Understanding the Choice and Impact of Resources on Firm Innovation: A Managerial Cognition Perspective

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ABSTRACT: We develop a theoretical model which links managerial cognition, resource choice, and innovation. A cognitive perspective puts managers back into innovation strategy and adds important theoretical understanding to innovation as a firm-level outcome. Examining the role of managerial cognition in the choice of resource for innovation, we propose that (1) a combined use of internal and external resources will increase innovation, (2) CEO’s cognitive style of global dominance will affect the combined use of resources, and (3) CEO’s cognitive style of complexity will moderate the impact of the combined use of resources on innovation. To inform future research direction, we discuss measurement and analysis approaches for empirical testing of the model.

Keywords: managerial cognition, resources, innovation

Innovation in business refers to the development and adoption of a product, an idea, or a behavior that is new to a firm (Hage, 1999). Traditionally, organizations attempt to develop resources internally to drive innovation. Resources are assets and capabilities that firms use to formulate and implement business strategies to generate competitive advantage (Barney, 1991). However, organizations have been increasing their reliance on external resources to complement their internal resources based on unique relational advantages that external resources generate (Dyer & Singh, 1998). Effects of internal and external resources on innovation have been examined as separate (Caloghirou, Kastelli, & Tsakanikas, 2004; Frenz & Ietto-Gillies, 2009; Takeishi, 2001; Wu, Wang, Chen, & Pan, 2008) and interactive (Cassiman & Veugelers, 2006; Hoang & Rothaermel, 2010; Laursen & Salter, 2006; Wuyts & Dutta, forthcoming).

While the literature on resources and innovation has provided us with a good understanding on how internal or external resources separately and interactively foster innovation, three issues remain unclear. First, would combining internal and external resources improve innovation? Potentially utilization of both internal and external resources provides superior opportunities compared to the separate and interactive impact of these resources. Second, why some firms choose to combine internal and external resources but
some firms do not? While we know that some industries, such as biotechnological and telecommunication, favor combining both internal and external resources (Joshi, Kashlak, & Sherman, 1998; Røthaermel & Deeds, 2004), our understanding on the firm level is less clear. Third, why are combining internal and external resources not always effective in creating innovation? Such a question suggests a missing contingent variable between resources and innovation outcomes. It is important to examine these issues because the way a firm manages resources is an important factor related to its performance and survival. To answer these questions, we need to understand what influences a firm to adopt a certain combination of external and internal resources.

A combined use of resources refers to the total sum of external and internal resources, and is a conscious strategic decision made by top managers. As managers make decision based on how they scan, interpret, and respond to information, we contend that we will be able to better understand this decision if managerial cognition is considered. Managerial cognition refers to the mental maps managers use in receiving, organizing, processing, and retrieving sensory input from the external world (Mitchell et al., 2002). In a review of cognitive research in strategy, Eggers and Kaplan (2013) suggest that capability and cognition approaches are parallel streams of research but do not intersect. While both attempt to deal with the match between organization and environment, capability research problematizes the organization, and cognition research problematizes the environment. Current research has largely examined the use of resources based on a capability approach. Since cognition plays an important role in capability development and deployment in response to the environment (Eggers & Kaplan, 2013), managerial cognition may address the research issues outlined above. A cognitive perspective on innovation will refocus research attention on scanning, information exchange, and absorptive capacity of managers and organizations (Mumford, Hunter, & Byrne, 2009).

In this study, we argue that the cognitive style of a firm’s top managers influences both the decision and impact of resource choice on innovation outcomes, focusing on the Chief Executive Officer (CEO) of a firm. To include managerial cognition in a model of how resources influence innovation, this study first proposes a link between cognition and innovation, and specifically investigates whether a combined use
of internal and external resources might be a cardinal firm-level decision based on CEOs having a
cognitive style of global dominance. This study also proposes a contingent relationship between resource
choice and innovation, and specifically examines whether CEOs with a cognitively complex style
moderates the impact of resource choice on innovation. In doing so, we integrate the important cognitive
approach into the extant capability model of innovation. We discuss some methodological considerations
to test this model at the end of the paper.

CONCEPTUAL FRAMEWORK

A Managerial Cognition Perspective

Cognition refers to how human acquire, store, and retrieve information from their memory (Walsh,
1995: 281). In an early review, Stubbart (1989) explored the linkage between cognitive science and
strategic management. He identified categorization, semantic networks and expert systems as three
research topics in managerial cognition that could inform strategic management. In another review on
managerial cognition research, Walsh (1995) suggested that cognitive psychologists have largely focused
on how to measure knowledge structure and how knowledge structure affects information processing.
Management researchers have been able to build on this foundation to investigate how knowledge
structure and information processing affect managerial decisions.

A cognitive perspective puts managers back into a model of firm strategy (Fiol & Huff, 1992;
Kaplan, 2011; Walsh, 1995). Managers employ knowledge structure or schema to navigate a bewildering
flow of information to facilitate information processing and decision making. Knowledge structure is a
mental template consisting of organized knowledge about an information environment that enables
interpretation and action in that environment (Walsh, 1995). The knowledge structure of the manager
results in a selective perception based on what is understood to be important, and influences beliefs about
what should be done. There has been growing recognition of cognition in management issues. Important
information possessing consequences of cognition in organizations that have been studied include;
performance appraisal (DeNisi, Cafferty, & Meglino, 1984), power (Krackhardt, 1990) and choice of
strategy (Fiol, 1989; Ginsberg, 1994). Some recent reviews on cognitive research in strategy, management, and innovation attested to the important role of cognition on strategy and innovation (Eggers & Kaplan, 2013; Kaplan, 2011; Narayanan, Zane, & Kemmerer, 2011; Reiter-Palmon, Herman, & Yammarino, 2008).

Applying a cognitive perspective on innovation strategy, we attempt to link cognition with resource choice and innovation. Both Eggers and Kaplan (2013) and Narayanan et al. (2011) have reviewed the literature on how cognition affects strategy. Eggers and Kaplan (2013: 296) suggested three processes where cognition and capability development are intertwined. First, cognition is involved in the development of routines. Second, cognition plays a role in assembling routines into capabilities. Third, cognition addresses what capabilities will match to the environment. Narayanan et al. (2011: 310) identified three cognitive processes, - scanning, sensemaking, and decision making – involved in strategy formulation, and three other cognitive processes - sensegiving, sensemaking, and issue selling – involved in strategy implementation.

We develop a cognitive model on resource choice and innovation in this paper. We argue that cognitive processes affect strategy formulation and implementation. Since choosing resources to develop innovation is a conscious strategic decision by top managers, the personal cognitive style of the CEO will affect the extent of combined use of internal and external resources. The influence of cognition on the combination of resources is an issue during strategy formulation (Hypothesis 2). On the other hand, the influence of cognition on the impact of the combination of resources on innovation is an issue during strategy implementation (Hypothesis 3). Cognitive style refers to the consistent individual differences in preferred ways of organizing and processing information and experience (Allinson & Hayes, 1998).

Among the considerable array of cognitive dimensions identified in the literature (Allinson & Hayes, 1998), we focus on global dominance and cognitive complexity as two cognitive styles that are closely related to the selection and management of resources. Figure 1 presents the model and the propositions put forward in this paper.

[Figure 1 about here]
Combined Resources and Innovation

Before exploring the role of managerial cognition, we first examine the effect of combining internal and external resources for innovation in Proposition 1. Internal resources are resources and capabilities that firms use to develop and implement business strategies (Ray et al., 2004). Unequal distribution of resources and capabilities across firms results in their potential to generate different competitive advantage and rents. This is because resource supply cannot be expanded rapidly and inferior resources remain in the market, providing Ricardian rents for those firms that possess superior resources (Peteraf, 1993). Entrepreneurial firms enjoy Schumpeterian rents immediately after the introduction of new products. However, when other firms imitate the resources, rents will dissipate and normal returns will be earned by homogeneous firms in the market (Peteraf, 1993). Internal resources of a firm generate rents through innovation activities. Key internal resources for innovation include the technological capabilities and functional support a firm draws from its various departments for innovation (Caloghirou et al., 2004; Yam et al., 2011). They provide important sources of resource heterogeneity across firms for innovation.

External resources are also important for innovation. Considering only internal resources represents a narrow conceptualization of the total resources that firms can mobilize. Firms are increasing drawing on external resources for innovation, such as the open innovation model (Chesbrough, 2003). Bonaccorsi (1992) in her study of export intensity of Italian manufacturers argued that strategies are not based solely on internal resources but also on external resources. Following this logic suggests that firms which possess external information capabilities will recognize the benefits and the additional capabilities that such information sources can bring to the organization. Zahra and George (2002) argued that exposure to diverse, external sources of knowledge increases the propensity to explore and acquire new knowledge. Therefore, external information may further increase exploration activity. In general, external information capabilities provide necessary expertise and validation of proposed courses of action. This information-based expertise is expected to be viewed as increasing the adaptive ability of the firm.

Therefore, a combined use of internal and external resources is likely to foster innovation. Internal resources can be more effective on innovation when external resources point to more rewarding
opportunities to apply existing capabilities and stimulate product sales (Lee et al., 2001). As firms take advantage of external opportunities to fully utilize their internal resources, they change their input sourcing, technology, or product disposal methods so that new products and processes can be created. External knowledge sources may also increase the internal technological capabilities of a firm, which in turn lead to higher innovation performance (Yam et al., 2011). Rather than relying on external or internal resources separately, we propose that the sum of internal and external resources represents the total resources that a firm can mobilize for innovation.

**Proposition 1**: The combined use of internal and external resources will increase innovation

**Cognition and Combined Resources**

With Proposition 1 established, we can now examine how managerial cognition affects the decision on resource choice. Managerial cognition provides a psychological foundation for organisational-level events (Lee, Senior, & Butler, 2012; Mitchell et al., 2002). This is because brain systems and mental processing patterns affect actors’ thinking, which determines their workplace behavior, decision, and attitudes. To the extent that resource choice is a decision made by CEOs, CEOs’ cognition could provide a fundamental source of variations across resource choice decisions. Two studies illustrate how CEO’s cognition underlines the choice of organizational strategy. Fiol (1989) found that CEOs’ perception of strong interdivisional boundaries within their organizations, and weak boundaries with other firms in their external environment predicted the formation of joint venture. De Visser, Faems and van den Top (2011) found that CEO’s cognitive style affected how R&D expenses would be allocated towards exploration and exploitation activities. We expect that the reasons why some firms combine internal and external resources for innovation lies in CEO’s cognitions.

Building upon Narayanan et al. (2011) and Eggers and Kaplan (2013), we examine four cognitive processes that are involved in strategy formulation and hence resource choice decision. First, scanning refers to the extent, scope, frequency, and focus of information scanning. Managers scan the environment to make choice and action on strategy through their cognitive frame (Kaplan, 2011: 667). While strategic
orientation affects scanning activities, results from scanning could lead to shifting to a new strategy frame (Narayanan et al., 2011: 316). Second, sense making refers to how managers diagnose the environment, which involves noticing, categorizing, simplifying, and the use of heuristics to make sense of the information they received (Narayanan et al., 2011: 316). Interpreting an issue as a threat or opportunity would affect what strategy will be adopted in response to the issue. Third, decision framing limits available options and dictates weighting of criteria used in decision choice. Cognition helps identify a purpose and understand capabilities, and shapes the choices about what kinds of capability to develop (Eggers & Kaplan, 2013: 305). Decision framing represents an important link between context and managerial actions. Finally, routine refers to the formalized decision making procedures that frames cognitive processes (Narayanan et al., 2011: 315). The encoding of experience and routines into capabilities forms the basis of strategy (Eggers & Kaplan, 2013; Gavetti, 2005). Cognition directs how managers interpret experience, routines, assets and knowledge and dictates which will get attention and be assembled into capabilities. A cognitive understanding of capabilities informs managers what an organization can do. Cognition is therefore important in the assessment and assembly of capabilities.

Based on the discussion above, we predict that CEOs with a cognitive style of global dominance will direct all four cognitive processes to favour the combined use of internal and external resources in organizations. Navon (1977)’s global precedence hypothesis suggests that perceptual processes are temporally organized so that they proceed from global structuring towards more and more fine-grained analysis (Navon, 1977, 1981). Managers who respond faster to global structure have a global dominance mindset. They pay more attention to global configuration than the component elements, focusing on the forest rather than the trees (Kimchi, 1992). A cognitive style of global dominance is also associated with right hemispheric dominance of the brain (MacNeilage, Rogers, and Vallortigara, 2009). Most studies in this area are concerned with visio-spatial awareness in the laboratory, but results from one applied study showed that right hemispheric dominance was related to better attention to global performance in workplace tasks whereas left hemispheric dominance led to better specific performance (Jackson, Hobman, Jimmieson & Martin, 2012).
With a global dominance mindset, managers scan for information both within and outside their
firms. They tend to make sense of the bigger picture of external environment as opportunity rather than
threat. They are willing to consider a wide scope of possibilities when making decisions. Finally, they are
able to tap into diverse experience and routines to develop a complex portfolio of resources. Based on the
way they scan and interpret information, managers with a global dominance mindset are more likely to
combine both internal and external resources in their innovation strategy than those with a local
dominance mindset.

**Proposition 2:** The more globally dominance a CEO’s cognitive style, the higher the probability
the organization will combine internal and external resources for innovation

### Cognition and the Impact of Combined Resources on Innovation

Managerial cognition also moderates strategy implementation. While the matching of strategy to
environment provides an external fit between strategy and environment in shaping strategic outcomes, the
matching of strategy to cognition provides an internal fit that is crucial for successful strategy
implementation. Cognition is a key contributor to outcomes of strategic choice by affecting how a
strategy is implemented (Kaplan, 2011; Eggers and Kaplan, 2013). Kaplan (2011: 684) argues that a
CEO’s cognition interacts with organizational capabilities in shaping strategic outcomes. Similarly,
Eggers and Kaplan (2013: 298) suggest that mere possession of capabilities does not always lead to
enhanced performance. Outcomes of firms’ capabilities are contingent on what managers decide to do
with their capabilities. The crucial role of cognition during strategy implementation implies that firms that
have comparable resource choice and face a similar external environment could produce different levels
of innovation based on the internal fit between cognition and resource choice.

Based on Eggers and Kaplan (2013) and Narayanan et al. (2011), we identify four cognitive
processes involved in strategy implementation. First, during sense giving, top managers provide meaning
for organizational change and shape organizational interpretation. Tripsas and Gavetti (2000) showed that
while Polaroid possessed technical capabilities of digital imaging, their managerial cognitive frames that
placed primacy on technical excellence prevented them from success in the digital camera market. Second,
top managers engage in attention and search processes. The focus of managerial attention uncovers potential matches between capabilities and environment. The matching affects how capabilities will be effectively mobilized, deployed, and implemented. Eggers and Kaplan (2009) found that CEO’s attention to technology either accelerates or slows down the launch of new products. In addition, middle managers will engage in the two remaining cognitive processes of sense making and issue selling. In sense making, middle managers actively interpret events and actions of top managers. Dougherty (1992) found that department mindset interact with organizational routines to inhibit the acquisition of new technology and market knowledge. In issue selling, middle managers frame their preferred alternatives and shape the actions and changes during implementation. Reiter-Palmon et al. (2008) reviewed crucial cognitive processes associated with individual and team level creativity.

We contend that a style of **cognitive complexity** will align with a combined use of resources. Cognitive complexity refers to the tendency to explain the environment in multidimensions and in a discriminating way. On the other extreme is cognitive simplicity, where few viewpoints or dimensions are used for explanation (Hayes & Allinson, 1994). To benefit from a combined use of internal and external resources, CEO’s cognitive style needs to align with the opportunity emerging from the combined resources. A complex mindset of CEOs is particularly important for the cognitive processes of sense making and attention and search when the combined resources are used for innovation. For sense making, Levy, Beechler, Taylor and Boyacigiller (2007) suggested that managers with complex cognition are able to see things from multiple perspectives. They are able to detect opportunities rather than threat in complex environment, and to generate multiple interpretations from competing scenarios. They tend to tolerate ambiguity and consider more alternative viewpoints. For attention and search, managers with a complex cognition have a superior information possessing ability and will pay attention to a diverse set of elements in problem solving. Dollinger (1984) found that high cognitive complexity of owners sensitizes them to salient information in environment and therefore enhances the performance effect of their entrepreneurial activities. We therefore expect cognitively complex CEOs are able to turn their attention to and seek solutions based on both internal and external resources. Because of the sense making and
information search processes related to cognitive complexity, CEOs with a complex cognitive style can effectively implement the strategy of combining external and internal resources.

**Proposition 3**: The more cognitively complex a CEO’s cognitive style, the higher the innovation outcome from a combined use of internal and external resources

**DISCUSSION AND CONCLUSION**

This paper proposes a cognitive model concerning the use and impact of combining internal and external resources on innovation summarized in three propositions. Specifically, we propose that (1) a combined use of internal and external resources will increase innovation, (2) CEO’s cognition will affect the combined use of resources, and (3) CEO’s cognition will moderate the impact of the combined use of resources on innovation. Some issues about this model merit further examination.

First, the model has focused on the cognitive style of CEOs rather than that of top managers or board directors. The upper echelon perspective suggests that top managers and board directors have strong influence on firm’s decisions and actions (Hambrick & Mason, 1984). Cognitive research on the upper echelon abound (e.g. Levy et al., 2007; Miller et al., 1998). Our model can easily be expanded to include team level cognition of the upper echelon without changing the underlying argument. We also expect CEO’s cognition to be more salient in small firm than large firm. The model can be used to compare the relative effect of CEOs and top managers’ cognition as firm size changes.

Second, the model has focused on the intensity rather than the type of innovation. As innovation type is an important contingency in the resources-innovation relationship (Damanpour et al., 2009), researchers empirically testing this model may wish to specify the type of innovation. Five pairs of innovation type are commonly identified in research: radical vs. incremental, product vs. process, technical vs. administrative, exploitative vs. explorative, and pioneer vs. imitator (Crossan & Apaydin, 2010). These can be incorporate into an empirical model to identify the unique pattern and consequences of resources and cognition for different innovation types. Formal definitions on innovation types by the Oslo Manual and the Fascati Manual (OECD) should also be considered.
The fundamental empirical task to verify the propositions put up in this study is to identify and measure the cognitive style of CEOs. Much cognitive research in organizational studies use demographic variables or behavior to proxy underlying CEO’s cognitive processes (e.g., Eggers & Kaplan (2009) used annual report to proxy CEO’s attention to technology; Yadav et al. (2007) used psycholinguistic analysis of communication by CEOs). To avoid blackboxing cognition, researchers should directly measure cognition using psychology tests. In this study, the various styles of managerial cognition can be measured with online psychological tests of cognitive skills such as those included in Hayes and Allinson (1994), Jackson (2011), or Jackson et al. (2012).

The other two crucial variables in the model are resources and innovation. Researchers can measure internal resources as technical intensity, human skill, and R&D investment to address various conceptualizations of internal resources (Santamaria et al., 2009). External resources can be measured as depth and breadth of partnerships in alliances and joint agreements that are used as sources for innovation (Frenz & Ietto-Gillies, 2009). Researchers should consider using the scales of the Community Innovation Survey (CIS). This is because traditional measures of innovation such as patents and number of new products (Cainelli et al., 2006) are inadequate for diverse industries that include both service and manufacturing. The CIS innovation scales are widely accepted in top management and technology journals such as Research Policy and Strategic Management Journal (e.g. Laursen & Salter, 2006). In addition to CIS innovation scales, firms can pioneer or imitate innovation. We suggest that researchers can measure innovation as idea generation and adoption (Perez-Luno et al., 2011).

Finally, a valid and reliable research design is required to test the proposed model. A questionnaire survey will enable researchers to collect the pattern and relationship of variables depicted in the model from a large number of firms. The design of the survey will require (1) measuring firms’ innovative activities comprehensively, (2) tapping into individual decision maker’s cognitions, and (3) assessing the threat of reverse causality between resources and innovation. Researchers can address the first aspect by conducting additional in-depth interviews to complement the questionnaire survey. In-depth interviews could expose the reasons why firms adopt different types of innovation and the performance implication.
Researchers can address the second aspect by including psychological cognitive tests in the questionnaire. This provides an additional method on top of the survey to collect data from decision makers and allow method triangulation. Finally, researchers can address the third aspect by adopting a longitudinal survey or applying two stage least squares regressions in their analysis to minimize the threat of reverse causality between the dependent and the independent variables.

This study contributes to the innovation literature by providing a micro foundation of innovation strategy (Eisenhardt, Furr, & Bingham, 2010; Felin, Foss, Heimeriks, & Madsen, 2012). Cognitive psychology is able to add a novel aspect of people to organisational study (Mitchel et al., 2004). However, research on the management of innovation has not integrated the research conducted by cognitive and personality psychologists. This paper attempts to integrate cognition and strategy research and contribute in two aspects. First, we examine the cognitive origin of innovation strategy formulation. In this study, cognition is taken as a key variable of a CEO that could affect innovation through managerial decisions on resource choice. With this assumption, we are able to systematically explain how CEOs formulate their decisions on innovation strategy. Second, we examine the moderating role of cognition on the resource-innovation relationship. This moderation role is important because both resources and cognition are important inputs to the implementation of innovation strategy.

Recognizing cognition as an important input in innovation strategy also has significant managerial implications. A cognition frame provides heuristics or rules of thumb that influence managerial judgment and attention in systematic and predictable ways (Lee, et al., 2012). Managers could benefit from deliberately developing a cognitive style as a capability (Eggers & Kaplan, 2013: 324) or better still recognizing that some styles have strengths in some applications whereas other styles have strengths in others. With a cognitive capability for innovation, managers will be able to interpret the environment in new ways, reconfigure resources to match newly identified opportunities, and be more tolerant about ambiguity. A cognitive capability will aid strategy formulation and implementation on innovation.
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Figure 1. A Managerial Cognition Model of the Resource choice and Innovation