Improving Radical Innovation in Established Firms

Dynamic Capabilities Perspective

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Abstract

This paper develops a process model of dynamic capabilities for improving performance, with respect to radical innovation (RI), in established firms. The dynamic capabilities for radical innovation are elaborated into four types of capabilities: sensing, coordination, autonomy and reconfiguration. Five hypotheses are further proposed in the paper. A dataset of 112 corporate RI-specific capabilities and innovation performance data, from the top 500 Taiwanese manufacturing firms, is collected via a postal questionnaire. The paper reveals that: 1) sensing capability is positively related to coordination capability and autonomy capability; 2) both coordination capability and autonomy capability are positively related to reconfiguration capability; 3) reconfiguration capability is positively related to radical innovation performance. Finally, this paper suggests established firms should search external sources and explore widely. An autonomous organizational climate is a necessary condition for cultivating radical innovation. Firms had better enthusiastically sense and reconfigure with all sorts of value chain activities.

Introduction

Radical innovations are designed to meet the needs of emerging customers or markets [1, 2]. Thus radical innovations take firms into high-uncertainty technical and market environments. Even, radical innovations may involve a higher degree of discontinuity in the sources of innovation, since knowledge sources previously used may be obsolete in the new context [3, 4]. The management of radical innovation is quite different from that of incremental (continuous) innovation [5, 6, 7, 8]because radical innovation concerns a significant leap in technical dimension and the potential for entirely new features and improvement in social dimension [9]. Established firms have a greater tendency to fall behind start-ups in the introduction of radical innovations. The reasons can be summarized as inappropriate structures and systems of established firms [5, 8, 10, 11, 12, 13, 14, 15, 16].

There were many studies concentrated on various mechanisms for introducing radical

innovation in established firms. These studies proposed the following methods to improve radical innovation performance in established firms, such as projects and programs [17], lead-user research [11, 18], artistic involvement [19], new forms of networks [10], internal and corporate ventures [5, 16, 20] etc. It was suggested established firms could adopt probing and adaptive learning [12, 16, 17], adjust their strategic planning [5, 16], become ambidextrous organizations [13, 15, 16], use appropriate scanning and evaluation processes [5] and establish corporate venture funds [16], to cultivate and support radical innovations. Although there are many organizational mechanisms and developmental procedures for the improvement of performance in radical innovation, research based on the aspect of holistically eliminating organizational inhibitors/inertia in established firms is neglected.

Early statements of the dynamic capabilities framework emphasize how firms utilize sources and methods to promote competitive advantages in environments of rapid technological change [21, 22]. An extensive literature on dynamic capabilities concentrates dynamic process perspective [23, 24, 25]. Ref [25] specifically defined dynamic capabilities as a firm's ability to *sense, seize and reconfigure* internal and external competence, to address a rapidly changing environment. The dynamic capabilities perspective may be a promising solution to overcome inappropriate structures and systems of established firms. The myopic and limited searching of established firms [5, 8] can be eliminated by sensing capability. The insufficient planning framework and evaluation methods [8, 10, 16] and a reluctance to experiment in unknown territory of established firms [5, 11, 12, 14] can be eliminated by seizing capability. The rigid organizational routines and culture [5, 8, 10, 13, 15, 16] and incorrect staffing, compensation and rewarding systems of established firms [8, 10, 16] can be eliminated by reconfiguring capability. Furthermore, dynamic capabilities have positive effects on innovative performance [26]. Therefore, this study bases on dynamic capabilities to improve inappropriate structures and systems of established firms and further promote radical innovation performance. Accordingly, this paper aims to answer the following questions: 1) *What are the organization's dynamic capabilities in searching for, planning, organizing, cultivating and experimenting in radical innovation?*; 2) *How do these types of dynamic capabilities influence one another and radical innovation performance in established firms?* In the next section, we develop the theoretical model.

Theoretical background and hypotheses

Dynamic capability

Since [22] proposed the perspective of dynamic capabilities, the topic has received substantial attention in the field of strategic management. Several researchers proposed the foundations comprising dynamic resource utilization and related connections with other theoretical perspectives [27], while other research focuses on dynamic process aspects [23, 25]. In terms of foundations of dynamic capabilities, [22] contended that the dynamic capability framework analyzes the sources and methods of wealth creation and capture by private enterprise firms operating in environments of rapid technological change. Moreover, [28] proposed an analytical framework on the basis of resource-based theory and adopted a dynamic perspective to determine the pattern and process of how different bundles of the key resources contributed to the strategic capabilities. Dynamic capabilities can be defined as those that operate to extend, modify or create ordinary capabilities [29]. Ref [30] defined dynamic capabilities as a firm's behavioral orientation to constantly integrate, reconfigure, renew and recreate its resources and capabilities, and most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage. Wang and Ahmed further identified adaptive, absorptive and

innovative capability as three component factors which reflect the common features of dynamic capabilities across firms. Ref [26] operationalized dynamic capabilities as a composite, unified construct defined by three interrelated dimensions: coordination capability, learning capability and strategic competitive response capability.

As for dynamic process perspective, dynamic capabilities emphasize the perspective of innovation creation process [23]. Ref [25] proposed that under a rapidly changing environment dynamic capabilities can be disaggregated into the capability to sense external opportunities, to seize the opportunities, and to reconfigure the enterprise's intangible and tangible assets. Consequently, the dynamic capabilities necessary for managing radical innovation can be described as follows. In the first stage, the sensing capacity is to learn and to sense, filter, shape, and calibrate opportunities [25]. In the second stage, the seizing capacity is to build enterprise structures, procedures, designs and incentives for seizing opportunities [25]. Some researchers pointed out that acquirers have to integrate acquired technologies in order to commercialize them in a coordinated manner and they have to preserve organizational autonomy for the technologies in order to avoid disrupting their capacity for continued innovation; therefore, coordination and autonomy should be concurrently applied to organizing for innovation in established firms [31]. Thus seizing capability is dependent on coordination (combinative) capability to determine the pattern and process of how different bundles of the key resources contributed to the strategic capabilities [28] and to integrate resources [30]. In addition, seizing capacity is also dependent on autonomy capability to learn and absorb the collected sources and methods [22] and further to extend or modify the original idea or recreate it [29, 30]. In sum, coordination and autonomy capability should concurrently exist in the seizing stage. In the third stage, the reconfiguring capacity is to continuously align and realign the specific tangible and intangible assets [25]. That is reconfiguring capability can be regarded as adaptive capability to flexibly upgrade and reconstruct core capabilities in response to the changing environment [30] and to commercialize innovative new ideas, processes, products and services [32, 33]. By applying the concept of dynamic capabilities, detailed above, the organizational capabilities necessary for radical innovation are a firm's ability to seek out, coordinate, tolerate and experiment with new products, processes and services. In other words, we can divide dynamic capabilities into four types of capabilities: sensing capability, coordination capability, autonomy (tolerating and cultivating) capability and reconfiguration (experiment) capability.

Relationship between sensing capability and seizing capability

Many innovative firms have organized open search strategies for new ideas that have commercial potential and changed the way they search for new ideas to help them achieve and sustain innovation [34]. Established firms acquiring small, technology-based firms have to manage them to both exploit their capabilities and technologies in a coordinated way and foster their exploration capacity by preserving their autonomy [31]. This study similarly extends to propose sensing capability should be associated with coordination capability and autonomy capability.

An open approach to innovation allows the firms to discover combinations of product features that would be hard to envision under integration [35].The effects of external knowledge-sourcing strategies on the development of both product and process innovations impact firms' internal integration/coordination capacities [36, 37]. Firms' critical capabilities of managing internal and external knowledge in open innovation processes are positively associated with the organizational coordination mechanism [38]. The openness strategy for knowledge and technology transfer activities between business firms and universities is significantly correlated to internal R&D coordination activities [39]. Consequently, this study hypothesizes:

H1: Organizational sensing capability is positively related to coordination capability, in established firms.

When partners have divergent goals, open innovation restricts the firm's ability to establish the product's technological trajectory [35] and therefore an autonomous culture fostering individuality supports the pursuit of radical innovation [14, 40]. Innovation networks can often be viewed as loosely coupled systems of an autonomous firm [41], and the sensing capability is likely to facilitate autonomous climate within firms. Searching knowledge has a different impact on firm's risk-taking and routinization [42]. In addition, firms' critical capabilities of managing internal and external knowledge in the open innovation processes affect organizational autonomous culture [43]. The sensing strategy for knowledge and technology transfer activities between business firms and universities affect the innovation culture [39]. Consequently, this study hypothesizes:

H2: Organizational sensing capability is positively related to autonomy capability, in established firms.

The relationship between Seizing capability and reconfiguration capability

Ref [44] suggested the combined use of long-term and short-term incentives, based on results, is positively associated with performing radical innovations. Ref [45] found clear R&D alignment and integration between corporate R&D centres and mainstream businesses may foster a firm to perform radical innovations. Radical innovation activities should be tightly coupled and perceived as co-produced [45], or an integrated system [17] between corporate R&D and lines of businesses. The fine integration and alignment of corporate R&D units and existing lines of business is crucial to commercializing radical innovation. It is a crucial to transfer radical innovation from the R&D stage, generally in corporate research labs, to the manufacturing and marketing stages, in existing and new businesses. It is quite usual to find the receiving business units are reluctant to divert resources to completing technical and market development of a radical innovation. Consequently, in moving radical innovation from the R&D stage to manufacturing and marketing, in a received mainstream business, champions are needed to make the transition or "hand-over" smooth [45]. Consequently, this study hypothesizes:

H3: Organizational coordination capability is positively related to reconfiguration capability, in established firms.

Ref [44] indicated team diversity and the development of risk-taking attitudes, within a team, is positively associated with performing radical innovations. In his study of the entrepreneurship climate, [46] found work discretion allows employees to take risks, make decisions in the work process and show a tolerance of failure, which are behaviors leading to performing radical innovations [46]. The availability of easily obtained resources usually encourages experimentation and risk-taking behaviors [47]. Consequently, this study hypothesizes:

H4: Organizational autonomy capability is positively related to reconfiguration capability, in established firms.

Reconfiguration capability and radical innovation performance

It is well documented a firm's ability to learn [12, 15, 17], probe [15, 17] and experiment with [5, 12, 13, 14] new ideas, new R&D, manufacturing/marketing tools, new disciplines and territories facilitates the introduction of radical innovation in established firms. From the organizational culture view, [13] argued supporting experimentation is one of the key cultural elements necessary for supporting radical innovation, in established firms. Based on studies of famous radical innovations, such as optical fibers in Corning, CT scanners in GE, cellular phones in Motorola, [12] found probing and learning are two crucial ingredients to the introduction of radical innovation. Probing is a firm's ability to experiment- to introduce an early version of radically innovative products to a plausible initial market. Learning is a

firm's ability to learn about technology and determine whether and how it can be scaled up for the market, any potential applications, or segments, and exogenous factors. Development of radical innovation becomes a process of successive approximation, probing and repeated learning, each time striving to become one step closer to a winning combination of product and market [12]. Consequently, this study hypothesizes:

H5: Organizational reconfiguration capability is positively related to radical innovation performance, in established firms.

Theoretical model of radical innovation capability

Having identified five major organizational inhibitors, or inertia, to radical innovation, in established firms, established firms might develop the appropriate dynamic capabilities to allow them to avoid, or to escape from these organizational traps, when dealing with radical innovation. Based on the above five hypotheses, this study proposes a process model of radical innovation capability to avoid the organizational inertia to radical innovation performance, in established firms (Figure 1). In other words, the framework allows established firms to develop their core capabilities for radical innovation and prevents them from falling into the vicious cycle of organizational core rigidities [48].

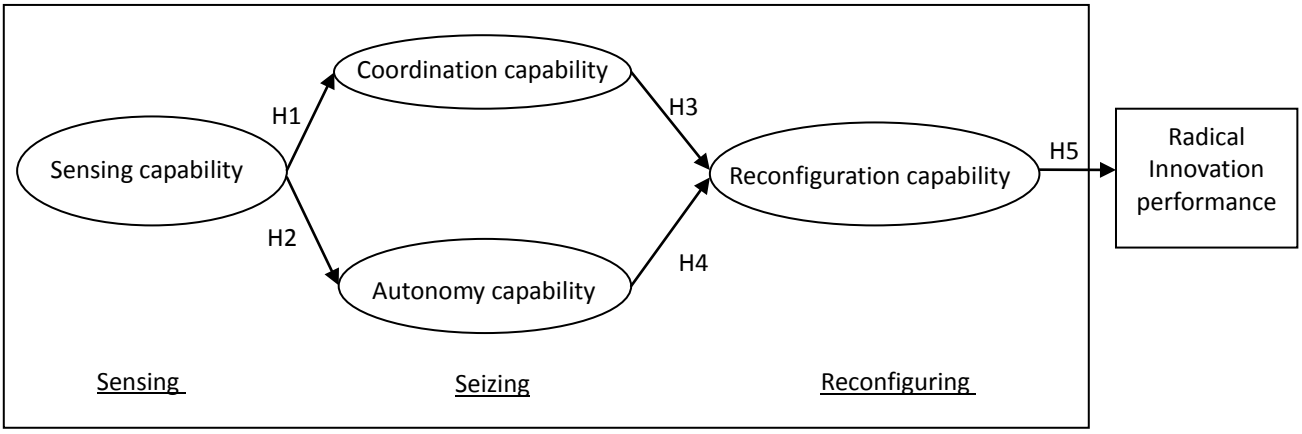

Figure 1 Radical innovation capability in established firm: A dynamic capability perspective

Methods

The questionnaire was an adaptation of the Canada MINE Innovation Management Survey. To develop new measures for these constructs, we first reviewed relevant literature and generated a pool of questions, pertinent to the domain of each construct. From this pool of items, we conducted a pre-test, involving 35 top managers at different firms. We asked these managers to complete the questionnaire and indicate any ambiguity in the phrasing of questions. During follow-up interviews, we invited managers to provide suggestions for the improvement of the questionnaire. The phrasing of questions was further refined by the authors and peers, until the final version of the questionnaire was generated. The wording, phraseology and structure were improved. Exploratory factorial analyses of the data from the pilot study indicated the meaning of the survey questions was clear. Since the study focuses on radical innovations in established firms, the study mainly examines large firms, such as the top 500 manufacturing firms in Taiwan, rather than SMEs. The survey investigated the top 500 Taiwanese manufacturing firms. After a three-wave postal survey, 117 firms had responded to the questionnaires. Ultimately, 112 effective responses were collected, with an overall response rate, 22.4%.

To determine the reliability of the scales of dynamic capabilities, in the model, we calculated Cronbach's alpha, for the scales. The Cronbach's alpha values were 0.77, 0.83, 0.78 and 0.79, for sensing capability (SC), coordination capability (CC), autonomy capability (AC) and reconfiguration capability (RC), respectively. These values suggest a moderate to high internal consistency between the items and their related constructs (Guilford, 1965). To test the construct validity of each scale, we conducted a confirmatory factor analysis (CFA) and analyzed the covariance matrix, using the maximum likelihood procedure of Lisrel. The statistical fit of the overall model ($\chi 2$ / df=1.28, goodness-of-fit index [GFI] = 0.90, adjusted goodness-of-fit index [AGFI] = 0.85, Normalized Fit Index [NFI] = 0.885, Non-Normalized Fit Index [NNFI] = 0.939, comparative fit Index [CFI] = 0.98, Root Mean Square Error of Approximation [RMSEA] = 0.037) corresponds reasonably well with those found in the literature. The CFA results show the indicators loaded significantly on their respective constructs. Item loadings were as proposed and significant ($p < 0.01$).

Results

To test the process model shown in Figure 1, the effects of control variables (Firm size, R&D size, ICT firm, OBM and R&D intensity) upon substantive variables were controlled in testing these models. Due to missing data in control variables, the resulting sample size used in structural equation model is 112. As displayed in Figure 2, the path coefficients are significant from sensing capability to coordination capability (.45, t = 4.64, p<.001) and autonomy capability (.68, t = 6.52, p<.001). The path coefficients from coordination capability and autonomy capability to reconfiguration capability were marginally significant (.11, t = 1.88, p<.1; .88, t = 9.55, p<.001). In addition, the path coefficient from reconfiguration capability to radical innovation performance was marginally significant (.26, t = 7.26, p<.001). The reported fit indices (RMSEA=.158, NNFI=.88, NFI=.88, CFI=.90) indicate the model fitted the data reasonably well (χ^2=292.46, df=72). Note, RMSEA had better be lower than 0.08. This can be further improved by increasing the number of samples.

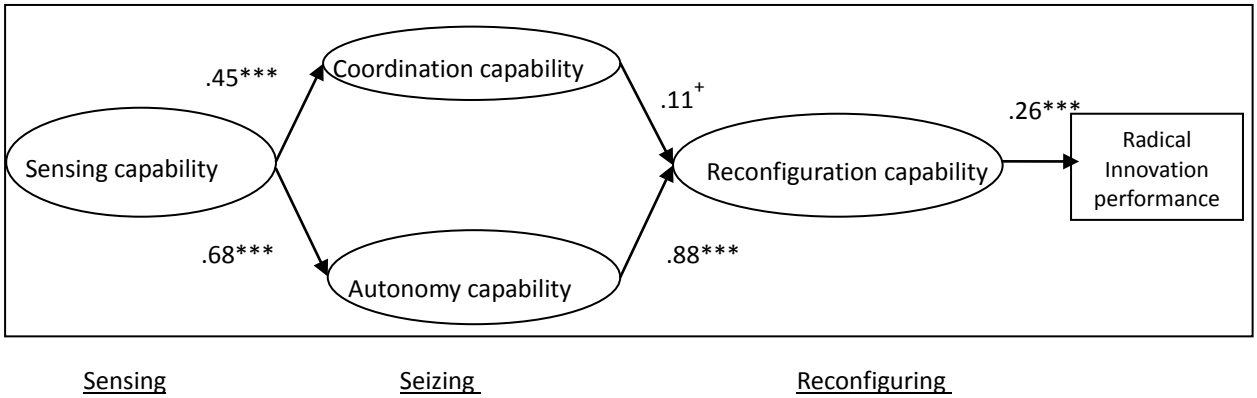

Figure 2 Results of hypotheses testing (Note. $^{+}p < .1$, $^{***}p < .001$)

Discussions

Overall, the results indicate the five hypotheses are supported, or partially supported. The process model of dynamic capabilities indicates how to improve radical innovation performance in established firms. Of these dynamic capabilities, sensing capability (SC) is positively related to coordination capability (CC) and autonomy capability (AC), respectively. To facilitate radical innovation, the SC should allow firms to access diversified sources of innovation, such as universities, research institutes and other firms [13, 49, 50, 51]. Moreover, both CC and AC are positively related to reconfiguration capability (RC). The result of CC-RC path is consistent with the findings of [52], who studied the transformation

of Samsung's corporate R&D Centre from a development-oriented to a research-oriented centre, by enhancing the R&D capabilities aligned with business strategies and integrated R&D processes. The result of AC-RC path is consistent with an organizational culture that encourages risk-taking [13, 44], tolerance of ambiguity [13], unused resources [53] and tolerance of failure [46], which facilitates 'crazy' ideas and more radical innovation. Finally, RC is positively related to radical innovation performance. This result strongly supports the notion of the development of radical innovation is a series of experimental processes [5, 12, 13, 14].

Conclusions

Although it is well recognized there are many organizational inhibitors and inertia, which prevent established firms from planning, developing and organizing and commercializing radical innovation, there is little research focusing on how to develop organizational capabilities to turn organizational inertia to radical innovation into core capabilities. However, the organizational capabilities thought necessary for radical innovation are quite fragmented and far from comprehensive. The major findings of the paper are established firms that develop a process model of sensing capability, coordination capability, autonomy capability and reconfiguration capability will increase their radical innovation performance. The paper suggests established firms broaden their organization's search of ideas to external sources and, explore widely. Clearly, an autonomous organizational climate and a culture that supports and tolerates radical innovation is a necessary condition for cultivating radical innovation. Firms with high radical innovation performance must enthusiastically probe and experiment with all sorts of value chain activities, such as new tools/concepts for R&D manufacturing productivity enhancement, markets and users. This paper's measurement of radical innovation performance is far from perfect. The time from incubation to the launch of radical innovation could be years or decades. It might be very fruitful to include the wider and long-term measurement of radical innovation in future research. Moreover, it is worth noting the main determinants of radical innovation may still be unidentified. Other factors, such as leadership or resource commitment, may need to be considered in future studies.

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