Learning Process and Capability Development of Thai Auto-parts Suppliers

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ABSTRACT

The purpose is to investigate two questions: what are Thai auto-parts suppliers learning strategy and associated learning activities? and how effective are these for technological capabilities development? The study investigated nine different Thai auto-parts suppliers, ranging from a small firm with 40 employees to a large corporate group with more than 10,000 employees. The primary data was collected through semi-structured interviews and all were audio taped and transcribed. Additional data was collected via secondary sources and direct observation. Then Nvivo (software for qualitative data analysis) was used to analyze the transcripts and other secondary data. The research findings indicate that aggressive firms’ learning strategy and internal effort are prerequisites for effective technological capabilities development. Firms with higher level of technological capabilities aggressively strategize for intensive learning effort to be invested in activities such as performing sequential technical experiments, hiring domestic and foreign experts, investing in human resource development, forming joint ventures and collaborating with external organizations. It is argued that without the aggressive learning strategy and investment in learning effort few learning activities will get initiated and firms cannot rapidly increase their absorptive capacity and have a slow rate of technological capabilities accumulation. In short absence these learning processes (i.e. learning strategy, learning effort and learning by ‘active’ doing activities) the Thai auto-parts suppliers will have insufficient technological capabilities and will probably fail to compete for the future.

Keywords: learning process, learning strategy, technological capabilities, Thai auto-parts suppliers
1. INTRODUCTION

The Thai economy had been averaging 7.6 per cent growth over the past two decades from 1977-1996 (Siamwalla, 2000: 1) and in mid-1990s most carmakers were planning for capacity expansion until July 1997 when the economic crisis hit. In 1998 there was a massive shrinkage of domestic demand (Chitravas, 2005: 15) and the automotive industry suffered the greatest impact (Dollar and Hallward-Driemeier, 2000: 4). The carmakers and their suppliers had to quickly shift to export strategy and this change was difficult. In addition the waves of liberalization and globalization enacted by the government had exerted even greater pressure. The firm challenges are succinctly stated “[the] triple challenge of globalization, liberalization and crisis” (Lauridsen, 2002a: 101), who further expressed “the need for local [Thai] firms to upgrade their technological competencies”.

Consequently an improved set of firm capabilities is required and the transition to higher capability level is complex for most firms and is exacerbated by the intensive investment in the learning effort. Today the local auto-parts suppliers are under an immense pressure to achieve both product engineering capability and the targeted quality, cost and on-time delivery (Takahashi, 2000: 88). The challenges facing Thai firms and increasing competitive pressure necessitate the need for a deeper understanding through more research on the Thai auto-parts firms’ learning processes and their capability development. To date most studies (Vongpanitlerd, 1992; Kumar et al, 1999; Costa, 2001; TDRI, 1989) either focus solely on analysis at the industry level or a set of interviews per se, but the in-depth case study of Thai firms is still lacking. Moreover studies that focus on technological capabilities development did not explicitly address the impact of firm learning strategy, for instance (Bell and Pavitt, 1995: 89) who stated “… [In most studies] there are few guidelines for firms to follow in designing

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1 Some Thai auto-parts suppliers are ‘indirect exporters’ since they do not directly export. These suppliers are linked into the production network of the carmakers, the ‘direct exporters’.

2 The phrase ‘technological competencies’ is used interchangeably with ‘technological capability.’

3 Learning processes include the learning strategy, the learning effort and the learning by ‘active’ doing activities. See Figure 1 for more details.
[learning] strategies to move from basic levels to these advanced capabilities”. The study objectives are to empirically explore the learning strategy and the learning activities4 as they happened on the ground and then to describe the importance of the linkages among learning strategy, learning activities and technological capabilities development.

2. OVERVIEW OF THE ANALYTICAL FRAMEWORK

In the past industrial learning research (Arrow, 1962: 155) had acknowledged two shortcomings: “the learning [process] takes place in effect only in the capital goods industry and no learning takes place in the use of a capital good once built” and the assumption that “learning takes place only as a by-product of ordinary production”. The view of learning process as an automatic by-product of ordinary production was heavily criticized later by some scholars (Bell, 1984; Bell and Pavitt, 1995; Kim, 1998; Kim and Nelson, 2000). In addition others had analyzed the issue of ‘what lies behind the learning curve’ (Adler and Clark, 1991). All these scholars shared similar contention that learning process is not automatic and it requires much effort. Only via appropriate learning strategy and sustained intensity of effort can firms increase their existing knowledge base (Kim, 1998: 508).

To properly analyze the capability development processes one should specify three conceptual dimensions: the learning activity characteristics, the types of technological capabilities and the learning strategy. First are the learning activity characteristics:

- Learning activities are costly and not automatic, and it requires intensive effort. “It is often idiosyncratic, cumulative, dynamic and uncertain in outcome, involving both knowledge and experience. Learning [activity] is usually costly and often difficult to undertake” (Hobday, 1995: 1190). Similarly, “learning takes time, and the process of learning is specific to each industry and activity (i.e. context-dependent)” (Lauridsen, 2002b: 160). A study on East Asian electronics

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4 Learning activities are defined as the level of learning effort and the associated learning by ‘active’ doing activities. For more details please see Section 2 and Figure 1.
industry in four countries (South Korea, Hong Kong, Singapore and Taiwan) by Hobday (1995) found that firms must engage in a painstaking, costly learning process (a “hard slog”) in order to build technological capabilities.

- Learning activities are not limited to just the production of capital goods and that learning could take place elsewhere. In the developing country context (where capital goods sector and formal research and development are weak) learning occurs most often via informal activities such as continuous improvement in processes (i.e. modification of capital goods) and product improvements at later stages (Gammeltoft, 2004: 51). In studying the Indonesian electronics industry, Gammeltoft (2004) concluded that most learning activities and capability development occurred informally via shop-floor production activities rather than through formal research and development.

- Several learning mechanisms\(^5\) do exist for each learning activity: learning by ‘active’ doing, learning by prior knowledge accumulation, learning by local training (on-the-job and off-the-job), learning by searching and collecting information and learning by foreign connections (Tran, 1999: 20-21). Other types of mechanisms include learning by user-producer interaction (Lundvall, 1992) and that “all learning are interactive” (Johnson, 1992: 23). In studying the Vietnamese electronics and textile industries, Tran (1999) concluded that the resulting effective learning outcome is highly likely when the local firms used a combination of several learning mechanisms and that interactive learning between foreign and local firms (i.e. user-producer interaction) is a crucial source of technical knowledge for the local firms (Tran, 2002).

\(^5\) All the learning mechanisms mentioned above were grouped under the category learning by ‘active’ doing. Since almost all learning activities virtually involve some forms of ‘doing’; it is only natural to group these activities under ‘active’ doing category. See Figure 1 and Section 4 for more explanation.
The issue of how much is learned and how external, new knowledge is internalized into the firm depends on the absorptive capacity\(^6\) (Cohen and Levinthal, 1990: 128), which can be augmented via a deliberate, strategic learning effort (Kim, 1998; 1999).

The second conceptual dimension is the types of technological capabilities. Most often learning process is defined as “a pathway to accumulate certain types of technological capabilities” (Figueiredo, 2001: 31; Bell and Pavitt, 1995) and different levels of technological capabilities were accumulated as a result of many learning processes. A scheme for classifying technological capabilities is illustrated in Table 1 (Lall, 1992: 166; Bell and Pavitt, 1995: 84).

<table>
<thead>
<tr>
<th>Table 1 About Here</th>
</tr>
</thead>
<tbody>
<tr>
<td>It classifies firm’s technological capabilities into three levels of complexity (‘simple routine capabilities’, ‘adaptive/duplicative capabilities’ and ‘innovative capabilities’) and six operational areas (pre-investment, project execution, process engineering, product engineering, industrial engineering and linkages). Table 1 provides significant insights into the hierarchical structure and content of firm technological capabilities, but it does very little in explicating the concept of learning strategy. Therefore a third dimension to improve the conceptualization of the capability development process is necessary.</td>
</tr>
</tbody>
</table>

The third conceptual dimension is the learning strategy. It is suggested that learning activities and learning strategy must be linked (Fiol and Lyles, 1985: 804-805; Leavy, 1998; Bierly and Hamalainen, 1995) and furthermore both learning strategy and learning activities must be linked to capability development concept. Only via such linkages can one achieve an improved, holistic analytical scheme of firms’ capability development. The industrialized country literature on strategic learning and knowledge management offers useful insights into the learning strategy. For instance, knowledge and learning strategy must be linked, forming knowledge strategy (Zack, 1999) or some scholars preferred the

\(^6\) Cohen and Levinthal defined absorptive capacity as the ability of a firm to recognize the value of new, external information and assimilate it to commercial ends.
terms strategic learning (Carayannis and Alexander, 2002; Dodgson, 1992). To strategically learn firms must analyze the organizational goals along with the identification of strategic and knowledge gaps (Zack, 1999) and then address these gaps via focused learning activities (Lin et al, 2001). From strategic management perspective learning is viewed as a process with great impact on firm’s adaptability, reconfigurability and competitive advantage (Teece and Pisano, 1994; Teece et al, 1997); in short learning is a fundamental process underpinning the creation and evolution of firms’ dynamic capabilities, the firm’s capability to learn (Zollo and Winter, 2002).

These conceptual insights were amalgamated into a category called learning strategy. One simple way of describing firms’ learning strategy is via the degree of aggressiveness (Zack, 1999), defined as the ability of the firm to identify the strategic and knowledge gaps (contrast between organizational goals and actual performance) and to reconfigure and adapt to embrace the challenges and seize the market opportunities and/or neutralize threats\(^7\). Firms with high degree of aggressiveness not only have clearly focused goals and clear assessment of strategic and knowledge gaps, but also they are able to adapt and reconfigure themselves to engage in formulating a learning strategy that will enable them to exploit and explore various knowledge sources, enabling them to learn and eventually seize the market opportunities and/or neutralize threats.

The integration of the three conceptual dimensions produces an analytical framework comprise learning strategy, learning activities and technological capabilities (see Figure 1).

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\(^7\) In the original paper Zack elaborated that the most aggressive learners (firms) are the ones who have “unbounded” knowledge (learning) strategy that involves both internal and external sources of learning as well as utilizing both existing knowledge (exploitation) and building knowledge for the future (exploration). Extremely aggressive learners are the ones who embrace the challenges, reconfigure and adapt the learning strategy in order to direct the learning processes and seize the market opportunities.
The main proposition of this study is the firm with an aggressive learning strategy and high learning effort will move toward the innovative level of technological capabilities.

3. METHODOLOGY

This study uses a firm-level unit of analysis. The sample consists of nine Thai auto-parts suppliers whose backgrounds are displayed in Table 2. These firms have between 40 and more than 10,000 employees and the registered capital between 1 and 435 million Baht. In short the sampled firms form a diverse group enhancing the cross-case comparison.

Table 2

In all there are three interview guides. The first two interview guides are designed for each firm: one for top management and another for the operational staff. The top management guide contains 34 questions to solicit information such as organizational goals, actual performance, plan and policy for learning activities and these provide insight regarding firm’s learning strategy and the planned learning activities. The operational staff guide contains 80 questions to solicit information regarding the operational management of engineering design, production processes, product improvement activities and technical assistance arrangements and these provide insights on firm’s learning activities and the implementation of its learning strategy. The last interview guide is for external institutions such as the Thai Automotive Institute and Thai Auto-parts Manufacturers Association and it contains 30 questions to solicit information on public policies that assist Thai firms with their capability development. This last guide complements the first two by providing an ‘outsider perspective’ on firms’ learning processes and

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8 The industry-level analysis was not chosen due to (Rumelt, 1991) who pointed out that the classical focus on industry analysis is flawed because firm performance is associated with unique endowments, positions and strategies of individual businesses and not with the industry. Likewise after an extensive literature review on organizational learning (Lahteenmaki et al, 2001) concludes that there is too much emphasis on the learning of individuals instead of on the learning of the firms. Hence these studies imply the appropriateness of the firm as the chosen unit of analysis.

9 Roughly 40 Baht equals to 1 US dollar.
this ensures the validity of the firms’ responses. After each firm interview the researcher asked permission for a plant tour; this enabled direct observations.\(^\text{10}\)

All interviews were conducted in two stages during 2004. The first stage is the pilot fieldwork conducted from March to May. From June to August, the researcher, an academic colleague and an international consultant revised all the interview guides. The second stage is the main fieldwork conducted from September to the end of 2004.

All interviews were audio taped and transcribed. The secondary data was gathered via annual reports, corporate brochures, press releases, newspapers and presentations at public conferences. Direct observation involved a plant tour, some meeting with operational staff and participation with the Thai Automotive Institute assistance programs. Then Nvivo\(^\text{11}\) (software for qualitative data analysis) was used to analyze all the data.

4. FINDINGS AND ANALYSIS

The study found three major learning categories (the latter two were grouped under ‘learning activities’, see Figure 1):

- Learning strategy
- Learning effort
- Learning by ‘active’ doing: experimenting, hiring, interacting, investing and training (on- and off-the-job)

First is the learning strategy. This is the firms’ perception toward the opportunities and challenges and the ability to formulate strategic plan for reconfiguration and adaptation to the changing environment. From the interviews the carmakers stated that they will soon relinquish the product design

\(^\text{10}\) Direct observation was used as a supplemental data collection means to ensure the validity of the main interview responses.
\(^\text{11}\) The researcher has to analyze more than 350 pages of transcribed notes and secondary data. NVivo facilitated the task by sorting, re-sorting, re-grouping and exploring differences and possible relations among existing and emerging themes.
and engineering activities to their first-tier suppliers. Viewing this as a learning opportunity (i.e. to
design auto-parts for new vehicle model), some Thai suppliers started to put forth the plan to invest in
intensive learning activities, both in financial investment and time, to build an indigenous product
engineering capability. In the future these suppliers could offer the carmakers a lower-cost, yet high-
quality and flexible product design. Hence the learning strategy of these firms will enable them to both
exploit the existing knowledge and explore future market opportunities from carmakers. In formulating
the learning strategy firms must plan for reconfiguration and adaptation to enable efficient management
accessing into various sources of knowledge (i.e. knowledge both from their own employees and from
collaboration with organization such as the Thai Automotive Institute).

Second is the learning effort. Most firms realized that merely formulating the learning strategy
per se was insufficient; the learning strategy must be followed by the willingness to invest sufficiently in
the learning effort. Here learning effort is measured by what learning by ‘active’ doing activities were
invested by firms, taking into account the degree of task difficulty and the diversity of tasks. In short it
would require firms more effort to concurrently invest and coordinate a diverse range of task than to
invest in just one single task.

Last is learning by ‘active’ doing activities. All firms engaged in one important activity, learning
on-the-job; it occurs when the operators are performing hands-on tasks, whereas learning off-the-job is
slightly more passive. For instance an operator sitting, listening to a lecture and interacting with a foreign
expert on certain production problems is an off-the-job training. One may think that the learning on-the-
job per se will lead to a better outcome on capability accumulation. However most firms found that on-
the-job training is a necessary (and often complementary to off-the-job training), but not sufficient
condition for effective learning. Most firms realized that other learning by ‘active’ doing activities were
necessary. Other learning by ‘active’ doing activities include experimenting (either improving production
process or product quality), investing in human resource development, hiring domestic and foreign
Experts, investing in new vintage of technology, interacting with suppliers, customers or competitors, forming joint venture with foreign firms, and investing in new production facility.

The findings were summarized in Table 3.

Table 3 illustrates that an augmentation of technological capabilities complexity levels (from three to five levels) is required. The two new levels are ‘insufficient capabilities’ and ‘innovative capabilities (non-research based)’¹². The former category was created to account for the poor performance of Firm F. The latter was developed to incorporate the fact that to date none of the sampled firms had achieved the status of ‘innovative capabilities (research based)’.

Both Firm D and Firm H do share similar characteristics. Currently both Firm D and Firm H are in their planning stage, to establish a formal product research and development department. Both firms undertake extremely aggressive learning strategy and exert high learning effort on exploring a multitude of learning activities. For instance a subsidiary of Firm H performs sequential experiments to determine the optimal cooling water temperature for their plastics injection machines and Firm D conducts collaborative research with the Thai Automotive Institute and the National Metal and Materials Technology Center to explore and technically improve the mechanical and physical properties of parking brake plastics handle sheath. In addition these two firms have invested overseas. Firm H invested in manufacturing facilities in India (joint venture firm), Malaysia (joint venture firms) and Indonesia. Firm D had invested in Vietnam.

Despite all the successes none of the firms had conducted in-house research-based activities, hence the need to augment the level of technological capabilities complexity presented in Table 1. If one considered an innovation, as something that is new to the firm but is not new to the world, then both Firm

¹² Note here that the word ‘research’ is taken in a formal sense as in ‘basic research and development’.
D and Firm H had conducted innovative activities. They are, however, non-research based innovative activities (i.e. applied problem solving methods) rather than basic science research. Consequently the innovative activities were augmented into non-research based and research-based and the shaded row indicated the deficiency area common to all firms (see Table 3). Urgent focus on research-based innovative activities is a prerequisite if the Thai suppliers wish to develop product engineering capability.

In contrast to firms with aggressive learning strategy, Firm F had a conservative learning strategy and invested very little effort in few learning activities. It was preoccupied with a huge financial debt, downsizing, lack of skilled personnel and recurring poor quality performance. The firm suffered greatly and significant customer orders were reduced since it could not meet the cost reduction requirements. It is predicted that without immediate rectification this firm can no longer compete.

In addition there are clear, emerging trends. Moving down from insufficient capabilities to innovative capabilities (non-research based) the learning effort increased. Likewise as the effort increased the diversity of learning by ‘active’ doing activities increased and the firms’ learning strategy shifted from viewing existing challenges as ‘threat’ to ‘opportunity’. Similarly the degree of aggressiveness of firms’ learning strategy had shifted from ‘conservative’ to ‘extremely aggressive’ as the level of technological capabilities increased. Thus it could be argued that a firm with an aggressive learning strategy and an intensive learning effort will be able to effectively build the innovative technological capabilities (see the proposition in Figure 1 and Table 3).

Furthermore there are apparent similarities and differences between firms. All firms engaged in learning activities but with different levels of effort and varied perspectives on learning strategy. Firms who exerted significant amount of learning effort achieved higher level of technological capabilities (successful firm), whereas those who invested lesser effort achieved lower level of technological capabilities (less successful firm). In addition the less successful firms were preoccupied with mostly

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13 The debt is huge relative to its size.
‘fire-fighting’ operational activities. Similarly successful firms strategically viewed challenges as opportunity (strategize to aggressively expanded its business and grow) while the less successful ones viewed them as threat (strategize to conservatively guarded their turfs and merely survive). It is argued that firms who embraced the challenges with an aggressive learning strategy and put forth the intensive learning effort will successfully accumulate the absorptive capacity and eventually build their technological capabilities (Kim, 1999: 133), “intensity of efforts is … [the] prerequisite to building technological capability in industrialization”. Likewise (Cohen and Levinthal, 1990) in their absorptive capacity framework stresses that the intensity of effort aids firms to recognize the value of new knowledge to be internalized. Once it is internalized it leads to a higher absorptive capacity (i.e. increased knowledge base) and eventually a fast rate of learning.

5. CONCLUSIONS

Overall this study found that the link among an aggressive learning strategy together with high investment in learning effort and a more diverse the range of learning by ‘active’ doing activities will enable firm to achieve higher level of technological capabilities. Effective learning is a combination of several ‘active’ doing activities, and that a single activity will not ensure effective capability development. Moreover to increase the chance for successful technological capabilities development, all learning activities must be driven by a focused, deliberate learning strategy. The best way, arguably, is for firms to properly align the co-requisites of capabilities development: learning strategy and learning activities. One of the most important issues is the learning strategy that carefully (but effectively) undertakes investment in the learning effort to achieve efficient coordination, reconfiguration and adaptability resulting in accumulation of technological capabilities.
TABLE 1. matrix of technological capabilities

<table>
<thead>
<tr>
<th>Level of Complexity</th>
<th>Investment Capabilities</th>
<th>Production Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-investment</td>
<td>Project Execution</td>
</tr>
<tr>
<td>Simple routine capabilities (experienced base)</td>
<td>Prefeasibility and feasibility studies, site selection, scheduling of investment</td>
<td>Civil construction, ancillary services equipment erection commissioning</td>
</tr>
<tr>
<td></td>
<td>Investment Engineering</td>
<td>Process Engineering</td>
</tr>
<tr>
<td></td>
<td>Debugging, balancing quality control, preventive maintenance, assimilation of process technology</td>
<td>Assimilation of product design, minor adaptation to market needs</td>
</tr>
<tr>
<td></td>
<td>Work flow, scheduling, time-motion studies, Inventory control</td>
<td>Monitoring productivity, improved coordination</td>
</tr>
<tr>
<td></td>
<td>Innovative capabilities</td>
<td>Turnkey capability, cooperative R&amp;D, licensing own technology to others</td>
</tr>
</tbody>
</table>

Sources: (Lall, 1992; Bell and Pavitt, 1995)
**Proposition**: The firm with an aggressive learning strategy and high learning effort will move toward the innovative level of technological capabilities.
TABLE 2. firms’ background

<table>
<thead>
<tr>
<th>Firm</th>
<th>Number of Employees</th>
<th>Registered Capital(^1)</th>
<th>Year Established</th>
<th>Joint Venture(^2)</th>
<th>Corporate Group (# firms)</th>
<th>Position in the Supply Chain</th>
<th>Listed in Securities Exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm A</td>
<td>628</td>
<td>240</td>
<td>1985</td>
<td>Yes</td>
<td>Yes (6)</td>
<td>First-tier</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm B</td>
<td>272</td>
<td>30</td>
<td>1965</td>
<td>Yes</td>
<td>Yes (6)</td>
<td>First-tier, second-tier</td>
<td>No</td>
</tr>
<tr>
<td>Firm C</td>
<td>300</td>
<td>100</td>
<td>2000</td>
<td>No</td>
<td>No</td>
<td>First-Second-Third-tier</td>
<td>No</td>
</tr>
<tr>
<td>Firm D</td>
<td>&gt;3,000</td>
<td>265</td>
<td>1979</td>
<td>Yes</td>
<td>Yes (&gt;20)</td>
<td>First-tier</td>
<td>No</td>
</tr>
<tr>
<td>Firm E</td>
<td>300</td>
<td>435</td>
<td>1993</td>
<td>No</td>
<td>No</td>
<td>REM(^3)</td>
<td>No</td>
</tr>
<tr>
<td>Firm F</td>
<td>40</td>
<td>1</td>
<td>1994</td>
<td>Considering</td>
<td>No</td>
<td>Third-tier</td>
<td>No</td>
</tr>
<tr>
<td>Firm G</td>
<td>1,285</td>
<td>220</td>
<td>1975</td>
<td>Yes</td>
<td>Yes (&gt;15)</td>
<td>First-Second-tier REM</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm H</td>
<td>&gt; 10,000</td>
<td>NA(^4)</td>
<td>1977</td>
<td>Yes</td>
<td>Yes (&gt;30)</td>
<td>First-tier</td>
<td>Considering</td>
</tr>
<tr>
<td>Firm I</td>
<td>750</td>
<td>208</td>
<td>1973</td>
<td>Considering</td>
<td>Considering</td>
<td>Second-tier</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: from corporate brochures and annual reports

1 in million Baht. 1 US$ is equivalent to about 40 Thai Baht.

2 ‘no’ means the firm is 100% Thai-owned

3 Replacement Equipment Market

4 not available
### TABLE 3. grouping firms: level of capabilities and learning characteristics

<table>
<thead>
<tr>
<th>Firm</th>
<th>Learning Strategy</th>
<th>Learning Effort</th>
<th>Learning By ‘Active’ Doing</th>
<th>Level of Technological Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms</td>
<td></td>
<td></td>
<td>• Mainly focus on ‘fire-fighting’ activities with very few strategic learning activities</td>
<td>Insufficient capabilities*</td>
</tr>
<tr>
<td>Firm F</td>
<td>Challenges viewed as threat and no opportunity (conservative)</td>
<td>Low</td>
<td>• Limited number of experiments</td>
<td>Simple routine capabilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited hiring of either domestic or foreign experts</td>
<td>(experienced based)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Moderate interaction with suppliers and customers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited investment in new technology, plant expansion and joint venture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Limited amount of on- and off-the-job training</td>
<td></td>
</tr>
<tr>
<td>Firm B</td>
<td>Challenges viewed as threat with little opportunity (minimally aggressive)</td>
<td>Minimal</td>
<td>• Moderately perform experimentation</td>
<td>Adaptive/ duplicative capabilities</td>
</tr>
<tr>
<td>Firm C</td>
<td>Challenges viewed as threat with little opportunity (minimally aggressive)</td>
<td></td>
<td>• Hiring mostly domestic and some foreign experts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Quite aggressive in interacting with suppliers and customers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Moderately aggressive on investment in new technology, plant expansion and corporate takeovers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Moderately aggressive on both on- and off-the-job training</td>
<td></td>
</tr>
<tr>
<td>Firm I</td>
<td>Challenges viewed as opportunity with moderate threat (moderately aggressive)</td>
<td>Moderate</td>
<td>• Extensively perform experimentation</td>
<td>Innovative capabilities*</td>
</tr>
<tr>
<td>Firm E</td>
<td>Challenges viewed as opportunity with moderate threat (moderately aggressive)</td>
<td></td>
<td>• Definitely hire foreign (Japanese) experts as permanent employees</td>
<td>(non-research based)</td>
</tr>
<tr>
<td>Firm A</td>
<td>Challenges viewed as opportunity with moderate threat (moderately aggressive)</td>
<td></td>
<td>• Aggressively interact with suppliers and customers</td>
<td></td>
</tr>
<tr>
<td>Firm G</td>
<td>Challenges viewed as opportunity with minimal threat (extremely aggressive)</td>
<td>High</td>
<td>• Aggressively invest in new technology, overseas plant expansion and corporate takeovers/joint ventures</td>
<td></td>
</tr>
<tr>
<td>Firm D</td>
<td>Challenges viewed as opportunity with minimal threat (extremely aggressive)</td>
<td></td>
<td>• Extensively train staff both on- and off-the-job</td>
<td></td>
</tr>
<tr>
<td>Firm H</td>
<td>Challenges viewed as opportunity with minimal threat (extremely aggressive)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>A threat</td>
<td></td>
<td>Limited</td>
<td></td>
</tr>
</tbody>
</table>

Augmented levels from research findings
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