencies, these approaches often fall short if knowledge processors don't follow or if emergent processes occur.

In previous section, two types of knowledge coordination mechanisms are distinguished, which are knowledge administrative coordination and knowledge process coordination. The former emphasizes the role of formal organizational design, while the latter focuses on the dynamics in a particular process. The mediating effect of knowledge process coordination on the linkage between knowledge administration coordination and performance outcomes has only been suggested indirectly in some prior studies. For example, Gittell (2002) proposes that formal coordination mechanisms improve performance in care provider groups through relational coordination, which focuses on the communication mechanism in process coordination. Faraj and Sproull (2000) present empirical evidence that expertise coordination, a team-process oriented coordination, improved performance of software development teams, by controlling the effect of administrative coordination.

In line with previous discussion on the distinct functions of knowledge administrative coordination and knowledge process coordination, our research framework on coordination issues shows that the knowledge process coordination mediates the effect of knowledge administrative coordination on the performance outcomes of business process management. We suggest four propositions describing how organizations obtain benefits through different type of knowledge coordination in business process management:

Proposition 1*:* Knowledge administrative coordination exerts a positive influence on knowledge process coordination.

Proposition 2*:* Knowledge administrative coordination exerts a positive influence on the performance of business process management.

Proposition 3*:* Knowledge process coordination exerts a positive influence on the performance of business process management.

Proposition 4*:* Knowledge process coordination mediates the positive relationship of knowledge administrative coordination with the performance of business process management.

CONCLUSION

To be successful in a knowledge-based global economy, organizations must effectively coordinate knowledge management in and across business processes. Fundamental to this achievement is the recognition of the components of knowledge coordination. Much has been done on attributes of coordination. However, knowledge coordination as a distinct concept has remained somewhat ambiguous. In addition to the key elements of knowledge coordination, it has remained unclear how different knowledge coordination mechanism are linked to each other in a business process, and linked to performance outcomes. These issues underlying knowledge coordination form an appropriate area to research, as today's organization try to improve knowledge coordination in their business process management in the interest of greater competitiveness.

This study begins to identify key elements of knowledge coordination. Built on our new conceptualization of knowledge coordination, this study develops a research framework, analyzing knowledge coordination issues in business process management, and describing the interrelations among knowledge coordination mechanisms and coordination benefits/outcomes. We hope that this framework will stimulate future research on knowledge coordination. Further research on addressing these issues will greatly enrich our understanding of knowledge coordination in business process management.

This study makes several important theoretical contributions. First, our conceptualization of knowledge coordination can be applied to any process management setting. It sharpens researchers' understanding of parameters of knowledge coordination, answers research calls on how knowledge as a process emerges from and is affected by knowledge-based activity dependencies (Davenport, 2014; Markus et al., 2002; Massey et al., 2002). Second, Figure 2 provides a research framework on knowledge coordination issues. Table 3 presents a list of research topics centered on these issues. Researchers can use this list to find future research directions. Third, this framework establishes a new research platform

to investigate how firms achieve benefits in business process management via knowledge coordination. In this study, we advance four propositions for this research framework. Empirical research is needed to attain deeper insights into the four propositions in various business process management settings.

This study also has implications for practitioners. First, this study provides managers with rich insights regarding how to guide knowledge coordination in business process management. The research framework on knowledge coordination issues can function as a checklist for managers to evaluate coordination tasks in project management or supply chain management. Second, this study suggests that, beyond administrative coordination features, managers or designers (e.g., software developers) for workflow management systems or knowledge management systems should strengthen the design on process coordination functions, which facilitate social interactions among knowledge workers.

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