Patterns Of Strategic Change And Technological Learning In The Korean Small And Medium Enterprises

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Abstract

This study attempts to explore the evolution paths of Korean Small and Medium Enterprises (SMEs') strategies and their technological learning processes. Several different evolution paths are identified based on a dynamic strategic group analysis of 115 SMEs' strategy in the Korean electronic parts industry for the period of 1990-1995. Further, in-depth case analyses on technological learning processes in 5 firms are undertaken.

Major findings of this study can be summarized as follows:

1) There are three dominant evolution paths in SMEs' strategy. First path indicates the evolution from a **subcontractor or petty imitator group** into an **innovator group** by accumulating technological capabilities. Second, some firms move from a subcontractor group into a **market focus** or **generalizer group** by simply adding product lines. Third path involves firms which evolve from a subcontractor group into a **production focus group**.

2) An in-depth case analysis shows those who succeeded in technological learning are managed by CEOs with strong technological expertise and strategic vision. They have made an effort to establish management practices to support innovation, such as employee educational program and performance-based reward system. The successful firms also aggressively pursue diverse external linkages with outside technology sources to learn product and process technologies.

Finally, this study discusses several implications of the findings for the theoretical development and strategic management of small firms in Korea.

Introduction

Since the end of 1980s, it has been a most important strategic agenda for Korean policy makers as well as business managers to transform labor intensive medium enterprises (SMEs) into technology-intensive ones or to establish more technology-based new ventures in high-tech industries. In order to do this, it must be prerequisite to understand which SMEs are more likely to learn technological capability, and how and why do they learn better than others.

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Many prior studies have addressed the learning process of the firms and identified the several factors facilitating or conditioning their learning activities such as the intensity of efforts, past history, and organizational inertia (Hannan and Freeman, 1977; Nelson and Winter, 1982; Cohen and Levinthal, 1992; March, 1993; Utterback, 1994; Nonaka and Takeuchi, 1995; Kim, 1980, 1997; Lee et al, 1988). To extend previous research, this study attempts to delineate different patterns of technological learning in Korean SMEs based on the strategic group analysis.

Specifically, the research questions raised in this paper are following:

1. What is the relationship between changes in strategic groups and technological learning of the SMEs in the Korean electronic parts industry?
2. What are the most crucial influencing factors in the process of their technological learning?

To address these questions, this study analyzes data from 115 SMEs in the Korean electronic component industry to identify the strategic group structures and the dynamic patterns of strategic group changes during the period of 1990 to 1995. Then, five firms are carefully analyzed to further understand the technological leaning process and critical factors facilitating the learning activities of SMEs in Korea.

Identification of Structures and Changes in Strategic Groups

Research Methods

143 SMEs in the Korean electronics part industry were sampled based on three criteria: 1) the firm must be established prior to 1988, 2) revenues from the electronic parts must account for more than 80% of the total sales volume, and 3) the number of employees must exceed 50. Each sample firm was contacted and requested to provide data, but 28 firms were excluded in the process. Average number of employees of sample firms is 227 and average sales volume is 16 million Korean won. The time horizon for strategic change in the study covered six years, which were divided into two strategically stable time periods: T1 (1990-1992) and T2(1993-1995) .

To classify strategic groups, the variables of the product/market domain and resource/capability of the firm were used[3]. A principal component analysis on these strategy variables was performed to delineate underlying dimensions of business strategy. It produced four different factors with eigenvalue greater than one, accounted for 64.3% of total variance: the first factor represents innovation capability, the second product diversity, the third market diversity, and the last indicates production capability. Using factor scores, a cluster analysis with a Ward method was undertaken to delineate strategic groups.

Characteristics of four strategic groups

Table 1 present the results of ANOVA among four different strategic groups derived from

[3] Six variables of product/market domain and seven variables of resource/capability were used in the strategic group analysis. Operational definitions and measures of them are available, upon request.

the cluster analysis and describes the characteristics of four strategic groups in terms of their product/market, resource/capability, other demographic and operational characteristics variables.

1) **Subcontractor group**: The firms in this group exhibit lowest scores in all four strategic dimensions: narrowest product line and market breadths, and lowest innovation and production capabilities. Relatively smaller and younger firms belong to this group. These firms have started their operation as a mere subcontractor of large set makers without any distinctive competence. 44.4% of sample firms belong to this strategic group during T1 period and 29.6% during T2 period.

2) **Production focus group:** These firms have a strong production capability in the very focused product/market. They have invested in automation of production facilities and substantially reduced the portion of simple assembly products in total sales (14.4% compared to 53% of subcontractor group). 17.4% of sample firms are classified into this strategic group during T1 and 20.9% during T2.

3) **Market focus or Generalizer group:** These firms maintain broadest product/market scope to meet with diverse needs of customer firms, large set makers. They have been able to diversify their products or to expand their market, although they do not have a strong technological capability, because they used to be a mere assembler of key components bought from outside, mainly from foreign firms, to develop a new product. They do not commit themselves to heavy investment in R&D or in production facility. 23% of samples are considered as this group during T1 and 27% during T2.

4) **Innovation group**: These firms have a competitive advantage in innovation capability in diverse markets. They are more likely to compete in an emerging sector such as information technology and telecommunication (the portion of these products accounts for 78.8% of total sales, compared to 40-50% in other strategic groups), based on indigenously developed electronic parts in focused product categories and to diversify their market abroad. 20.9 of samples belong to innovation group during T1 and 22.6% during T2.

<Table 1> Strategic Groups in the Korean Electronic Parts Industry: 1990-1995

	Strategic Groups				
	Sub-contractor	Production Focus	Market focus	Innovation	ANOVA F-values
Innovation Capability	-0.674	-0.335	0.212	1.266	87.3***
	(0.489)	(0.571)	(0.696)	(0.996)	
Production Capability	-0.467	1.317	-0.208	-0.151	56.60***
	(0.456)	(1.182)	(0.604)	(0.852)	
Market Diversity	-0.842	0.123	0.560	0.761	64.24***
	(0.675)	(0.790)	(0.824)	(0.701)	
Product Diversity	-0.252	-0.674	1.340	-0.414	96.92***
	(0.771)	(0.547)	(0.573)	(0.656)	

Year of Establishment	1982	1975	1976	1978	5.17**
Num. of Employees	116	400	459	326	10.13***
Total Asset (M won)	3,298	37,112	20,489	19,110	5.95***
Ann. Sales (M won)	5,166	32,747	25,843	19,754	6.84***
Portion of Info. & Telecom products (%)	41.45	44.25	49.86	78.77	5.17**
Portion of assembly products (%)	52.98	14.40	37.14	28.64	5.68***
Labor cost in total production cost (%)	20.33	21.05	16.44	15.51	2.20$
Number of Firms during 1990-1995	85 36.96	44 19.13	53 23.04	48 20.87	Chi-Square(3) = 5.625 p= 0.131
Number of Firms at T1 (1990-1992)	51 44.35	20 17.39	22 19.13	22 19.13	
Number of Firms at T2 (1993-1995)	34 29.57	24 20.87	31 26.96	26 22.61	

Significant level, $: p = 0.1, * : p = 0.05, ** p= 0.01, *** p= 0.001

The performance of four strategic groups: During both T1 and T2 periods, innovation group outperformed other strategic groups in profitability measures such as ROA and ROS, as shown in Table 2. After controlling size and age of the firm, four different strategic groups show a similar growth rate.

<Table 2> Performances of Strategic Groups in the Korean Electronic Parts Industry:

	Strategic Groups					
The first period (1990-1992)	Subcon-tractor (G1:n=51)	Production Focus (G2: =20)	Market focus (G3: =22)	Innovation (G4: =22)	ANOVA F-values	Duncan's M-R Test
Return on Asset	4.89	2.08	4.78	6.68	2.35$	G4>G2
Return on Sales	4.50	5.34	6.98	10.29	5.30**	G4>G1,G2,
Sales Growth Rate	28.60	23.70	18.78	25.12	0.21	G3
The second period (1993-1995)	Subcon-tractor (n=34)	Production Focus (n=24)	Market focus (n=31)	Innovation (n=26)	ANOVA F-values	Duncan's M-R Test
Return on Asset	6.17	5.13	3.12	6.95	2.48$	G4 >G1,G3
Return on Sales	5.00	7.18	4.47	8.64	4.77**	G4> G3
Sales Growth Rate	25.23	21.81	20.42	22.67	0.51	

Significant level, $: p = 0.1, * : p = 0.05, ** p= 0.01, *** p= 0.001

The evolution paths of strategic groups: Table 3 presents the cross-tabulation of strategic groups during both T1 and T2 periods. It shows three different strategic change paths of the Korean electronics firms. First, subcontractor group firms have evolved to production focus group by investing in production facilities and lowering manufacturing costs. Second, another subcontractor firms have broadened their product lines and increased the number of customers to grow into a market focus group. Finally, small firms in the Korean electronic parts industry have also become members of innovation group by enhancing their technological capability to develop new products and processes. In toto, about 30% of sample firms have changed their membership of strategic groups between T1 and T2 periods.

<Table 3> Changes in Strategic Group Membership from the first to the second time periods

Time T2 / Time T1	Sub-contractor	Production Focus	Market focus	Innovation	T1 Total
Subcontractor	31 60.78%	7 13.73%	8 15.69%	5 9.80%	51 44.35%
Production Focus	2 10.00%	15 75.50%	1 5.00%	2 10.00%	20 17.39%
Market focus	0 0.00	1 4.55%	19 86.36%	2 9.09%	22 19.13%
Innovation	1 4.55%	1 4.55%	3 13.64%	17 77.26%	22 19.23%
T2 Total	34 29.57%	24 20.87%	31 26.96%	26 22.61%	Chi-Square(9) =117.664 (p = 0.001)

The Case Analyses on Five SMEs:

This study further examined the technological learning process of five sample firms with key influencing factors in the learning process. Each firm exhibited a different pattern of strategic group change. Table 4 summarizes the characteristics of these five firms.

1) Case A: Subtronics

The founder of Subtronics had been an employee in other small electronic parts firm. In 1986, it began to assemble power supply parts as a mere outsourcing partner for another parts maker. It did not have any distinctive competence but lower waged workers. In 1988, the former purchasing manager in a large set maker acquired the firm. After that it was able to provide power supply parts directly to the set maker, for which the new CEO has worked, partly due to the personal relationship with him and dual purchasing source strategy of the customer firm. However, there has been a constant pressure from the customer to reduce costs and delivery time, and to improve the quality of products, since it was solely dependent on the customer for its sale.

To cope with these environmental challenges, Subtronics have actively employed foreign workers from LDCs and rationalized its production processes with assistance from the customer firm. Most of its efforts, however, focused on reducing defect rates of production and squeezing work forces for higher productivity. It did not have any strategic attempt and slack resources to invest in developing technological capability for a new product and in automation of production facilities. Given its low value-added business activities and a constant pressure for cost reduction, its profitability (2-5% of average ROA) has not been so high, in spite of a high growth rate (50-60% of average sales growth rate).

2) Case B: Manutronics

Manutronics was founded in 1977 to produce transformers and coils used for TV and other home electronics goods. Most transformers and coils were standardized products and manufactured by many local competitors using production facilities imported from Japan. Manutronics was one of them and has grown rapidly since 1979, when it was designated as a

subcontractor of Samsung Electronics.

Late 1980s have witnessed, however, a rapid change in the industry environments: a drastic increase of wage, a cutthroat price competition due to over-capacity, and relentless pressure from the set makers to reduce costs. To cope with these environmental challenges, Manutronics has striven to improve its operating efficiency by investing in automation of exiting production facilities. The firm has adopted many new production facilities co-developed with local supplier and replaced existing production equipment one by one. From 1990 to 1995, the production volume has been doubled with 30% less manufacturing manpower.

Top management himself has initiated all these strategic efforts, since he had hands-on experience in manufacturing from the inception of the firm. He pointed out many problems of the existing facilities and generated numerous ideas to improve efficiency and production quality to the local supplier of production equipment. However, its financial performance was lower than the industry average in terms of ROS. Its main products became mature and pressures to reduce cost exceeded the gains in production efficiency. Manutronics has developed only two incremental new products in the same product/market segment during T1 and T2 periods.

3)Case C: Marketronics

It was found in 1977 by the former sales executive in Samsung electronics to produce "color filter parts" for TV sets. Key engineers were hunted from existing competitors and used production facilities were imported from Japan. It has grown to 108 of employees and 5 billion won of asset size in 1990.

In response to decline in market demands of TV sets, Marketronics has diversified into emerging sectors such as computer HDD and FDD. As electronic set makers in Korea have expanded the number of suppliers for second-sourcing to secure stable purchase as well as to reduce production costs, there were opportunities for electronic pasts firm to diversify their product lines. Marketronics took advantage of the close relationship with the set maker, Samsung electronics, and was able to move into diverse new product/market segments earlier than many other competitors. In spite of many new products added in its product lines, its operation has not been changed a lot and has been confined in the value chain process to the assembly of key components purchased outside as before. Except for gaining knowledge in diversified assembly lines and in changing customer needs, it could not acquire new capability nor learn additional technology. As a result, it could not maintain competitive advantage in newly entered product/markets. Annual sales growth rate from 1990 to 1995 falls between 15 and 20% and profit turns in red.

4) Case D: Innotronics

In 1984, an electrical engineer resigned from a large set maker and established Innotronics to produce buzzer and coil used for a variety of products such as microwave oven, TV set, and cellular phones. From the outset, it has penetrated export market on the OEM basis to avoid price competition in the domestic market and to stay competitive in the international market in terms of product quality and cost. Innotronics has started to just implement the

specification given from foreign customers like Siemens, but gradually improved their production and development capability in the process of satisfying the challenging technical requirements. Although its development efforts still have focused on the localization of foreign technologies in 1990, its products were more advanced than existing ones and enjoyed competitive advantage in local markets, due to technical gap between advanced countries and Korea.

Since 1990, Innotronics has chosen dual strategies: direct foreign investment in China to produce low-end existing products and technological innovation to develop high-end new products such as piazo buzzer for mobile phones and pagers or noise filter for microwave oven. It also has made an effort to automate the production line by developing SMT and using CAD/CAM with a technical collaboration with a local university.

Innotronics has not diversified its product lines much, rather focused on the same products domain but added value on them by technological innovations. Consequently, it has grown annually between 1990 to 1995 by 20 – 30% and maintained a relative higher profitability, about 9% of ROA and 4% of ROS.

5) Case E: Ventronics

The founder of Ventronics was also a material engineer once worked for KIST, a government-sponsored research institute, and for a large industrial firm as an R&D director in the field of magnetic technology. In 1981, he established his own firm, Ventronics, to produce PCM (purity convergence magnet) used for TV sets, VCRs, computer monitors, cameras and automobiles. It first developed a new product for import substitution and later a series of magnet used for various electronic goods for export market. In 1990, R&D center housed more than 20 engineers with 4.9% of R&D intensity.

Since 1990 it has reduced the portion of low-end magnet products in production, which was quite vulnerable to the increase of wage and price competition. Meanwhile, it began to develop numerous higher value-added new products, such as hyper-precision magnet sensor, Nd-Fe-B bonded magnet, to name a few, based on accumulated technological capability in magnet area. In doing so, Ventronics has chosen target new products imported from foreign suppliers and tried to collaborate with potential customers such as Samsung and LG Electronics, to secure initial markets. Once gaining cost competitiveness in domestic market, it was not difficult for Ventronics to supply these products to foreign customers such as Hitachi, Toshiba, RCA, Nokia, and LEGO.

<Table 6> Summary of five firm cases

Sample Firms	Firm A	Firm B	Firm C	Firm D	Firm E
Evolution Path	Subcontractor => Subcontractor	Subcontractor => Production Focus	Subcontractor => Market focus	Subcontractor => Innovation	Innovation => Innovation
Main products at early stage	Power supply	Coil & Transformer	TV Tuner	Buzzer & Coil	Plastic Magnet
Technology learned	Simple assembly	Production Technology	Simple assembly	Product design technology	Raw material development and application
Year of establishment	1986	1977	1977	1984	1981
CEO's prior experience	Purchasing Manager in large electronic end-product firms	Manager in small electronic part producer	Senior Manager in large electronic end-product firms	Engineer in large electronic end-product firms	Researcher in government sponsored research organization
Total asset(M won)(90->95)	570 -> 1,197	4,301->7,500	5,120->7,910	2,170->5,510	5,656 -> 21,592
# of employees (90->95)	95 - > 170	128-> 108	108->250	120->150	251-> 323
# of engineers (90->95)	4 -> 7	5->8	10->16	4->10	20-> 40
# of new product development	0	2	13	10	53
Reliance on the one largest customers(%) (90->95)	100 -> 100	70 -> 40	87->75	40->30	18-> 12
Net increase in domestic fixed asset/annual sales (%)	1.9	5.1	2.4	4.0	1.2
Foreign investment/ annual sales (%)	0.0	2.0	0.7	4.2	5.2
Changes in # of product lines (90->95)	1->2	2->2	2->6	2->6	2-> 4
New products added	CRT components	None	HDD, FDD, VTR components, connector	Noise filter, Coils for SMD	Sensor, PTC thermistor, Vibration motor
Portion of export in total sales(%) (90 ->95)	0->0	0-> 10	6-> 11	85-> 65	16 -> 40
Changes in major customers	None	None	Increase in local customers	Increase in local and foreign customers	Increase in foreign customers
Portion of subcontracting in production process(90->95)	0->5	30->20	17->42	40-> 65	60-> 80
Performance					
Return on Asset(T1->T2)	1.8->4.9%	5.1->6.3%	5.0->-2.0%	10.0->9.3 %	10.2-> 15.6 %
Return on Sales(T1->T2)	3.8->3.8%	2.3->2.3%	2.8->-2.8%	4.3->4.3%	9.7-> 12.5%
Annual Sales Growth Rate	50-60%	10-15%	15-20%	20-30%	30 - 40 %

Besides magnet technological capability, this firm had an opportunity to learn a new core technology, PTC (positive temperature coefficient), with collaboration with a local university and a Japanese university professor. He was invited several times to introduce the technology and a couple of engineers were also dispatched to Japan to further master the related technologies. Thanks to the acquisition of new technological capability, Ventronics was able to successfully broaden its product lines and expand its customers. Furthermore, it is now making an attempt to combine PCM and PTC technologies to develop a new product.

Given its technological innovations in magnet and PTC product/markets with superior quality and cost advantage, Ventronics outperformed other firms in both growth rate and profitability (36% of annual growth rate and 13.4% of ROA during the period of 1090-1995). At the moment, it is estimated that Ventronics accounts for almost 30% for PCM and 12% of PTC in the world market. In 1998, Ventronics awarded the best high-tech venture prize from the Korean government.

Conclusion

Technology capability learning in the SMEs in the Korean electronic parts industry

The major findings in this study can be summarized as follows:

1) The strategic change of the firm appeared path dependent. The initial selection of product/market and strategic posture within that domain were strongly bound by the prior knowledge or experience of top management, and almost 70% of SMEs in the Korean electronic parts industry remained in the same strategic groups during 1990 to 1995.

2) Changes in strategic groups were not symmetrical, and movement from the subcontractor group to other strategic groups was more frequent than the other way around.

3) The SMEs in the electronic parts industry, on average, have evolved from narrow product/market scope with less technological capability into diverse product/market scope with more technological capability. However, the evolution paths of the individual small firm in the Korean electronic industry were not linear, but complex, following its strategic intent.

Factors facilitating technological learning activities in SMEs in the Korean electronic parts industry

Critical factors in the technological learning process of the SMEs found in this study include:

- prior strategic posture or membership of strategic group
- top management vision and prior experiences or knowledge
- environmental changes in product/market domain
- collaboration or strategic alliance with customers, suppliers, local universities and research institutes, and foreign technological sources
- past performance and availability of slack resources
- management of organization and human resource
- intensity of indigenous efforts to develop technological capability. Figure 1 explains the process of technological learning and factors facilitating technological learning activities of SMEs. Figure 1 depicts technological learning process in the SMEs in the Korean electronic parts industry and the factors influencing the learning process.

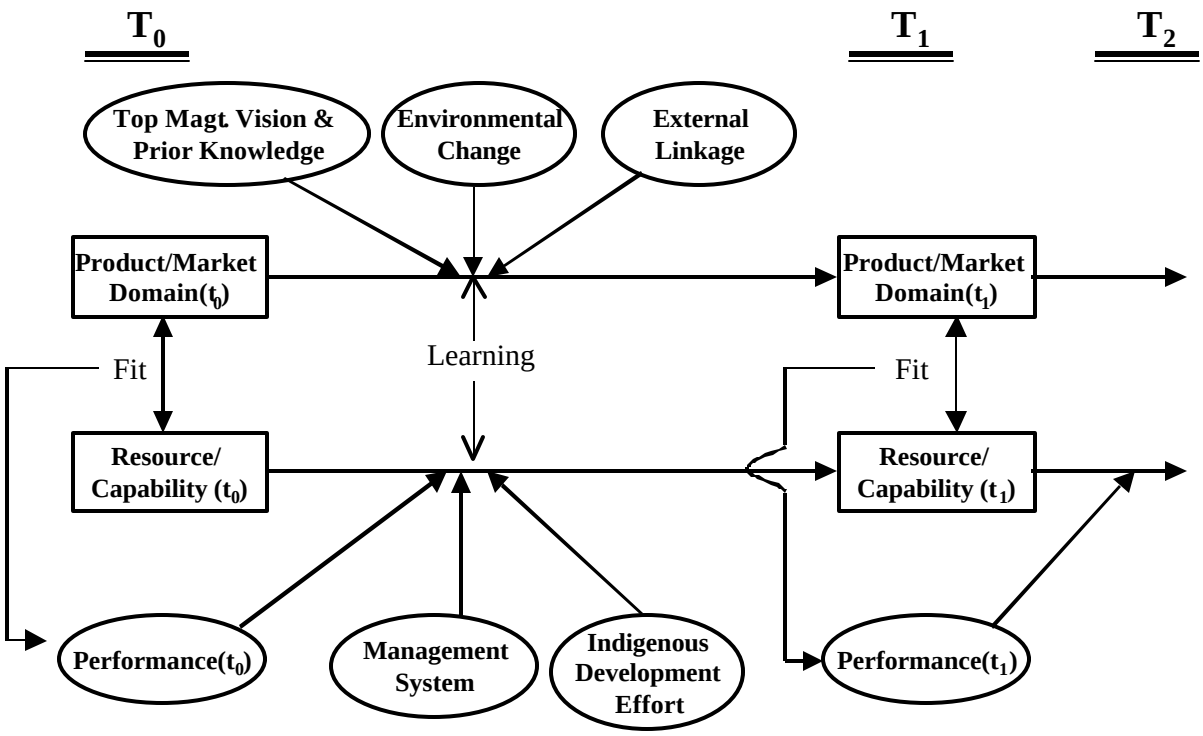

Figure 1. Factors influencing the SMEs' technological learning

Performance outcomes of technological learning

The financial performance depended on the nature of learning or the degree of exploration in learning. In short-run, high level of exploration of new product/market domain and resource capabilities would induce the misfit or the mismatch between P/M domain and resource/capability of the firm, and result in low performance. On the contrary, the firm that exploit the existing resource/capability could realize profit in short-run by increasing the utilization and productivity of them.

In the long-run, however, performance outcomes would be determined by the iterative patterns of learning. The firms that always seek to explore new P/M segments could not maintain the fit between P/M domain and existing resource/capability and could not realize high performances. The firms that have made efforts only for exploitation also could not realize high performance, since their resource/capability would be deteriorated and not be able to meet the changing key success factors in P/M segments. The most viable pattern of learning in the changing environment would be the dynamic or dialectic evolutionary process through an iterative exploration and exploitation cycle.

Limitations and Future Research

Given the small number of samples in a specific Korean industry, this study is an exploratory attempt in nature. The results found and the relationships proposed in this study have surely many limitations. They must be validated by further research with a more rigorous research method in diverse research settings for the external validity.

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