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Corporate-level technology strategy and its linkage with corporate strategy in multi-business companies: IKCO case study

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ABSTRACT

This article deals with technology strategy and its linkage with overall strategy at multi-business, diversified groups. In the last two decades, the alignment of technology and business strategy has been one of the important research fields in strategy and technology management literature. These researches has been concentrated on single companies through which different frameworks, models, and decision support tools have been developed and widely utilized by industries. Although multi-business and diversified groups play an important role in national economy of developing countries and need a comprehensive and overall plan for the management of their diversified technological capabilities, there is little research focused on corporate-level technology strategy (CTS). This paper introduces a preliminary framework based on literature review, with a deductive approach and content analysis method which tends to more reflect the context of developed countries. Its applicability in a latecomer context has been investigated in practice through a case study in Iran Khodro Company (IKCO)—the largest car manufacturer in the Middle East and a multi-business diversified group in Iran. Based on the proposed framework and through reviewing the related documents and interviewing IKCO senior and middle managers; and using thematic analysis method, we describe and explain how technology strategy is linked to corporate strategy at IKCO. This investigation reflected some mismatches with our initial framework which can be interpreted in a pleasing manner due to IKCO's latecomer context and its position in catch-up path. Process and results of this illustrating study showed that our conceptual framework makes sense as a tool for analyzing CTS in a multibusiness corporation (MBC). Resulted amendments such as highlighting the importance of integration make our modified framework a good basis for further researches.

1. Introduction

Diversification is a major path of firms' growth (Christensen, 2002). Business groups accounted for 45, 40, and 20 of the 50 biggest companies (excluding state-owned enterprises) in India, South Korea, and China, respectively (Ramachandran et al., 2013). More than 60% of Indian multibusiness groups generated better returns during 1997 to 2011 than a comparable portfolio of standalone companies did (Ramachandran et al., 2013). After reaching a saturation point in their initial business due to technological as well as market limitations, they can aspire for more growth through realizing opportunities in different local markets and businesses using their previously earned capabilities (Amsden and Hikino, 1994; Kock and Guillen, 2001; Damodaran, 2009). Competitive advantage of a multi-business diversified company usually is latent in some relationships between different business units (BUs). Prahalad and Hamel (1990) advocate that diversified corporations should not be seen just as a portfolio of discrete businesses but as a collection of competitively important competencies that could be used in different products and markets. Technology may be considered as one of the most important of these competences (Vannoni, 2003). Thus, diversification is not related just to the business portfolio of large corporations but also to their usual multitechnology characteristic (Torrisi and Granstrand, 2004). Although multi-business groups need a comprehensive and overall plan for management of their technological capabilities, there is little research focused on corporate-level technology strategy (Edler et al., 2002; Arasti et al., 2010).

The linkage and alignment of technology and overall strategies at BU level is relatively rich in strategy and technology management literatures and scholars have introduced different frameworks, models, and decision tools for this purpose considering positioning or resource-based approaches (Vernet and Arasti, 1999; Chiesa, 2001; Christensen, 2002; Pieterse and Pretorius, 2005). Such a linkage at the corporate level is a prerequisite for achieving growth goals (Bellotti, 1994; Hax and Majluf, 1996; Ryan, 1996; Berry and Taggart, 1998; Zahra et al., 1999; Christensen, 2002; Hipkin, 2004; Lenz, 2004; Larsson, 2005).

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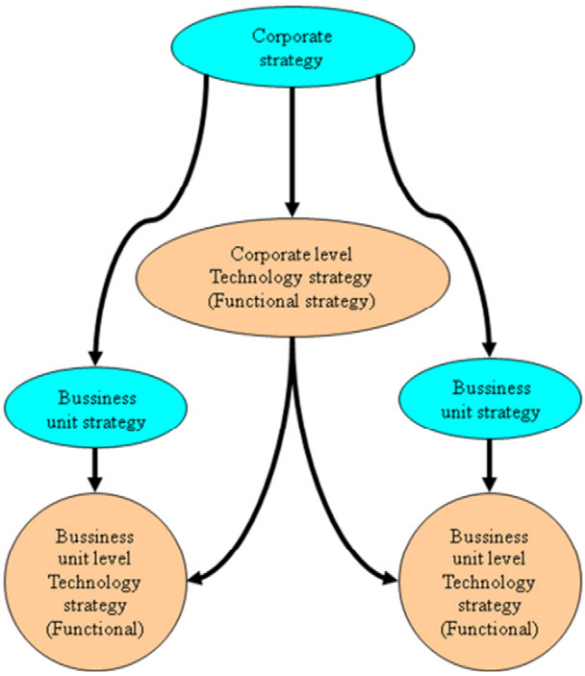

Fig. 1. Technology strategy position in hierarchy of corporation strategies.

However, few researches have investigated the relationship between diversification of businesses and technologies (Patel and Pavitt, 1997; Granstrand et al., 1997).

The aim of this paper is to present a framework which steers the linkage of CTS and corporate strategy (CS) at multi-business companies. For this purpose, a vast and comprehensive literature survey is accomplished, which led to a conceptual framework. In order to illustrate the applicability of this proposed framework, the case of Iran Khodro Industrial Group – an Iranian multibusiness corporation – is investigated.

In the next section, the conceptual framework is presented. Research method is discussed in Section 3. Based on the proposed conceptual framework, results of a confirmatory in-depth case study of IKCO – the largest car manufacturer in the Middle East and a multi-business diversified group in Iran – has been reported in Section 4. The final section is dedicated to discuss the modified version of conceptual framework and some concluding remarks.

2. CTS and its Linkage with CS

Based on a comprehensive literature review, we have already published the result of a research regarding the concept and the main elements of CTS and its linkage with the firm's overall strategy (Arasti et al., 2010). A theoretical framework that shows the paths of this linkage has been also developed and presented. In this section, we rediscuss the framework with some minor modifications.

2.1. Corporate-level technology strategy

Almost all research argues for the position of technology strategy in a firm's hierarchy of strategies as a functional strategy at BU level. Based on our best knowledge, there is no framework or model which has explicitly recognized technology strategy at the corporate level.[1] Even though many of scholars have confirmed the concept of CTS explicitly (Christensen, 1998; MacAvoy, 2001; Grienitz and Ley, 2007; Burgelman et al., 2009) or implicitly (Mitchell, 1986; Hax and Majluf, 1996; Betz, 2011; Filippov, 2011; Lahovnik and Breznik, 2014), they have mentioned the following reasons to show importance and necessity of technology strategy at the corporate level:

- Technological core competencies play a major role in competitive advantage of multibusiness group (Mitchell, 1986; Christensen, 1998; Hobday and Rush, 2007; Betz, 2011). Corporation growth leads to dispersal of their technological capabilities all over the group; thus, it is necessary to manage cooperation at the corporate level to avoid parallel efforts and improving synergies (Coombs and Richards, 1993; Argyres, 1995; Christensen, 1998; Bruche, 2000; MacAvoy, 2001).
- Managing technological collaboration and integration (vertical and horizontal) is usually realized better at the corporate level than BU (Christensen, 1998; Roberts, 1999).
- Groups should support those single BUs that lack essential competencies or financial resources to acquire needed technological capabilities (Christensen, 1998; MacAvoy, 2001).
- The parent company should consider acquisition of long-term technological needs of its current businesses (Coombs and Richards, 1993; Christensen, 1998; Roberts, 1999; MacAvoy, 2001; Birkinshaw and Fey, 2003; Larsson, 2005; Betz, 2011; Filippov, 2011; Helland, 2012; Diam et al., 2013; Du et al., 2013).
- The parent company should have technological intelligence (Suominen, 2011) and should plan and proceed with acquisition of required technologies for its future diversification (MacAvoy, 2001; Christensen, 2002; Betz, 2011; Du et al., 2013).
- The parent company should plan and proceed with acquisition and employment of supporting or shared service technologies which are not the responsibility of any BUs (Argyres, 1995; MacAvoy, 2001; Cuenca et al., 2011).

Considering the aforementioned notes, we can envisage the relationship of technology strategy and firm's overall strategy as shown in Fig. 1.

Technology strategy, like any other strategy, consists of content, process, and context dimensions (Pettigrew, 1987; De Wit and Meyer, 2005; Meyer, 2007). Regarding the content, the main elements of CTS

[1] For this purpose, we have reviewed the literature of related fields through credible indexing sites like as Elsevier, Emerald, Google Scholar, Scopus, and Science Direct using different keywords such as corporate level, technology strategy, and corporate technology strategy.

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have been revealed from the literature and summarized in Table 1. The most important elements are as follows:

- Overall priority of technology and investment rate
- Corporate's strategic technology portfolio aligned with corporate's business portfolio
- Proper balance between short-term/exploitative and long-term/explorative objectives
- Mode of technology acquisition
- Technological collaboration and integration (vertical and/or horizontal)
- Technology sharing priorities between BUs
- Directions and policies of technology development
- Priority of common technologies (shared services and supporting technologies)
- Intellectual properties protection strategy
- Organizing technology management all over the corporation

Fig. 2 illustrates the relations between the main elements of CTS based on supporting literature. As shown, investment portfolio should be determined first. Literature introduces some criteria such as internal capabilities, external availability, timing and technology importance, in regard to technology acquisition mode (Ford, 1988). Although technology management literature has not sufficiently dealt with such criteria at the corporate level to show differences with business unit level, some differences has been acknowledged. As Fig. 2 shows, BUs tend more to specific and short-term programs in technology development (MacAvoy, 2001; Betz, 2011; Helland, 2012; Du et al., 2013), while parent companies are supposed to deal with more fundamental and long-term programs[2] (Coombs and Richards, 1993; Christensen, 1998; Roberts, 1999; Birkinshaw and Fey, 2003; Helland, 2012; Du et al., 2013). Acquisition of those technologies in short-term programs which are common within different BUs may be pursued by the parent company too.

2.2. The linkage of CTS and CS

Scholars have pointed out the linkage between CTS and CS (Mitchell, 1985, 1986; Bellotti, 1994; Basant, 1997; Edler et al., 2002; Larsson, 2005; Tambo and Ostergaard, 2015). They believe that this linkage is bidirectional, interactive, and dynamic (Itami and Numagami, 1992; Bellotti, 1994; Berry and Taggart, 1998; Zahra et al., 1999; MacAvoy, 2001; Hipkin, 2004; Lenz, 2004; Betz, 2011; Tambo and Ostergaard, 2015). Here we just focus on necessity of formulating technology strategy in alignment and integrated with corporate strategy (Porter, 1988; Berry and Taggart, 1998; Pieterse and Pretorius, 2005; Tambo and Ostergaard, 2015). Some of the main reasons indicated in the literature are as follows:

- Important role of technology in creating synergy between BUs (Friar and Horwitch, 1986; Hax and Majluf, 1996)
- Impacts of CTS and CS linkage on different performance measurements of the firm (Ryan, 1996; Edler et al., 2002; Birkinshaw and Fey, 2003)
- Impacts of CTS and CS linkage in creating opportunities for vertical integration (Friar and Horwitch, 1986)
- Impacts of CTS and CS integration in earning benefits from technological changes (Hax and Majluf, 1996; Edler et al., 2002; Kameoka, 2001)

Although, integrating technology management into corporate-level strategic planning is widespread and complicated (Berry & Taggart, 1998), there are few researches that have considered the issue (Hax

[2] This may promote some specific modes of technology acquisition like internal R&D or Strategic alliances with Universities at the corporate level.

Table 1
Corporate-level technology strategy content: basic elements

References → / CTS elements ↓	Suharto and Diam (2013)	Betz (2011)	Grienitz and Ley (2007)	Larsson (2005)	Pieterse and Pretorius (2005)	Breschi et al. (2003)	Christensen (2002)	Edler et al. (2002)	Macapanpan (1999)	Hax and Majluf (1996)	Ryan (1996)	Prahalad and Hamel (1990)
Corporate strategic technology portfolio analysis	√	√	√	√	√	√	√	√	√	√	√	√
Acquisition mode			√		√		√	√	√	√		
Priority, rate, and level of investment	√			√	√		√	√		√		
Synergy making and horizontal technology strategy	√	√					√			√		
Organizing of technology management	√	√					√		√	√		
Timing	√	√	√				√	√	√	√		
Level of acquisition	√	√					√	√	√	√		
Integration and technological collaborations		√					√					
Technology leakage control								√				
Supporting and service technologies							√			√		
Human resource needs					√							

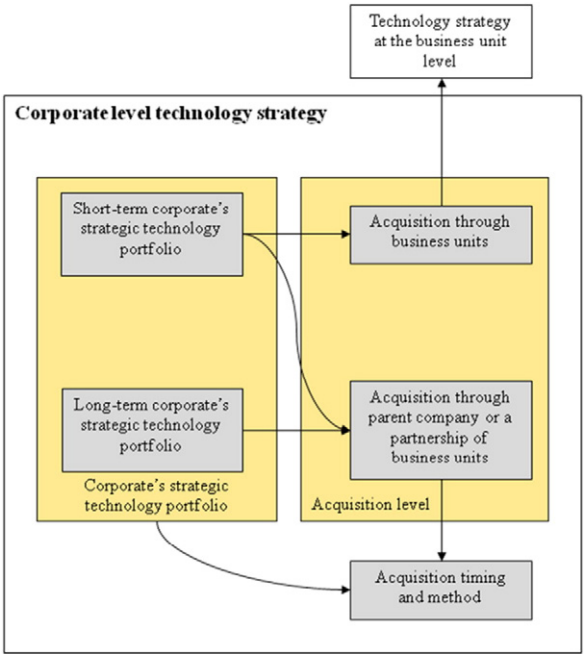

Fig. 2. Relations between the main elements of CTS.

and Majluf, 1996; Seppanen and Makinen, 2009). We have captured the most important paths of CTS and CS linkage from the literature as follows:

- Bidirectional relation between corporate's strategic technology portfolio and business portfolio (Mitchell, 1986; Hax and Majluf, 1996; Berry and Taggart, 1998; Zahra et al., 1999; Bruche, 2000; Vannoni, 2003; Larsson, 2005; Diam et al., 2013; Tambo and Ostergaard, 2015)
- Participation of top managers in CTS formulation and vice-versa (i.e., participation of technology managers in corporation's overall decision makings) (Mitchell, 1986; Bellotti, 1994; Edler et al., 2002)
- Impact of corporate's strategic technology portfolio on corporate's strategy in order to synergy making and parenting value creation and vice-versa (Friar and Horwitch, 1986; Mitchell, 1986; Hax and Majluf, 1996; Christensen, 1998, 2002; MacAvoy, 2001; Lenz, 2004; Betz, 2011; Diam et al., 2013)
- Business portfolio's impact on technology acquisition method and timing (Basant, 1997; Hobday and Rush, 2007, 2007; Christensen, 1998, 2002; MacAvoy, 2001; Birkinshaw and Fey, 2003; Du et al., 2013)
- Corporate vertical integration strategy's impact on corporate's strategic technology portfolio and vice-versa (Friar and Horwitch, 1986; Christensen, 1998, 2002).

Fig. 3 presents the conceptual framework for CTS and paths of its alignment with CS.[3]

3. Research method

In the previous section, the important elements of CTS and their linkage with the main components of corporate strategy are clarified (Fig. 3). In order to illustrate the applicability of the proposed theoretical framework, the technology strategy in IKCO industrial group was investigated. Using a confirmatory research strategy through an in-depth case study, we first tried to examine the match between the conceptual framework and what is running in IKCO. Indeed, we made some modifications in our initial framework based on the practices experienced in IKCO.

Interview is one of the main data collection methods in qualitative researches (Patton, 2002). We used semi-structured interviews as the main tool to perform our empirical work. Trustworthiness of derived data from interviews is very important in qualitative researches (id.). By employing judgmental sampling, more than 30 potential informative audiences in three groups were nominated as following:

- Group A: board of directors and former and predecessor CEOs, vice presidents, and strategy deputy
- Group B: former and present R&D deputies, product engineering deputy, CEOs of subsidiaries, engineering, and technology deputies of subsidiaries
- Group C: experts and academics that have had the experience of providing consulting services to IKCO

Ten interviews in total were conducted with some members from all those groups till we reached a good saturation level. For this purpose, a questionnaire including 12 key questions was used. These questions were sent to the audiences in prior to make them more mentally prepared for the interviews. In order to discover and understand the reality of phenomenon as it actually is, some interview questions were added or deleted considering each interviews' circumstances. The interview questions were designed to support and explore much more details regarding the initial framework. Interview protocol was employed for all interviews, which was revised as the research proceeded to accommodate emergent findings. Each interview was lasted about 2.5 h. All interviews were carried out with individual rather than groups in order to aid check data and perception. By the permission of the interviewees, interviews were recorded digitally. Usually on the same day, interviews were transcribed to serve as data items along with the documents and field notes. Finally by employing thematic analysis, collected data were analyzed and clustered. In this stage, the raw data was coded and classified into tables which were containing final themes.

[3] Diversification strategy is the most technology-related element of CS (Bruche, 2000).

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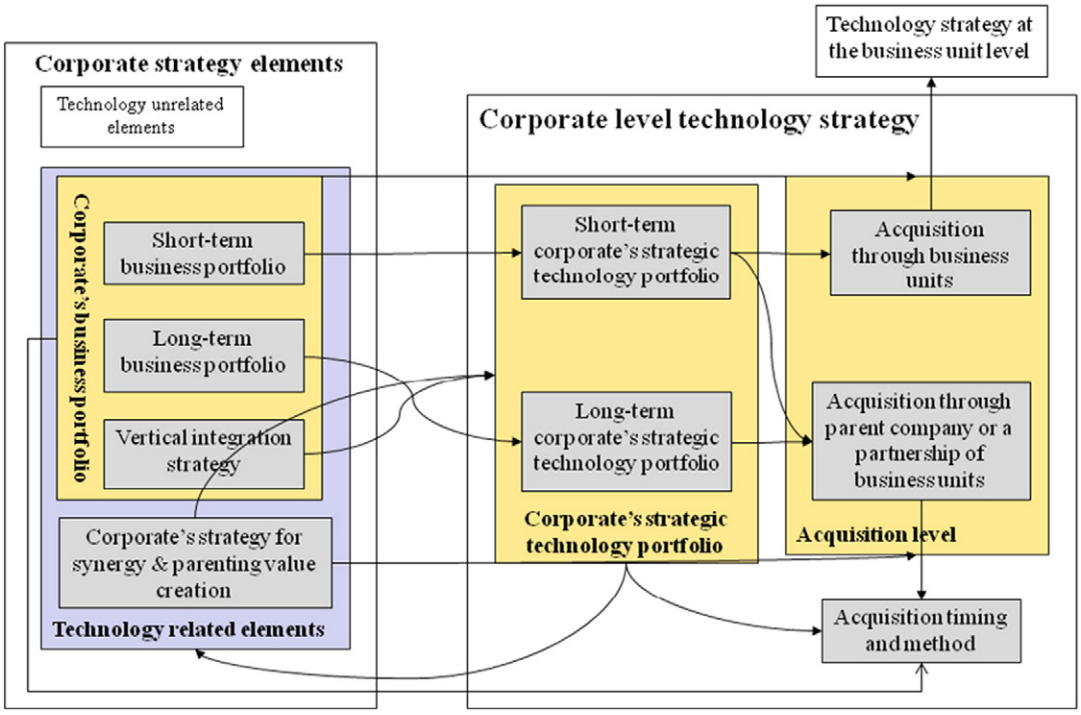

Fig. 3. Conceptual framework for CTS and paths of its alignment with CS

For assessing the quality of the results, four tests such as construct validity, internal validity, external validity, and reliability (yin, 2014), and their relevant tactics have been employed. Using multiple sources of evidence (triangulation of related literature, authors experience in IKCO and experts opinion (Johnson, 1997; Golafshani, 2003)) as well as establishing the chain of evidences support constructs validity. Pattern matching and explanation building are tactics which provide support for internal validity. For testing external validity, replication logic has been conducted and by employing case study protocol we tried to support reliability of the results. On the basis of the aforementioned tests, we believe that the rigor (Gordon, 2008) of the study is met. Furthermore, data analysis has been performed by all 3 authors of this paper and also results have been confirmed in our interviews by 10 informative experts. Thus, triangulation in data analysis and results confirmation again improves the quality of our results (Johnson, 1997; Golafshani, 2003). Finally, researchers' experience and their several-years presence in IKCO have been useful for the efficiency and reliability of findings.

4. IKCo case study

IKCO was a large multibusiness and multitechnology corporation based in a medium-high tech industry, which seemed to made technology management at its corporate level meaningful. IKCO with its history of several diversifications also appeared to have a rich story on the linkage between CTS and CS. Authors had been in touch with IKCO in regard to consulting services and one of them had a close collaboration and presence in IKCO for several years. This relationship provided us with a good sense of how IKCO faces with technology strategy and also a very good access to the most informative managers and experts and other sources of data as well. These characteristics made IKCO an ideal case for our purpose. In this section, we first introduce IKCO and briefly present its context and growth path. Then, based on a confirmatory strategy, we will apply the developed framework to the case of IKCO trying to answer these questions:

- How much the proposed framework does match with what it goes in practice in such an MBC?
- Can we clarify the basic elements and linking paths of CTS with CS in IKCO like what our initial framework proposed?

In correspondence with our conceptual framework, the results have been reported in three subjects: overall strategy (with a focus on diversification strategy), CTS, and their linkage. Some illustrating results which have revealed during this case study has been summarized here in the fourth subsection.

4.1. IKCO introduction

IKCO is Iran's largest industrial group and the largest auto producer in Middle East. It was established on March, 19, 1963, and has experienced a large growth in last 3 decades from 76,000 to 1,000,000 units before its crisis due to international sanctions on Iran. In 2009, IKCO had the highest level of sales ($11.7m USD), highest level of job creation (60388 personnel), and second position in profitability ($1.7m USD) between large Iranian corporations. Indeed, some of IKCO's subsidiaries like as SAPCo or Parsian bank are recognized as the third or fourth rank in their businesses. IKCO has diversified away from its automotive beginning, and is now active in various related and unrelated businesses like oil, rail way, power generation, banking, part manufacturing, construction, and mining, after-sale and repair businesses which makes it a good example of a large multibusiness corporation. Also, due to the specific characteristics of the automotive industry such as wide range of technologies used, attention to technology seems essential for this industry and technology may be managed at all levels, including corporate level. IKCO's diversification to other industries like industrial automation or railway more reflects its multitechnology characteristic. Hence, IKCO is an appropriate and rich case for our study. In the following, while presenting some evidences and viewpoints from informed experts and managers in IKCO, we have tried to examine the adaption of our conceptual framework with what it goes in

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IKCO. We also tried for deepening and improvement of our initial framework.

4.2. IKCO's corporate strategy

Analysis of interviews with IKCO's top managers about the corporation's portfolio of businesses and how it is managed shows that IKCO's headquarter is merged within its car manufacturing since it started with this BU in 1963. In other words, IKCO is a specialized parent company which is directly active in car manufacturing value chain. Top managers believe that this structure is not appropriate for implementation of corporate strategies since it leads to special attention of top managers for this BU and may results to insufficient budget allocation for other BUs. Thus, it is necessary to reorganize the corporation's headquarter in separate from car manufacturing so that it can formulate and implement CS for the whole corporation. IKCO's CS is mostly reflected in some strategic orientations about each BU which is raised from customer, headquarter, legal, or social requirements. These requirements form the product strategy of each BU, and based on it, other elements of each BU's strategy will be formed. Although some scholars have pointed to the portfolio of corporate's key products or strategic processes as the interface of linkage formation between CTS and CS (Mitchell, 1986; Vernet and Arasti, 1999; Christensen, 2002; Breschi et al., 2003; Pieterse and Pretorius, 2005), we had not considered it in our initial framework until this case study led us to such a modification. Regarding diversification strategy, top managers believed that IKCO should not diversify to unrelated businesses in future because:

1- Its current businesses wont satiate in near future
2- Lack of surplus capital
3- Lack of necessary technologies in unrelated businesses

Yet they said they may diversify to related businesses like increasing its market share in export markets or expanding to other parts of the value chain.

Our study revealed that although IKCO has chosen some overall strategic directions for development of its business portfolio and TAM, SAPCo, Parsian bank, or Irankhodro leasing Co. are some of IKCO's subsidiaries, which have been created on a planned basis, some interviewees tend to highlight other examples of diversification due to governmental policies or exploitation of emergent opportunities. This may have roots in mostly non-technological changes.

4.3. IKCO's CTS

A chromatic CTS, which covers all divisions and subsidiaries of corporation, has not formed yet. Technology strategy in car manufacturing business unit is centrally directed, and the parent company intends to take technology strategy of other divisions in hand through structures that have been recently created in its headquarter.

The necessity of CTS in IKCO is confirmed by top managers because of available opportunities for synergy making through common production or investment capabilities and the necessity of utilizing some supporting technologies in the whole corporation. These managers agreed that most product, process, and support technologies, which IKCO deploys, are easily available for use through licenses from their foreign partners or market transactions. Thus, fundamental technology development projects were rare in IKCO's CTS agenda. Like the BU level, the time horizon of a technology portfolio at corporate level is not so long. Regarding IKCO's approach to technology development, CEO's senior advisor argued:

> "*There are technologic poles in industrialized societies. Vehicle manufacturers are not responsible for technology development on their own. They are just technology integrators unless they have been supposed for such a role … for example in cases of technological bottleneck or when technologies are not offered in market … In IKCO, we have not faced with such a technology lack yet. We usually deploy available technologies. Our technology strategy limits to technical assistance … We have not dealt with product concept definition yet … We capture available concepts. Change them to some extent and then we will produce them. Our work mainly focuses on process technologies to produce cars cheap, on time and with a good quality … We are far from creating a completely new concept … In regard of industrial maturity, we move on technology surface yet. We are not in its depth … Apart from some exceptional cases; attitudes have a short time horizon and emphasize profitability and rapid commercialization.*"

This may have roots in IKCO's context. Other subsidiaries (aside from the car manufacturing business unit), which constitute a large part of the corporation, are legally independent from the parent company. Environmental instability intensifies short-term orientation of BU managers, too. On the other hand, these BUs only need technology deployment to fulfill their operational needs. Altogether, formal proclamations from the parent company about long-term synergy making or strategic investments on R&D projects are not achieved. This may cause challenges in internal technology integration. Similarly, no serious effort for internal development of critical technologies has been observed at the corporate level. It was just in recent years that some long-term projects have been started (hybrid or telematics for example) at the corporate level. Changing the name of IKCO's research center to NPD[4] center is noticeable, which shows corporation's priority for product development instead of technology development. One of top managers has stated that:

> "*BUs try to acquire technology independently and through their own capabilities. When they face a challenge, they ask their foreign partners for help…This brings a gap between CTS and what BUs do in practice in order to create their required capabilities. For example, we insisted on AMT[5] technologies for automatic gearboxes. This direction had been selected and imparted to subsidiaries but such a capability was hard to be created in the corporation. So, they used available capabilities of their foreign partners instead of internal development and transfer which makes synergy. This made BUs deepen in other technologies different from chosen direction.*"

The example on AMT technology for automatic gearboxes illustrates the parent company's role in technology integration to some extent. The second challenge that has been recognized as one of the most important element of CTS in IKCO was external technology integration. This challenge was more significant when IKCO dealt with a complex product design. To cope with this challenge, IKCO centralized its supply chain management in SAPCo and established IKCO's NPD center whose collaborations with SAPCo brought a good level of success in managing technological integration. One of interviewees believes that:

> "*There is an unwritten mechanism for integrating of technologies through value chain. For example, assume that we want to improve the local content in manufacturing of Peugeot 206… SAPCo coordinates the main suppliers in order to realize this decision. If a supplier cannot satisfy the requirements of NPD center, as the customer, the issue would be followed by SAPCo till they reach to an agreement regarding the attributes of manufactured part.*"

The concept of technology integration has been supported by the literature as well (Terpend et al., 2008; Pero and Andrea, 2009) and therefore is considered in the modified version of conceptual framework as a new element of CTS.

[4] New product development.
[5] Automated manual transmission.

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From the basic elements of CTS in our initial framework, just a few examples of technology and acquisition method selection have been observed to occur at the corporate level. Hybrid technology as a common core technology or ERP[6] as a supporting system has been selected at the corporate level. The Parent company has decided to pursue hybrid technology in both technology centers of car and commercial vehicle BUs separately. They also decided that the IT department of the parent company is centrally responsible to implement an ERP system in the whole corporation.

Based on interviewee arguments, we can state that two important strategies have been designed at the corporate level to provide parenting advantage and synergy making. Due to the lag of commercial vehicle BU and rail BU in their technological capabilities, the first strategy was to link research and technology centers of different divisions through these actions:

- Human resources, procedure, structure, and software transfer from technology centers in better situated divisions (car manufacturing) to lagged divisions (commercial vehicle BU and rail BU)
- Creating a shared technology center for the whole corporation

4.4. CS and CTS linkage in IKCO

Results of our document studies and interviews have not revealed any reliable evidence for bidirectional linkage of CS and CTS. We can state that IKCO's portfolio of businesses development is not usually based on corporation's technological capabilities. In this regard, one of the top managers in IKCO indicated:

> "*It is unlikely that businesses in IKCO have based on technological capabilities. There are some efforts to make this happen now. In two recent years, they tried to link business strategy to technology strategy. Even if you make this happen in planning, you should control it through implementation which we have troubles in. Many of businesses which we have entered like commercial vehicle and rail businesses had not a technologic cause.*"

In fact, in no case of diversification, technology has played the main role. IKCO's latecomer context seems useful to explain this. Some top managers believe that IKCO's diversification to railway transportation, banking, and also commercial vehicle was mainly driven with external opportunities or requirements instead of technology. However, it seems that IKCO has chosen such a resource driven approach recently where TAM entered into new businesses in related (railway transportation) and also unrelated (oil and Gas) fields based on its previous capabilities in production and engineering.

At the other site, we can find some evidence which indicates to CS impact on CTS formulation. There was no sufficient evidence in our interviews to support significant impact of CS on timing and acquisition method of CTS. In other words, we can pursue CS's impact on CTS just in technology selection. For example, alignment of technology portfolio with product portfolio in car manufacturing (which makes an interface with business portfolio) has been in the agenda while formulating CTS. Normally, planning for acquisition of necessary technological capabilities is a lateral step while IKCO diversifies into new businesses and in most cases it lays on their foreign partners' capabilities (transferred capabilities). More opportunistic nature of IKCO's diversification strategy should be accounted in this regard. This keeps little room for corporation's technological activity in such situations and this dims such a linkage. IKCO's diversification to new businesses normally begins with assembling of new products to decrease the technical risk and big investments. This assembling is not so advanced and deep and just relies on assembling process technologies. Thus, they miss the consideration of technology needs of their future business portfolio when they will need more fundamental technological capabilities and this linkage disappears again.

4.5. Results

As we mentioned before, IKCO has chosen some overall strategic directions for development of its business portfolio, but the majority of diversification decisions in IKCO seems more emergent than planned. These decisions are not usually based on corporation's technological capabilities. At the other site, we can observe CS's impact on CTS just in technology selection. (There was no evidence for such impact on mode of acquisition or timing.) In regard to basic elements of CTS:

- IKCO has focused on process and support technologies during its fragmented efforts for creation and analysis of corporate's strategic technology portfolio in alignment with its business portfolio. These efforts are not adequate for identifying synergy opportunities between different BUs. IKCO's need for technological investment seems to increase in prospecting years. Thus, a more systematic and coherent approach for analyzing technology portfolio for time and application balance should be considered.
- Currently, horizontal technology strategy in regard to process and systemic technologies is tangible to some extent but there has not been notable common activity for product technologies.
- At least in recent years, there has been no case of corporate support for acquisition of BU exclusive technologies (even in car manufacturing). Independence of different divisions, lack of technological capabilities in the corporation, and lack of technology diffusion between different divisions might be considered as the main reasons.
- The specific technology center of each division is responsible for related technology acquisition, which may lead to parallel works and cost increase. In other words, there is no technology center for the whole corporation. In car manufacturing, some level of centralization is observable while TAM Company is responsible for process technologies, IPCO for engine technologies and SAPCo for development of component and product technologies. NPD in collaboration with SAPCo are responsible for integration of product technologies. These technology centers are considered to provide some level of centralized and specialized services to all subsidiaries and production lines in car manufacturing.
- There is no formal structure and organizing for the technology management of the whole corporation. Thus, there is no CTO[7] person for the whole corporation, and technology-related responsibilities are usually directed by deputy CEO. Some CTS tasks such as technology selection and support for its acquisition are handled through market and product committee in car manufacturing.
- Vertical technology integration through the supply chain can be recognized as the most sensible element of CTS. Especially at car manufacturing, integrated management of technology and product development implicitly occurs through interactions between SAPCo, the corporation's supply chain, NPD, or other corresponding centers.
- There were some arguments for determining common standards in different BUs while they want to adopt a technology to guarantee internal technology integration.
- ERP was the only technology that the parent company itself tried to acquire. In the case of hybrid technology, it seems to be selected by the parent company but it has been authorized to technology centers of car and commercial vehicle BUs to acquire it.
- There has been no evidence for identification or utilization of shared

[6] Enterprise resource planning.

[7] Chief technology officer.

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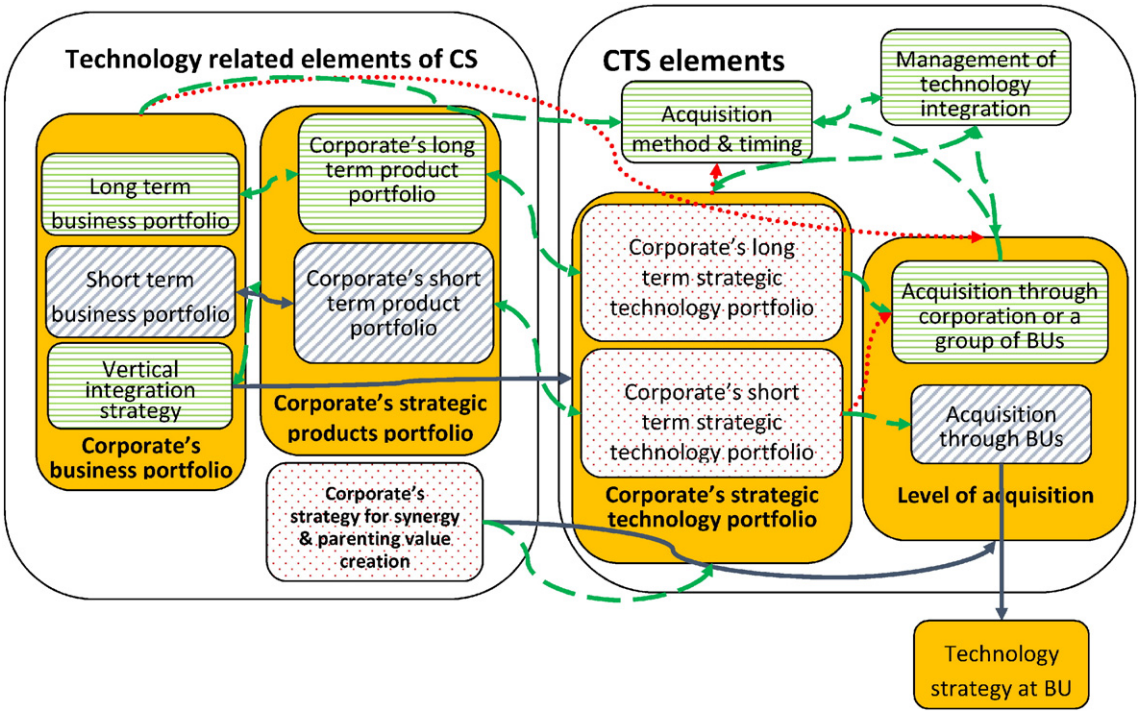

Fig. 4. CTS and CS linkage in MBCs.

service technologies in the arguments, but we can imply to ERP or automation system as some common supporting technologies.
- Formulation of synergy making incentives for BUs has not been observed in IKCO's CTS agenda up to now.

Although some mismatches were revealed in our case study, process and results of this study showed that our conceptual framework makes sense as a tool for analyzing CTS and it's linkage with overall strategies in an MBC. Fig. 4 presents the results of such an analysis in IKCO and some improvements in our framework, too.

Those elements of CTS or its linkage paths with CS which make sense and are in the agenda in IKCO has a Diagonal hatch. Areas with a Horizontal hatch are those elements and linkage paths which make sense to some extent but are not paid a complete attention yet. Hatched areas with a dot pattern shows the elements or linkages which have no relevance in IKCO or have not received any efforts up to now.

This study also proposed two modifications to our initial framework. First, to consider technology integration as an important element of CTS. We can argue that one of the most important elements of IKCO's CTS – and perhaps in other corporations with a large complex supplier network – is technological integration through value chain which has been considered in the literature recently (Terpend et al., 2008; Pero and Andrea, 2009). Thus, we have added a box for technological integration to our previous framework in the Fig. 4. Second, we saw that CTS is affected with product portfolio (and not business portfolio directly). It seems that product portfolio is extracted from CS and specially its business portfolio element. Then we can propose that product portfolio plays the role of an interface between CS (business portfolio) and CTS. This should be confirmed through other case studies in large MBCs.

Further, deep analysis revealed that most of aforementioned conflicts root in IKCO's context in a developing country. Thus, we will build our concluding discussion through catch-up literature of latecomer firms which provides a deep understanding of the story.

5. Conclusion

A conceptual framework that includes basic elements of corporate-level technology strategy and their linkage paths with corporate strategy had been developed through a large survey of related literatures (Arasti et al., 2010). In this paper, we re-discussed that conceptual framework to capture it (with minor modifications) as the basis for an in-depth case study in IKCO industrial group to answer these questions:

- How much the proposed framework does match with what it goes in practice in such an MBC?
- Can we clarify the basic elements and linking paths of CTS with CS in IKCO, like what our initial framework proposed?

Based on its recent technological achievements, Iran has been considered as a developing country in related literatures (Kiamehr et al., 2015). The context of developing countries differs from developed ones in multiple ways (Kiamehr et al., 2015). It brings market-related (Hobday, 1995; Freeman and Soete, 1997; Mathews, 2002) and technological (Hobday, 1995; Mathews, 2002) disadvantages for latecomer firms just to imply to most important ones. This makes latecomer firms different from either leader or follower firms in developed countries who enjoy a better situation to decide on their leader/follower strategy (Mathews, 2002). Thus, they should pursue a catching up path (i.e., approaching the frontier) to improve their situation in business (Lall, 1992; Bell and Pavitt, 1995; Kim, 1997). In order to do this, latecomer firms should accumulate some levels of different capabilities while climbing the staircase of catch-up stages (Abramovitz, 1986; Katz, 1987; Lall, 1992; Amsden and Hikino, 1994; Bell and Pavitt, 1995; Kim, 1997; Figueiredo, 2003). Catch-up stages are also in correspondence with different kinds of innovation, value creation, and firm's knowledge base (Kim, 1997).

From a technological perspective, these companies are isolated from advanced sources of knowledge and also have a laggard internal technology base (Mathews, 2002). This has some implications for our purpose as follow:

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- Late comer firms usually approach to their industries' value chain from downstream (Kim, 1997), which contains those activities with lower financial and technical risk and complexity (Katz, 1987). In other words, the path of catch-up in technology is suggested to begin with simple, technology-deploying production capabilities, continuing through investment capabilities and finally to advanced innovation capabilities (Dahlman and Westphal, 1982). Necessity of CTS in IKCo was confirmed by top managers because of available opportunities for synergy making through these common production or investment capabilities and the necessity of utilizing some supporting technologies in the whole corporation. However, these managers agreed that most of product, process, and support technologies which IKCO deploys are easily available for use through licenses from their foreign partners or market transactions. This may explain why CTS in a latecomer MBC tends to focus on process technologies which are required in elementary and intermediate stages of catch-up staircase in addition to some sorts of supporting or shared services technologies.
- It seems now understandable why CTS in a latecomer MBC does not contain long oriented investments in basic R&D. This study also revealed that emergent opportunities for diversification had more weight in comparison to planned ones. This may not directly relate to its latecomer context but again leads to short-term orientation of CTS Portfolio. Changing the name of IKCo's research center to NPD center, which shows corporation's priority for product development instead of technology development while considering its current situation in catch-up staircase, seems reasonable.
- Parent company and business units both have roles to play regarding technology integration. It seems that parent company has a more important role in integrating the needs of its different business units through selection phase. It may also play the hub role in external or internal technological collaborating networks while business units may have a major role in deployment of acquired technologies. The role of parent company also depends on the context of the corporation in developed or developing countries. For example, IKCO lacked a capable local supply chain. This challenge has been more sensible when IKCo moved up from catch-up staircase and dealt with more challenging innovations in its product designs. As a Latecomer MBC, IKCo should play a “semi-parenting” role to create and develop its local supply chain. This makes external technological integration more challenging in comparison to corporations in developed countries who face with an advanced established network of suppliers.
- Latecomer MBCs usually tend to positioning approach as their limit access to required technological capabilities. Thus, while scholars believe that the linkage of CTS and CS is bidirectional, interactive, and dynamic at corporate level like as BU level (Itami and Numagami, 1992; Bellotti, 1994; Berry and Taggart, 1998; Zahra et al., 1999; Hipkin, 2004; Lenz, 2004), we observed less evidences of CTS impact on CS. Most evidences showed how CTS is developed based on CS. It is noticeable that our interviewees implied to those activities like increasing IKCO's market share from export markets or expansion of activities in their current value chains which are consistent with IKCO's catch-up path while they asked for suitable directions for IKCO's diversification in future.
- Normally, planning for acquisition of necessary technological capabilities is a lateral step while IKCO diversifies into new businesses and in most cases it lays on their foreign partners' capabilities (transferred capabilities). More opportunistic nature of IKCO's diversification strategy might be an interpretation.

While the applicability of proposed framework has been illustrated through IKCO case study, further studies are necessary in wider range of contexts for generalization. Qualitative studies may reveal more about the process of CTS formulation, whereas quantitative research may identify the relationships between different elements of CS and CTS. These studies may reveal more about parent's role in technological integration through supply chains, whereas other researches may focus on how CTS affects CS to identify the relationships between corporation's technological capabilities and diversification strategies and paths.

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