



# Stocks and flows underlying organizations' knowledge management capability: Synergistic versus contingent complementarities over time

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## ABSTRACT

What are the components of a knowledge management (KM) capability and how do they impact firm performance? Based on prior research, we modeled a firm's KM capability in terms of its accumulations of stock – in the areas of human resources, technology infrastructures, and strategic templates – and regulation of flow, via institutionalization and internal and external learning processes. We then considered the extent to which these components complement one another in their impact on two types of firm performance – efficiency, based return on assets, and value creation, assessed as Tobin's  $q$  (the ratio of the capital market value of the firm to the replacement value of its assets). We posited differential types of stock-flow complementarities across these two performance outcomes over time – stable, positive effects on firm efficiency, *synergistic complementarity*, and initially positive, but subsequently negative effects on value creation, *contingent complementarity*. Data gathered from 218 Korean firms supported this premise. Implications for practice in the evolving fields of organizational capability and complementarities were explored.

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## 1. Introduction

Understanding a firm's knowledge management (KM) capability is essential to both efficient deployment of the firm's resources and growth of its value. Research has described components of a KM capability and demonstrated its impacts on firm performance [16]. However, a holistic picture of the structure and impacts of a KM capability has yet to emerge. How do components of a KM capability influence firm performance? Does the nature of the interaction differ for different aspects of firm performance? Do these effects change over time? These were the focal questions we addressed.

We consider the interaction among KM capability components through the lens of complementarity: this recognizes that valorization of activities in one realm is a function of commensurate activities – investments and/or supporting decisions – in other realms. Complementarity is the patterning of design elements that individually confer no, or limited, organizational advantage. Further, the inimitability of capabilities derives from complemen-

tarities. Competitive advantage occurs when the organization applies methods that are valuable to users but are difficult for others to duplicate. While complementarities have been visible in myriad areas [15], they have not been explored in the context of firms' KM capabilities.

A lifecycle perspective of organizational capabilities suggests that capabilities are seldom valuable indefinitely [9]. Work by Gilbert [8] suggests that complementarity may be one mechanism by which capabilities decline over time. Specifically, the coupling inherent in complementarities makes it difficult to change them. In designing organizations and organizational capabilities, Argote et al. [2] suggested that "research is needed to identify dimensions of fit and to specify a priori *when* components fit each other and *when* they do not".

We began our work by re-conceptualizing a KM capability in terms of firms' accumulation of knowledge stocks and their management of knowledge flow. We conceptualize two forms of complementarity and consider the way in which the age of a KM capability determines which complementarity is relevant to the capability and performance relationship, specifically examining two disparate aspects of firm performance – efficiency and value creation.

Impacts of a KM capability on organizational performance were then empirically tested using data from 218 Korean firms that had implemented enterprise-wide KM systems. KM became important to Korean organizations after the foreign exchange crisis, which

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caused many to suggest that a national knowledge economy was needed. Before the crisis, the market capitalization ratio in Korean firms was 75% for tangible and 25% for intangible assets; in the knowledge economy that emerged following the crisis, this allocation was reversed, with 75% normally being allotted to intangible assets and 25% to tangible resources. This national-level attention to KM ensured that KM capabilities were considered by a firm despite variations in the KM capabilities across firms.

## 2. Conceptualizing the KM capability

A KM capability is defined here as *an organization's ability to accumulate critical knowledge resources and manage their assimilation and exploitation*. This is consistent with the analysis of economic systems in terms of stocks, i.e., levels of accumulated resources, and flows, i.e., speed with which those resources are used.

### 2.1. Accumulation of knowledge stocks

A stock is a strategic asset that increases performance and affects the organization's ability to accumulate additional stocks. Knowledge stocks have been considered "reservoirs" of knowledge available for re-use, which often entails moving knowledge from one unit to another. Thus, being appropriated is a key requirement of stocks. Three organizational assets or stocks are typically identified: people or human resources, tools or technologies, and strategic templates. These are organization-specific and accumulated over time, not simply acquired.

*Human Resources.* Individuals store organizational memory using their brains, causal maps, assumptions, values, and beliefs. They store both codified and tacit knowledge. Critical elements of firm knowledge often exist only in pockets within the organization and transferring the knowledge is essential to effective organizational functioning. Knowledge transfer may result from cross-functional teams, electronic repository-based knowledge sharing, or even business units "lending" staff members to one another to help them solve a problem.

*Technology Infrastructure.* Business rules may be developed by the employees and must be encoded and stored, transferred to new employees, used to constrain employees by limiting their possible actions, or even take the place of employees by performing pre-defined tasks. For example, database interfaces and data entry screens and reports provide knowledge about how business transactions are to be conducted. Technology infrastructure also provides a vehicle for knowledge sharing through electronic forums and knowledge repositories.

*Strategic Templates.* These assert the organizational goals, as well as specifications of how they are to be attained, including routines for transforming inputs into outputs and roles designating job descriptions and behavioral patterns between individuals. They are a stock or asset because they operate as guiding principles by virtue of the knowledge embedded in them [5]. For example, Intel's Copy Exactly and AMD's Copy Intelligently programs help to transfer best practices from one manufacturing unit to others, thereby enhancing quality and consistency of the outputs.

### 2.2. Regulation of knowledge flows

Knowledge flows are processes for acquiring, transferring, and leveraging knowledge [13]. Here, regulation of flows involves rules governing KM in general and the processes for acquiring, modifying, and utilizing knowledge stocks. For example, the expectation that employees work collaboratively should aid in the deployment and replenishment of knowledge stocks. Expectations of and support for individual learning and knowledge transfer can

aid in ensuring flows necessary to accumulate stock. In contrast, a punitive culture or competitive rules may preclude knowledge transfer and reuse by making employees afraid to share knowledge for fear of failure or status loss [12]. We therefore view regulation of knowledge flows as necessary for effective implementation of KM and both internal and external learning.

*Institutionalization.* Institutions can provide a KM environment that rapidly socializes new employees into their culture. This occurs through informal socialization by peers as well as through formal activities instituted by management.

*Internal learning processes* are critical for acquiring knowledge and converting personal knowledge to organizational knowledge. They involve knowledge acquisition, distribution, retention, and interpretation. *Acquisition* exposes employees to activities or environments that change rapidly, requiring learning. While tacit knowledge can be shared, it tends to be a difficult process to implement. *Distribution* of new knowledge is thus facilitated by *codification*, which facilitates knowledge *retention* in the firm. *Interpretation* is facilitated by a knowledge adapter or broker, who assists prospective re-users in using the knowledge [11].

*External learning processes* are critical to organizations when adapting to crises. External sources introduce more heterogeneous and dynamic knowledge than do internal ones. These occur through external relationships, which provide diverse knowledge. New knowledge may be created by combining internal and external knowledge.

## 3. Capability as complementarity

Complementarity involves the coordination of investments in different areas in order to optimize returns on each investment. This requires the components to have reciprocal positive effects on one another. The consequence of this is that the value of one activity increases with an increase in the level of the other.

Organizational capabilities and complementarities intersect in two ways. First, organizational capabilities necessarily entail complementarities because of the pattern of activities they represent. Second, by virtue of their interdependence, they become a source of competitive advantage.

### 3.1. Forms of complementarities

There are two types of complementarities. The first is a *synergistic* form where each activity has non-negative consequences (either none or positive consequences). The consequences that accrue from undertaking both activities exceed the sum of those that accrue from each independently. An example of this complementarity is Song et al.'s [14] finding that the effect of marketing and technological capabilities was amplified when they occurred in turbulent environments.

The second is a *contingent* form, where an organization is unable to elicit value from one activity without also undertaking another. In fact, undertaking one activity without the other may actually worsen performance. This has been noted in several studies, such as Sirmon and Hitt's finding of the negative effects when firms' capital investment did not match their resource deployment and the positive effects when there was a match between these activities as well as Tanriverdi and Lee's finding of negative effects of implementing either market-related or platform-related diversification, but not both. Statistically, while main effects may be possible in the presence of synergistic complementarities, they are not possible in the presence of contingent complementarities as the combined absence of activities would be preferable to their individual deployment. Consequently, the interaction will appear non-intersecting for synergistic complementarities and intersecting or X-shaped for contingent complementarities.

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