A recent study proposed a learning-based technology strategy with three dimensions – proactive technology posture, process adaptation and experimentation, and collaborative technology sourcing. The study investigated the three dimension's relationships with plant competitiveness (cost, quality, delivery, flexibility, and innovation).

The results showed that although the three dimensions are not individually related to plant competitiveness (direct effects perspective), their co-alignment impacts strongly on plant competitiveness (co-alignment perspective). Furthermore, this co-alignment creates an environment in which employee suggestion and feedback can add innovation, leading to superior plant competitiveness (mediation perspective).

Over the years, researchers and practitioners have argued that technology can play an important role in gaining competitive advantage. However, despite superior technology, organizations may fail to compete successfully in the marketplace. This is particularly true if organizations take a tactical rather than a strategic view of managing their technology. More importantly, we propose that organizations need to finesse their technology strategies that foster continuous learning in order to fully exploit their potential to gain competitive advantage.

Learning-based technology strategy and competitiveness

There are two dominant perspectives on connections between competitive and technology strategies. The first perspective presents a view of a company's technology choice jointly determined by its competitive strategy and internal capabilities. The second perspective views technology as a subset of resources that a company can use to attain competitive advantage. There is an argument that both perspectives are static, and a third perspective is presented. It posits that technology and strategy variables influence each other continuously, and both variables should embody an element of prospecting to pave the way for novel development to evolve. One aspect of technology strategy should be to explore and proactively seek manufacturing capabilities in advance of needs and to anticipate the potential of new manufacturing technologies. A company's technology strategy should reflect its proactive technology posture (PTP) which involves constantly exploring for innovation in process technology and commitment to continuously advancing its manufacturing technology.

Technology strategy involves long-term plans for acquiring, managing, and exploiting technological knowledge and ability to attain competitive advantage. There is the need for learning by doing on the shop floor manufacturing technologies in order to achieve continuous process improvement.

Exploitation of technology entails continued experimentation with existing process technologies so that companies can make further improvements. The knowledge created in the process becomes valuable input in developing technology strategy in the future.

As competition has increased, a firm's technology sourcing strategy has become ever more critical to its performance. A plant can source its technology internally or externally. While sourcing all technologies internally increases a firm's risk, including obsolescence, relying completely on external technology sources can lead to competitive disadvantage due to the inability to foster innovation internally. Thus, extreme positions along the
internal-external technology-sourcing continuum may minimize a plant's potential to be competitive in the marketplace.

Balancing internal and external technology sourcing can have positive implications for performance because this balance allows a firm to leverage its core competency and incorporate innovations from external sources. Collaborative technology sourcing (CTS), when a plant works closely with external technology sources to develop new process technology, provides such a balance. For this reason, developing technology in collaboration has become an important component of technology strategy.

We define learning-based technology strategy (TECHSTR) as a long-term vision for managing technology that sets a pattern of consistent decision making to foster creation and exploitation of knowledge to attain superior competitiveness. We conceptualize TECHSTR along three dimensions: PTP, process adaptation and experimentation (PAE), and CTS.

The exploration-exploitation framework of organizational learning can help understand the relationship between a firm's technology sourcing and its performance. TECHSTR allows for both the exploration and the exploitation of process technology. Absorptive capacity is the ability of a firm to identify and value the potential of new knowledge from external sources and assimilate and integrate the new knowledge into the firm's existing knowledgebase. The learning-based technology strategy builds and enhances a plant's absorptive capacity through continual exploration and exploitation of its process technology.

Proactive technology posture (PTP)

A static strategy is of limited use since any resulting competitive advantage will be short lived, especially for technology strategy. Organizations that select manufacturing technologies by only accounting for current contexts and without much regard to future needs will be defeated by the competition. Therefore, organizations' technology strategies need to be dynamic.

Process adaptation and experimentation (PAE)

A misalignment can occur when a new process technology is introduced to existing technologies and/or work systems. This disruptive phase provides an opportunity for adaptation, improvement, and learning. Experimentation during and after this adaptation phase not only helps resolve the current misalignment but the accumulated knowledge also provides new insights into how the entire process can be improved. Such experimentation also helps identify requisite organizational and skills changes for effective adaptation.

Collaborative technology sourcing (CTS)

From time to time, organizations need to acquire new process technologies. Competitive pressure or strategic intent drives such initiatives and involves major capital outlay. Any wrong decisions can have tremendous impact on the organization's survival. These acquisitions also present opportunities to influence development of the new technologies based on the organization's accumulated process knowledge. Such a collaborative effort in sourcing technologies can create competitive advantage. For this reason, firms are increasingly managing technology partnerships as an integrated element of their technology strategy.

Synergy amongst the three dimensions

The dimensions of learning-based technology strategy are mutually reinforcing. For example, an organization with a PTP is in constant search of next generation process capabilities. PAE allows that organization to continuously learn through experimentation and identify capabilities needed in the future. A broad range of experimentation also helps that organization recognize new technological possibilities. CTS allows the organization to
work with technology suppliers to incorporate knowledge to achieve process capabilities it identified during experimentation. Working together, these dimensions coalesce and enhance an organization's competitiveness more than any one of the dimensions in isolation.

The role of employee suggestion and feedback (ESF)

Companies use a huge amount of resource to analyse and refine technology strategies but they do not pay sufficient attention to harnessing the human resources needed to realize the goals of these strategies. This is surprising given that an organization's attempt to create and retain process knowledge cannot be successful without employees' active involvement. The employees' keen observations help identify idiosyncratic behaviours of a production system. The accumulation of such observations leads to tacit knowledge that is hard to emulate and, hence, can be a source of competitive advantage. To take full advantage of this phenomenon, an organization needs to create an atmosphere in which employees are encouraged to make improvement suggestions. To gain the confidence of the employees, management has to show that it values all suggestions and takes them seriously. They can do this by implementing those suggestions that have the potential to improve process technology and by explaining why other suggestions are not implemented.

Without proper encouragement or the right environment, employees will avoid making suggestions, resulting in the loss of many potential learning opportunities. Consequently, the organization will fail to exploit employees' tacit knowledge to gain competitive advantage. The learning-based technology strategy described above creates an environment in which employees' suggestions are channelled to identify and accumulate process knowledge. Thus, learning-based technology strategy facilitates the link between employee suggestions and competitiveness.

The theoretical frameworks

Working together, the three dimensions of learning-based technology strategy foster both tacit and explicit knowledge that is valuable and hard to imitate, which leads to superior organizational competitiveness. Additionally, from the dynamic capabilities perspective, learning-based technology strategy and employee involvement (employee suggestions and feedback) enable an organization to integrate, build, and reconfigure socio-technical competencies to address rapidly changing environments and enhance organizational competitiveness.

Implications

The findings of our study emphasize the need for a systems approach to developing learning-based technology strategy. From a socio-technical systems viewpoint, learning-based technology strategy provides a platform on which technology, existing expertise, and work procedures undergo mutual adaptation to achieve a fit between the technical sub-system and the social sub-system. Such a fit yields shared understanding and knowledge that is socially constructed and embedded within the organization. The three dimensions of learning-based technology strategy, when implemented together, foster synergy, leading to superior competitiveness, because other organizations have difficulty emulating such a socio-technical system. Many plants take a piecemeal approach and develop some aspects of learning-based technology strategy while paying little or no attention to the rest. As the findings of the study show, such an approach will contribute very little to achieving competitive advantage in the marketplace.

Employees are reservoirs of process knowledge. Knowledge accumulation cannot happen without their active participation. However, management has to create a proper environment to foster employee involvement and idea exchange. The learning-based technology strategy provides a conducive environment in which employees can share, suggest, and experiment with their ideas for process improvement that ultimately leads to enhanced plant competitiveness. Support for the mediation perspective highlights the importance of learning-based technology strategy (TECHSTR) in the context of ESF.
Employees gather knowledge as they interact with each other in a social context (such as a production environment). This knowledge and understanding impacts on employees’ behaviours, perceptions, interpretations, and cognitions, which help them to innovate, generating both tacit and explicit knowledge. This aspect of learning-based technology strategy (TECHSTR) provides knowledge ambiguity, asset specificity, complexity, and inimitability leading to superior competitiveness, as predicted by the resource-based view.

Based on manufacturing plants, our study indicated that the management of technology has significant implications for competitiveness. More specifically, a plant with PTPs is expected to achieve superior competitiveness if it is able to foster an environment in which learning can take place during PAE. The resulting knowledge can then be utilized strategically in technology sourcing decisions. A piecemeal approach to technology management is ineffective. This has an important implication for practice as many organizations pursue only parts of learning-based technology strategy and consequently fail to increase their competitiveness.

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