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# Competitive advantage in an industry cluster: The case of Dalian Software Park in China

Weilin Zhao [a], Chihiro Watanabe [a,*], Charla Griffy-Brown [b]

[a] Department of Industrial Engineering and Management, Tokyo Institute of Technology, 2-12-1 W9-49 Oo-okayama, Meguro-ku, Tokyo 152-8552, Japan
[b] Graziadio School of Business and Management, Pepperdine University, 6100 Center Drive, Los Angeles, CA 90045, USA

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A B S T R A C T

This paper explores the competitive advantage of Chinese software parks for promoting industrial development. These industry clusters provide competitive advantage because they are rooted in local institutional systems. Taking the case of Dalian Software Park in China, this analysis is conducted qualitatively based on Porter's "diamond" model, SWOT framework and interview results. Industry clusters, which encompass a series of interconnected firms in designated geographic concentrations, show competitive advantages for industrial development with substantial resources rooted in local institutional systems including government, industry and academia aspects. In order to successfully navigate the economic paradigm shift from mass manufacturing production to innovative new product development in China, it is essential that the competitive advantages of industry clusters are strengthened and sustained in order to enhance industrial development, generate innovation and increase regional economic growth.



## 1. Background

Since the emergence of information and communication technology (ICT) in the 1990s, a tremendous amount of socio-economic changes has occurred, transforming daily life, global economic markets, and business practice. ICT is central to discussions about economic growth and performance because it is pervasive and widely diffused.

China, with its rapidly expanding economic growth, has experienced tremendous development and change in various sectors of ICT, particularly in the development of the software industry. The Chinese government stepped forward to promote the software industry in the mid-1990s. Although this emphasis began later than the promotion of the hardware sectors in ICT, software development in China benefited from the hardware development that preceded it. Simply put, software development increasingly demands a sizeable installed computer base, with reliable and pervasive telecommunications links both domestically and internationally. These requirements were addressed by the rapid strides in PC and Internet development in China.

Development has been accelerated by a series of regulations, important policies, excellent industrial support, and many factors that benefit rapid development. In particular, the Eleventh Five-Year Plan (2006–2010), which began in the spring of 2006, accelerated these strengths [1]. In this plan, innovation was again key, and improving innovation capability was identified as the crucial task for future development in all areas. In addition, developing the information service industry was also pinpointed as an important development strategy. Industrialization by informatization, or an information-driven economy, was also emphasized in the plan. As a core industry, the information industry was given high priority to develop

* Corresponding author. Tel.: +81 3 5734 2248; fax: +81 3 5734 2252.
*E-mail address:* watanabe.c.aa@m.titech.ac.jp (C. Watanabe).

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rapidly and promote the development of related industries. The software industry, as another important sector, continues to develop innovative products that can compete in the global market.

The development history of the Chinese software industry is relatively short. In its brief history, a distinct industrial structure with two basic strategies—development in domestic markets, and exports—have led this effort. By stimulating domestic market demand and encouraging software exports, resources for software development are expected to improve in quality and in turn, induce further expansion of the domestic market and strengthen the competitive advantages of the industry.

It is generally understood that demand is an important factor in promoting industrial development. ICT development brings with it a huge demand for software in various sectors of an information society. The compound annual growth rate of ICT software spending[1] in 38 countries, between 1993 and 2004, ranked China at the top [2]. This demand is an important catalyst for the remarkable development of the software industry in China.

At the same time, China has been adjusting its development strategy, and in 2000 it began strengthening its export policies [3]. The underlying principle of this policy is to make the software industry face two kinds of market and two kinds of resources, domestic and international, in order to make the industry more competitive globally and technologically. Efforts continue at the national level to promote software-related industry clusters in order to help realize China's goals and to achieve success in domestic and international markets.

Since the early 1990s, China has begun to establish software parks, including 11 national software industrial bases and 6 national software export bases, which support the overall planning and layout of the Chinese software industry. As a result, the development environment of the Chinese software industry has been dramatically improved and awareness of the competitive advantages of these industry clusters has greatly increased. Thus, more research on the recognition and improvement of competitive advantage in an industry cluster is indispensable.

### 1.1. Objectives and structure

This article seeks to identify institutional sources for the competitive advantages offered by Chinese software parks. To do this, we take the case of Dalian Software Park (DLSP). Dalian's local institutional systems, and especially their drive toward software exports, are the focus. Section 2 introduces some related research work. Section 3 outlines the analytical framework, including methodology and data collection, and Sections 4 and 5 provide results and discussion of the analyses.

## 2. Literature review

### 2.1. Competitive advantage

"Competitive advantage" is a popular term in many fields, and broader definitions include national, industrial, and firm levels. The advantage is termed "competitive" when what the firm does is unique and difficult to replicate. In the global context, developing competitive advantage has become the core strategy for many businesses. And when it comes to this term, existing work must be introduced from the basis of the theory and research concerning competitive advantage completed by Michael Porter [4]. In his book *The Competitive Advantage of Nations*, he addresses the question "Why [do] nations succeed in particular industries, and [what are] the implications for firms and for national economies?" He stresses the important role played by "a nation's economic environment, institutions and policies" that lead to successful competitive industry development, and he states:

> Differences in national economics structures, values, cultures, institutions and histories contribute profoundly to competitive success. The home nation takes on growing significance because it is the source of the skills and technology that underpin competitive advantage. ([4], p. 19)

Based on this view, our paper analyzes the competitive advantage of industry clusters embedded in local institutional systems within the macro context of national institutional systems. Porter developed the "diamond model"[2] which he uses to discuss the determinants of national advantage based on four broad attributes of a nation: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry [4]. Porter states:

> The determinants, individually and as a system, create the context in which a nation's firms are born and compete: the availability of resources and skills necessary for competitive advantage in an industry; the information that shapes what opportunities are perceived and the directions in which resources and skills are deployed; the goals of the owners, managers, and employees that are involved in or carry out competition; and most importantly, the pressures on firms to invest and innovate. ([4], p. 71)

[1] ICT software spending refers to "expenditure for ICT development/utilization including the purchase of all software products, external customization of computer programs, systems software/utilities, application tools and application solutions" [2].

[2] Diamond is used to refer to the determinants as a system [4].

Since our analysis is also based on Porter's diamond model, its content and application in this study are discussed in Section 3.

### 2.2. Industry cluster

"Industry cluster" is a current concept in economic development, also popularized by Porter [4]. As a recognized expert in global economic strategies, he discusses the power of industry clusters to advance regional economies. He writes:

> The concept of "clusters," or groups of interconnected firms, suppliers, related industries, and institutions that arise in particular locations, has become a new way for companies and governments to think about economies, assess the competitive advantage of locations, and set public policy.

However, there has been no exact definition of "industry cluster" until now. Recent research by Doeringer and Terkla [5] and Leveen [6] examine the literature regarding industry clusters and identify them as "geographical concentrations of industries that gain performance advantages through co-location". "Geographical concentration" is the key that defines the basic but distinctive characteristic of an industry cluster. As a specialized concentration of firms and industries in a region, they usually have common markets, and share common suppliers, trade, or education institutes, and intangible things like know-how and information; similarly, they also may face similar opportunities and threats.

There are many industry cluster development models in countries around the world. For example, in the U.S., Silicon Valley (California) and Route 128 (Massachusetts) are well-known industry clusters. The former is famous for microelectronics, biotechnology, and venture capital markets while the latter is well known for its software, computer, and communications hardware [7]. The reasons why software firms tend to cluster were analyzed, with a special focus on the transfer of information and knowledge [8]. In fact, although research about industry clusters has been examined from the perspectives of economic development, strategic management, knowledge sharing, and technology spillover, there is little research that addresses the competitive advantage offered by industry clusters that are based on institutional systems.

As introduced by Leveen [9], industry clusters can be classified into two types: vertically integrated clusters and horizontally integrated clusters. The first type of cluster is "made up of industries that are linked through buyer-seller relationships"; the second one "includes industries which might share a common market for the end products, use a common technology or labor force skills, or require similar natural resources" [9]. The software parks that we examine in this paper can be considered part of the second type.

### 2.3. Institutional systems

The development of industries is led by innovation, assimilation and utilization of technology that chiefly depends on the economy, society, culture, habits, systems and policies embedded in a specific geographical context. This kind of comprehensive system can be referred to as an "institutional system". In terms of institutional systems, North's definition must be cited. He considered institutions as "The humanly devised constraints that structure human interaction. They are made up of formal constraints (e.g. rules, laws, constitutions), informal constraints (e.g. norms of behavior, conventions, self-imposed codes of conduct), and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies" [10]. Kondo et al. suggested that "While a number of works have conducted broad-ranging theoretical and empirical analyses on the behavior of institutions, their focus is not necessarily the identification of the role of institutions as a core inducing factor of innovation and stimulator for broad diffusion. Binswanger's work [11] paid special attention to the role of institutions in inducing innovation" [12]. Watanabe et al. [13] have also conducted intensive analyses on the behavior of institutional systems. They defined institutional systems as a three dimensional system with specific details in each dimension consisting of (i) national strategy and socio-economic system,(ii) entrepreneurial organization and culture, and (iii) historical perspectives. Using this framework, we consider the local institutional systems to be shaped by the cooperation and co-evolution of government, industry and academia. The following analysis is conducted based on this framework.

### 2.4. Software parks in China

Since the 1990s, there has been a clustering of industries, particularly high-tech industries, in various Chinese cities. As Hu notes: "Although neither Silicon Valley nor Route 128 came into existence by design, countries around the world, developed or under-developed, have tried to emulate the American success stories by offering policy incentives to encourage high-technology firm formation in designated locations" [14]. China is one such country. Situated in a special geographic location, industry clusters can take many forms. The firms share well-constructed infrastructure and services, specialized customer markets, labor markets, human resources, know-how, and information. These shared resources create helpful synergies between industrial and regional economic development. In addition, clusters fuse indigenous strengths with global best practices from firms in a variety of countries that have different institutional systems.

The establishment of software parks in China began in the 1990s. Important policies included the "policy for promoting the development of the software industry and integrated circuit industry" (initiated in 2000) and the "action program for the vitalization of the software industry" (2002–2005) [3], both of which stimulated the development of software parks. Today, software parks are a crucial incubator for the development of the software industry. Regional clusters, which served as

**Table 1**
Comparison between main software parks in China (2003–2005).

| | Sales revenue (Yuan billion) | | | Export ($ million) | | | Number of firms | | | Total employees (thousand) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2004 | 2005 | 2003 | 2004 | 2005 | 2003 | 2004 | 2005 | 2003 | 2004 | 2005 |
| Beijing[a] | 3.07 | 9.18 | 15.00 | 29.30 | 35.00 | – | 120 | 217 | 300 | 7.8 | 13.6 | 30.0 |
| Shanghai | 4.00 | 5.00 | 6.00 | 20.00 | 50.00 | 70.00 | 228 | 223 | – | 6.0 | 9.0 | – |
| Dalian | 2.40 | 4.50 | 5.00 | **80.00** | **200.00** | **300.00** | 173 | 230 | 267 | 6.0 | 20.0 | 25.0 |
| Xian | 1.98 | 2.80 | 4.0 | 23.04 | 31.00 | – | 359 | 400 | 420 | 14.1 | 16.0 | 20.0 |

Source: Authors' summary, derived from [3].
[a] Data for Beijing in 2005 is estimated based on 2006 data.

mechanisms for policy implementation, not only led the growth of the local software industry, but they also were crucial for national development in this area.

In 2001, the Chinese government launched 11 national-level software industry bases in Beijing, Shanghai, Dalian, Jinan, Xian, Nanjing, Changsha, Chengdu, Hangzhou, Guangzhou, and Zhuhai [3]. Based on an export-oriented development strategy, the Chinese government tried to increase exports by establishing specialized industry clusters of export bases and encouraging firms to be more active in software exports. Subsequently, in 2003 six software parks in Beijing, Shanghai, Dalian, Shenzhen, Tianjin, and Xian, were authorized as software export bases [[3]]. Well-constructed infrastructure, preferential support policies, a continually improving legal environment, a supply of suitable talent, and sound education among the local population were major factors driving software development in these parks. In addition, software parks in other cities have tried to develop their own unique parks that set them apart from the earlier parks. For example, the software park in Beijing focuses more on the domestic market, R&D, and product provision. The software parks in Dalian and Shanghai focus on foreign markets and exports by providing more relevant software services.

Cities with software parks have emerged as leading software cities in China. Table 1 compares the main software parks that have two identities—both as a national software industry base and a software export base in China.

Among these cities, the software park in Dalian demonstrates particular excellence in exports, which can be attributed to a geographical advantage as well as suitable development strategies and industry policies that are supported by the local government. At the firm level, the top two firms in software exports in 2004—Neusoft[3] and Hi-Think—are located in Dalian [15]. Similarly in 2005, the top three, Neusoft, Hi-Think, and Hi-soft are all from Dalian.

Although Dalian is not economically developed like Beijing or Shanghai, it is located in a comparatively important geographical position as a marine gateway. Dalian is famous for its beautiful harbor, finance, trade, tourism, and recently developed high-tech industries. It is becoming a leading city as a result of increased economic reforms and activities. It also plays a crucial role in promoting regional economic development for most of the northeastern part of China, which traditionally relied on old manufacturing industries before economic reforms were implemented. Dalian's attractiveness features and location continue to encourage more firms to come and conduct business. Friedman notes: "There are still plenty of miserable, backward ones, which are grabbing business as knowledge centers, not just manufacturing hubs. The signs on the buildings tell the whole story: GE, Microsoft, Dell, SAP, HP, Sony and Accenture" [16]. At Dalian, the strength of Chinese firms and the learning effects of global best practice from foreign firms are well fused. Table 2 provides the number and ratio of local and foreign firms in DLSP. Compared with the 33% of foreign firms in Shanghai's software park and 30% in Beijing's [3], DLSP has the highest rate of foreign firms, which in turn plays a major roles in inducing additional clustering and learning. Thus, as a result of the clustering effects, firms from various countries with different cultural backgrounds and institutional systems stimulate and encourage a co-evolutionary development that leads to the win-win development as illustrated in Fig. 1.

As Table 1 shows, compared with other software parks, DLSP is especially strong in exports. After it was established in 1998, DLSP has grown into an important software outsourcing service provider, particularly to Japan because of its geographical proximity to Japan and historical background. DLSP's goal is to be the "software, business process outsourcing (BPO) and IT-enabled service (ITES) center of north Asia" and to be "a global resources center of multinationals to serve and support their northeast Asia operations and the American and European markets" [17]. The upward trend in basic indicators for DLSP isshown in Fig. 2. DLSP's achievement can be attributed largely to clustering, which induced a good business environment, preferential supportive policies, and a huge pool of talented human resources. All of these features are significantly rooted in its local institutional systems.

## 3. Analytical framework

### 3.1. Methodology

The overall methodology for this research is a case study of DLSP. Yin regards case study as an empirical inquiry that "investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon

[3] In the case of Neusoft Group, the location of the export-oriented subsidiary is in Dalian.

**Table 2**
Number of Chinese and foreign firms in DLSP (2005–2007).

| Number of firms/Year | 2005 | 2006 | 2007 |
|---|---|---|---|
| Chinese firms | 159 (60%) | 211 (58%) | 227 (58%) |
| Foreign firms | 108 (40%) | 153 (42%) | 165 (42%) |
| (including global 500 corporations) | (22) | (27) | (33) |
| Total | 267 | 364 | 392 |

Source: Authors' summary based on [17].

and context are not clearly evident" [18]. If qualitative discussions rather than technical issues are the focus of the research, the case study methodology is ideal for understanding the dynamics of competitive advantage at DLSP.

Furthermore, we analyzed the institutional sources of the competitive advantage enjoyed by DLSP using Porter's "diamond" model and a SWOT (strength, weakness, opportunity and threat) analysis, to do the analysis.

In addition to the general analyses described above, interviews were conducted and information from them provided more practical management implications based on the industrial experiences of managers at DLSP.

#### *3.1.1. Porter's diamond model*

Michael Porter's diamond model [4] was used as the framework for evaluating the competitiveness of regional industries and elucidating local industry clusters. This framework is illustrated in Fig. 3, which shows the relationships between the key drivers.

#### *3.1.2. SWOT analysis*

SWOT refers to strengths (S), weaknesses (W), opportunities (O), and threats (T). A SWOT analysis is useful for analyzing firms' strategic management and identifying the level of firms in each dimension. Our SWOT analysis provided a clearer map of the four factors as they appear in DLSP, which helped to make it aware of its strategic position and indicated how to strengthen its competitiveness.

#### *3.1.3. Interview survey*

To support the general analyses from the industry's point of view, interviews were conducted to evaluate more qualitative aspects and gain insights into current development issues. Interviews of people from selected firms were conducted in Dalian in January 2007.

### *3.2. Data collection*

Most of the statistical data in this paper came from websites such the China Software Industry Association [3], and published documents like the Annual Report of Dalian Software and Information Service Industry [19] and *China Statistics Yearbook on High Technology Industry* [20]. In the interview phase, the selected firms represented all firm types in DLSP, including four branches of foreign firms, two of China's top-ranked firms in software exports, and one SME (Small Medium Enterprise). All the interviewees held manager-level positions responsible for project management and practical business management. Table 3 summarizes the profiles of the firms and interviewees.

## 4. Results

### *4.1. Diamond model analysis*

Porter states: "Promoting cluster formation in developing economies means starting at the most basic level. Policy makers must first address the foundations: improving education and skill levels, building capacity in technology, opening access to capital markets, and improving institutions" [22]. Dalian has tried to encourage cluster formation ranging from the construction of basic

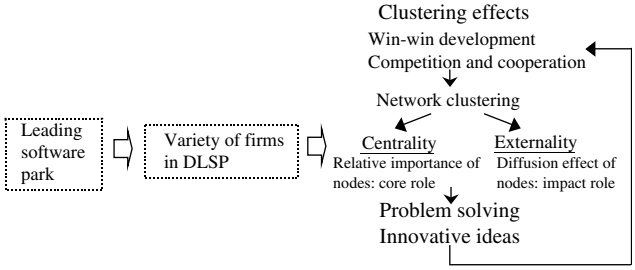


**Fig. 1.** Co-evolutionary function of clustering effects in an industry cluster.

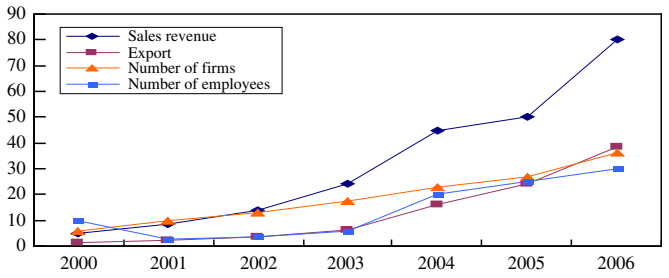


**Fig. 2.** Increase trend in basic indicators of DLSP (2000–2006). Note: Real data with 0.1 billion yuan in revenue and export, thousand in number of employees, 10 times in number of firms, \$1 = 8 yuan). Source: Authors' summary and elaboration based on [1].

infrastructure to a wide range of human resources. With Dalian's local institutions providing substantial resources, cooperation between government, industry, and academia is crucial for creating a good business cluster. Based on Fig. 3, the factor determining the competitive advantages of DLSP in the local institutional systems represent a kind of virtuous cycle or self-propagating function. The cooperation between government, industry and academia is demonstrated in Fig. 4.

In order to highlight the competitive advantages of DLSP shown in Fig. 4, the analysis focused on the three aspects of government, industry, and academia in combination with the elements of the diamond model. Since all the determinants of the diamond model can be summarized in these three dimensional aspects, this kind of consideration for the analysis is appropriate. With detailed descriptions of support policies and strategic actions in the three dimensions, it is noteworthy that the competitive advantages of DLSP are rooted in the cooperation between government, industry, and academia. This cooperation is driven by the local institutional systems, which incorporate different factor determinants from the diamond model. The local institutional systems seem to be "fertile soil" that promotes the growth of DLSP as a mature industry cluster and supports and expands its competitive advantages.

### *4.1.1. Government*

Unlike Silicon Valley, DLSP was initially established and organized by the local government with government support. Although Porter's view is that government is only a facilitator [4], the government has played a decisive role in establishing and developing DLSP with well-organized infrastructure construction, top-down development guidance, and supportive policies. Factors conditions in the diamond model, including physical, capital resources, and infrastructure, can be attributed to support from the government. All kinds of government-sponsored events are regularly held in Dalian to improve the city's reputation and to encourage more foreign investment. The government's high priority on development makes infrastructure construction happen with more efficiency, top quality, and modern information equipment. The subsequent increased users of PC and Internet construct the basic information infrastructure. Policies provide support for software firms including taxes, finance, and technology. For example, software firms do not pay any taxes for the first two years. Thereafter, they pay only half of the assessed taxes for the following three years. The total of five years of preferential tax treatment enables many firms to develop rapidly and encourages more start-ups. A special fund has also been established for ventures. In order to improve intellectual property (IP) protection awareness, the first IP service center in China was set up in DLSP with the Dalian government's help. In conjunction with laws governing private data protection in Japan, DLSP took early action to provide guarantees for Japanese customers. Clearly, ongoing government efforts have led to the successes and achievements of DLSP.

### *4.1.2. Industry*

DLSP was established to promote the development of the software industry. Industry is the core part of this endeavor and all parts of the diamond model are represented here. The rapid development of ICT, and information infrastructure

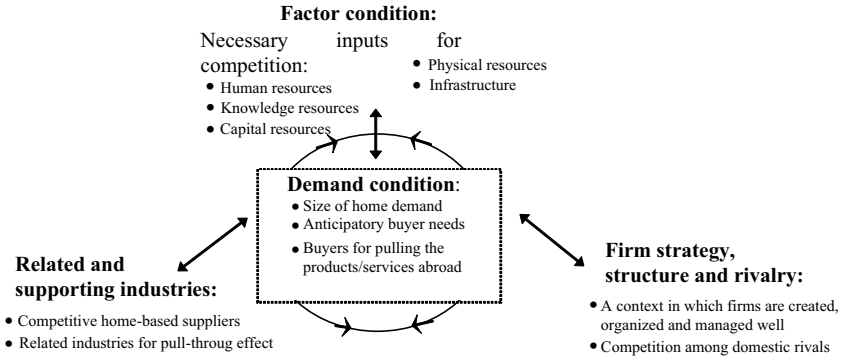


**Fig. 3.** Factor relationships in the "diamond" framework. Source: Authors' summary based on [4].

**Table 3**
Profiles of firm types and interviewees.

| Firm type | Interviewees |
|---|---|
| A: branch of one of global 500 corporations from the US, focusing on IT hardware and software. It mainly serves the clients from the US and Japan in project development, outsourcing and consulting. It is a CMMI[a] 5 firm. | I-a: total 2 years work experience in A, responsible for software development and project management. |
| B: branch of one of global 500 corporations from the US, focusing on management and IT consulting. It mainly serves the clients from Japan in outsourcing and consulting. It is a CMM 5 firm. | I-b: total 4 years work experience; 2 years in B, responsible for outsourcing project. |
| C: branch of one of global 500 corporations from Japan, focusing on software development and maintenance for its parent company in Japan and other branches in other cities of China. It has its own quality standard. | I-c: total 2.5 years work experience in C, responsible for project management and communication as BSE (Bridge System Engineer). |
| D: branch of one of famous IT corporations from Japan. In dependence or by cooperation with local firms in Dalian, it mainly serves the clients from Japan and Japanese firms in China in system development, system integration and outsourcing service. It is a CMMI 3 firm. | I-d: total 4 years work experience, 3 years in D, responsible for Japan-oriented project management and communication as BSE. |
| E: one of China's top-ranked firms in software export and outsourcing service. With a good reputation in Japan, it mainly serves the clients from Japan. It also has excellent performances in system, solution and service in Chinese domestic market. It has its own specialized IT training institutes. It is a CMMI 5 firm. | I-e: total 5.5 years work experience in E, responsible for software quality and multi-projects management as a department manager. |
| F: one of China's top-ranked firms in software exports and outsourcing services. It mainly serves the clients from Japan and has a good cooperation relationship with Japanese firms. It is also attracting the projects from the US and Europe. It is a frontier in providing professional IT training. It is a CMM 5 firm. | I-f: total 4 years work experience in F, responsible for Japan-oriented software development and project management. |
| G: one of local ventures set up by an IT professional with work experience in Japan and good connection with some Japanese firms. It mainly serves the clients from Japan in software development and outsourcing service, focusing on medium-small scale projects with lower cost. | I-g: total 8 years work experience in Japan, responsible for the whole management in particular in connecting with Japanese firms to get new projects. |

[a] CMM means Capacity Mature Model, which is a kind of international quality standard for evaluating the capacity mature of software development. Now CMMI (Capacity Mature Model Integration) replaces the CMM [21]. The level difference is from 1 to 5.

construction, generated huge domestic ICT markets, while the need for human resources had a pull-through effect on the development of the related IT training industry. Both of these factors resulted in more innovations in traditional IT education at the universities.

At the end of 2007, nearly 50% of the firms in DLSP were foreign, including major participation by well-known multinational corporations seeking to establish a base of Asian operations.[4] This can be ascribed to the unique business environment, rich development resources, and high growth potential for DLSP. The competition and cooperation among the firms is another virtuous self-propagating cycle that brings out more innovative ideas, which in turn continues to stimulate industry dynamics. Related industries are benefiting from the development of the software sector. Intel has invested US$2.5 billion to set up a new chip factory in DLSP, which will be Intel's largest chip factory in Asia [17]. In the meantime, Intel has collaborated with Dalian University of Technology to encourage the development of local talent for the semiconductor industry, which is expected to be another important sector of DLSP in the near future.

#### *4.1.3. Academia*

As a knowledge-intensive industry, the software industry cannot develop well without qualified human resources. One role of academia is to guarantee the availability of human resources, which are another important factor in the diamond model. Since DLSP was established, software-related education has been strengthened. In addition to quantity, the current education system focuses on the quality of graduates. Many private training institutes and centers are pursuing a new demand-oriented training model that focuses on practice as a supplement to traditional education. By collaborating with firms, basic research in the universities has a more practical focus in software research and development. This not only enhances the reputation of the academic institutions but also promotes the firms' capacity to develop innovative products.

### *4.2. SWOT analysis*

After the diamond analysis of Dalian's local institutional resources, a SWOT analysis was conducted to identify the general opportunities and threats associated with Dalian's competitiveness, thus providing further insight into the strengths and

[4] Famous global corporations include GE, Dell, Accenture, IBM, SAP, Panasonic, HP, Nokia, Sony, NEC, Hitachi, Ricoh, Mitsubishi, Convergys, Omron, Sumitomo, Siemens, Intel, Avaya, Oracle, NTT, and Fujitsu.

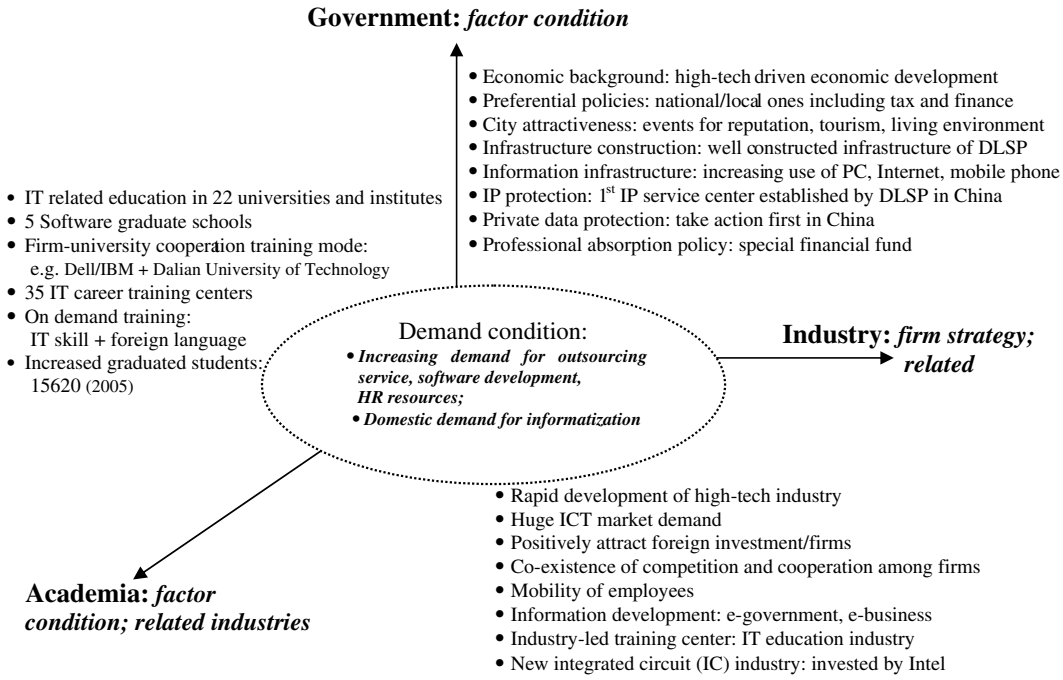


**Fig. 4.** Factors governing the institutional sources of DLSP's competitive advantages.

weaknesses of DLSP. Such an analysis would also help to identify areas in which the existing institutional systems could be improved. The results of the SWOT analysis are tabulated in Table 4.

Strengths are the ways DLSP can obtain opportunities and face existing threats. In most cases, weaknesses are the opposite of strengths, but there are areas that existing strengths cannot easily overcome. Strengths need to be further improved, weaknesses should be overcome, opportunities need to be taken, and threats should be resolved in order to enhance DLSP's competitiveness.

Though Dalian has a favorable geographical location, the increasing cost of living is threatening the availability of human resources. Dalian's attractiveness needs to be strengthened both in hard aspects and soft aspects. In order to guarantee a strong talent pool, traditional IT educational institutions are being challenged to focus more on quality rather than quantity only. When some firms take a leadership role in the software industry's development, a performance gap exists and sometimes widens. The problem is that many firms tend to pursue a popular technology without previous experience in that area. Thus, the formation of technology concentration creates bottlenecks for developing competitive advantage. Developing

**Table 4**
Key aspects of the DLSP SWOT analysis.

| Strengths | Weaknesses |
|---|---|
| Government:<br>• Good geographical location/attraction<br>• Well constructed infrastructure environment<br>• Developed communication equipment<br>• Preferential government support<br>Industry:<br>• Improved legal environment/protection<br>• Endeavor to get international certification like CMM<br>• Partnership between firms and collective visions<br>Academia:<br>• Efforts in providing IT talents<br>• General lower cost | Government:<br>• General control in living cost<br>Industry:<br>• Not so effective/efficient in use of development resources<br>• Underlying weakness like popular technology pursuit<br>• Smaller scale of firms<br>• Performance gap between firms<br>• Comparatively lower innovation capability in most firms<br>• Not standardized in project management in some firms<br>Academia:<br>• HR provision: quantity focus, quality neglected<br>• Not enough HR with good English skill |
| **Opportunities** | **Threats** |
| • Huge demand from foreign and domestic markets<br>• Increasing demand for outsourcing service and BPO<br>• Information-driven economy/High-tech development<br>• Status of increasing cost and lack of HR in India | • New emerging countries as outsourcing locations<br>• New emerging coastal cities as offshore locations<br>• Increasing living/training cost for HR in Dalian<br>• Market bottlenecks due to market concentration |

unique requisite technology (rather than everyone pursuing a similar technological area) will diminish these bottlenecks and reduce the performance gap, thus making firms more competitive.

### 4.3. Interview results

In addition to the general analyses using the diamond model and the SWOT factors, it is crucial to clearly understand the firms' strategic thinking and to know what their real needs are.

Considering the local institutional systems as a co-evolutionary process between government, industry, and academia, the interviews focused on these three dimensions. The results are summarized across several important issues that consistently arose during the interviews regarding specific issues in software development, quality management, outsourcing, clustering effects, and education.

#### 4.3.1. Government

In general, interviewees regarded DLSP as a good environment in which to do business, and they recognized the substantial number of supportive government policies. However, they consider the network—including information exchange and cooperation among the firms in DLSP—to be the most attractive feature. In particular, when they need special skills for certain projects, it is easier to obtain help from other nearby firms if good connections have been established. Therefore, firms in DLSP believe it is essential to develop and maintain good relationships with other firms.

Interviewees also remarked that sometimes competition is very intensive in DLSP, especially among some of the SMEs. Interestingly, interviewees from foreign firms felt that competition in DLSP was healthy and would produce more innovative ideas; in contrast, interviewees from local firms felt that such competition was dangerous and risky, particularly for SMEs who pursue popular technology in software development without having their own specialized skills in-house. The SMEs felt this was risky because their only competitive advantage was reduced cost. One interviewee said that his firm experienced this situation and he could understand the difficulties faced by smaller firms trying to survive. He said it is crucial for SMEs to master some of the requisite skills as soon as possible in order to move beyond the simple labor cost advantage.

We found it somewhat surprising that in general the question about DLSP was typically shifted by interviewees toward discussions about cooperation and competition between firms. They all agreed that the efforts from all parties, including government, industry, and academia, led to greater competitiveness in DLSP.

#### 4.3.2. Industry

*4.3.2.1. Quality management.* Quality is still at the core of software development. A successful project means not only few bugs but also standardized controls. In the past, many Chinese software firms focused more on meeting a deadline rather than quality control. Recently they have recognized the importance of getting international certifications in software development.

Achieving Capacity Mature Model (CMM) certification has been the goal for most firms. Interviewees agree that CMM helps them be more standardized in project management. One interviewee stated that passing the tests for CMM certification is troublesome, but the process helped them learn a lot and realize improvements. Standardization actually made project management much easier. Another interviewee stated that although his firm currently does not have the ability to obtain CMM certification, quality is emphasized in detail throughout their business processes. They do well not only in programming but also in documentation management, because customers pointed out that documentation was badly managed by SMEs. Although it takes time for them to pass CMM, this firm will continue striving to achieve this goal.

When asked about quality comparisons with Indian software firms, interviewees from U.S. firms thought China lagged behind India in this sector, and that China should do more to improve its quality management in software development. However, interviewees from Japanese firms and local firms stated they were very confident that Chinese SMEs could compete equally with Indian software firms on the issue of quality management. In general, the U.S. position was based on frequent contact and work with both Chinese and Indian software firms, while the positions of the Japanese and local firms was based on their experience with the improving quality management in Chinese software firms.

*4.3.2.2. Key factors for outsourcing.* What are the key factors for success in outsourcing? This is a question to which none of the respondents could provide a complete or exact answer. The interviewees mentioned internal and external factors. Some observed internal factors such as government support, a large talent pool of engineers, and labor costs as advantageous. Other firms felt that specialized skills and foreign language proficiency were more important. Still other firms pointed out that in addition to the requisite technology and human resources, good connections and communications with customers were essential.

These observations and industrial experiences are valuable for further development and research specifically on outsourcing in China. The factors mentioned here are all incorporated in the competitive advantages of DLSP and related to local institutional systems. It can be concluded that the competitive advantages of DLSP lie in the positive actions taken by firms in the park and the cooperation between these firms.

*4.3.2.3. Potentiality and clustering effects.* The competitive advantages of DLSP rely on Dalian's good geographical position, and supportive government and industrial policies, which are rooted in local institutional systems. The long-term goal for DLSP is

to become the largest resource center for software, BPO, and ITES [7]. DLSP has had some success along these lines, in terms of creating opportunity for development and entrepreneurship. In the meantime, additional clustering effects of DLSP in enhancing competitiveness are expected.

All interviewees observed that DLSP shows great potential. This observation was based on expanded globalization, Chinese economic growth, huge market demand, and DLSP's own competitive advantages.

One interviewee commented that their customers prefer to outsource to China now more than ever. More Chinese engineers now can speak English well, and their skills are highly valued. Since more foreign firms do business in Dalian, there are more opportunities. Some interviewees agreed that because of its geography and a strong pool of people who can speak Japanese with some proficiency, Dalian would remain the first choice for Japanese firms that wish to outsource. One interviewee observed that continual improvements to the business and legal environment would provide legal guarantees for further development.

In terms of clustering, all interviewees mentioned the networks among the firms in DLSP. Similar to the first question about DLSP, their answers concentrated on the topic of cooperation and competition. Although the term ''clustering effects'' had multiple meanings to the interviewees, they considered partnership to be the most important, since collaboration and information sharing are essential for success, and resource supplement and technological upgrading can be accomplished best through partnerships with other firms. In addition to frequent connections among the firms, a club for managers is available, organized by DLSP and meeting every month to provide opportunities for more communications between firm managers. One interviewee confirmed that by joining the club, and through frequent communications with other firms, a partnership was formed, and he received timely help when he encountered difficulties in project development.

#### *4.3.3. Education*

The available IT talent pool is undoubtedly a strong piece of the software industry's development. Though Dalian's government is endeavoring to strengthen IT education in order to guarantee the availability of quality human resources, the interviewees indicated this was not enough. They suggested that current IT education at universities lacked an emphasis on practical skills, which resulted in a negative attitude in some firms about employing new graduate students.

Some managers commented that the IT education in the universities was outdated. Although basic education is important, the practical content is indispensable for IT education. They suggested that their decisions about employing new graduate students depended on whether or not the students had some practical experience. For this reason, they embarked on some collaborative education with one university in Dalian to put practice content into the traditional IT education.

In addition to Company A, local firms like Companies E and F have tried to do business in IT training. Firm E have set up specialized IT training institutes, both in Dalian and other cities of China, since the beginning of the 2000s. Firms are realizing a win-win both in human resources and firm revenues by expanding the IT training opportunities for students. This supports traditional education and promotes innovative education.

## 5. Conclusion

By analyzing DLSP through the use of qualitative data collection and analyses, this article identified the sources of competitive advantage for DLSP and provided insight into industrial development. With the increasing awareness of an industry cluster's competitive advantages for industrial development and regional economics, our research highlighted the role of local institutions in promoting and expanding this competitiveness. Based on the determinants of Porter's diamond model, institutional sources were categorized into government, industry, and academic vectors. Then a SWOT analysis pointed out areas for further improvement and development by identifying the strengths, weaknesses, opportunities, and threats faced by DLSP. Interview data reflected observations from the industry that supported the general analyses.

China is facing a paradigm shift from labor-intensive manufacturing processing to the production of more high-tech innovative products because development that depends on low-value-added products is not sustainable. China is trying to move up the value chain in the global context. Its strategy is to develop competitive advantage in high-tech industries as a priority. The specific action taken is to encourage industry cluster formations in different cities for regional economic growth. The establishment of these industry clusters provides the industry with a favorable environment that includes attractive incentives and a well-constructed infrastructure that includes communication facilities and environmental services.

Behind the visible construction, the potential intangible effects from clustering firms in industry clusters are equally important. The clustering effect stimulates more competition and collaboration among firms to produce more innovative ideas and establish a win-win environment. This process of competition and collaboration, often referred to as co-evolution, leads to good performance by the firms. Because of the clustering effects, the firms grow and promote related industry development, and then play a profound role in regional economics by growing to be more competitive internationally. Since the clustering effect also has qualities that are embodied in network externality, the more the industry clusters grow, the more firms are attracted to do business in DLSP. This attractiveness to foreign firms leads to further co-evolutionary development among the Chinese and foreign firms resulting in sustainable competitiveness.

The success of DLSP as an industry cluster is based on institutional resources including strong efforts from government, industry, and academia. DLSP is an excellent model of a localized cluster in which development is deeply rooted in its local institutional systems. DLSP displays another competitive advantage by encouraging networks among firms, integrating into

the international value chain of activities, and improving its reputation internationally. The utilization of an array of resources from different firms stimulates more innovation and facilitates industrial and regional economic development. While Porter believed that top-down government guidance would not impact development, Dalian's government continues to develop strategic plans to strengthen the industry's development both as a guider and a facilitator, even though DLSP is operated by the private sector. The competitive advantages of DLSP are nurtured and supported by Dalian's institutional environment in which the local government has played an important role.

The limitation of this research is the lack of empirical analysis of the networks among the firms in this industry cluster, since a clustering effect from networks is strongly observed in the interview results. Therefore, an empirical analysis of networks could be a future undertaking to further elucidate this relationship and mechanisms for cooperation and innovation in the Chinese context.

Undoubtedly, some weakness and underlying threats remain in DLSP. Interview results show that opportunities and challenges co-exist in DLSP, and industry observations include practical suggestions for further development of DLSP. Key implications are the reinforcement of quality management, software-related education, and partnerships among the firms, since quality is the origin of competitiveness, human resources are the key for sustaining development, and partnership is at the core of clustering.

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**Weilin Zhao** is a Ph. D. candidate in the Department of Industrial Engineering and Management, Tokyo Institute of Technology, in which she finished her master course in one year. She received her Bachelor's degree from Dalian Maritime University in July 2002. After that, she worked as system engineering in Tokyo for 2.5 years taking charge of software development and outsourcing from Japan to China. She is currently a research assistant in the *Research Center for the Science of Institutional Management of Technology*. Her research interests include MOT (Management of Technology), institutional innovation, software innovation and outsourcing issues.

**Chihiro Watanabe** graduated from Tokyo University with a Bachelor's Degree in Engineering (Urban Planning) in 1968 and received his Ph.D.(Arts and Sciences) in 1992, also from Tokyo University. He joined Japan's Ministry of International Trade and Industry (MITI) in 1968 and is a former Deputy Director-General of Technology Development in MITI. He is currently a professor in the Department of Industrial Engineering and Management and Director of the *Research Center for the Science of Institutional Management of Technology* at Tokyo Institute of Technology. He is also Senior Advisor to the Director on Technology at the International Institute for Applied Systems Analysis (IIASA).

**Charla Griffy-Brown**, an associate professor of Information Systems at Pepperdine University's Graziadio School of Business and Management, is currently part of an international research team examining technology and development issues. She is a former researcher at the Foundation for Advanced Studies on International Development, Tokyo, and earlier served as an Associate Professor at the Tokyo Institute of Technology. She graduated from Harvard University, is a former Fulbright Scholar, and holds a Ph. D. in Technology Management from Griffith University in Queensland, Australia.