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Technological Innovation Capabilities and Firm Performance

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***Abstract*—**Technological innovation capability (TIC) is defined as a comprehensive set of characteristics of a firm that facilities and supports its technological innovation strategies. An audit to evaluate the TICs of a firm may trigger improvement in its future practices. Such an audit can be used by the firm for self assessment or third-party independent assessment to identify problems of its capability status. This paper attempts to develop such an auditing framework that can help to determine the subtle links between innovation capabilities and business performance; and to enable the auditor to determine whether good practice is in place. The seven TICs in this study include learning, R&D, resources allocation, manufacturing, marketing, organization and strategic planning capabilities. Empirical data was acquired through a survey study of 200 manufacturing firms in the Hong Kong/Pearl River Delta (HK/PRD) region. Structural equation modelling was employed to examine the relationships among TICs and various performance indicators: sales performance, innovation performance, product performance, and sales growth. The results revealed that different TICs have different impacts on different performance measures. Organization capability was found to have the most influential impact. Hong Kong manufacturers are now facing the challenge of high-mix-low-volume customer orders. In order to cope with this change, good capability in organizing different activities among various departments is critical to the success of a company.

***Keywords*—**Hong Kong/Pearl River Delta, Innovation audit, Manufacturing, Technological innovation capability

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I. INTRODUCTION

A firm's competitive advantage could come from the efficiency and capability of new product developments [1], [2]. The increase in product innovation is attributable to the accumulation of capabilities and contributed to innovation outputs. In most circumstances, high performance firms would have stronger capabilities as compared to low performance firms. Innovation capability is the skills and knowledge needed to effectively absorb, master and improve existing technologies, and to create new ones [3]. Technological innovation capability (TIC) is a comprehensive set of characteristics of an organization that facilities and supports its technological innovation strategies [4]. They are a kind of special assets or resources that include technology, product, process, knowledge, experience and organization [5].

Various researchers and institutions have developed different approaches to audit a firm's TIC. For example, Christensen [6] examined TICs in terms of science research asset, process innovation asset, product innovation asset and esthetics design asset. Chiesa et. al. [7] used two methods to assess the innovation capability of an organization – a process audit and a performance audit. The process audit focused on the individual processes necessary for innovation which includes concept generation, process innovation, product development, technology acquisition, leadership, resourcing, system and tools. More recently, Yam et. al. [8] adopted a functional approach where the separate functions of an organization were to be evaluated. The capability dimensions are learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organization capability and strategic planning capability.

II. THE IMPACT OF TECHNOLOGICAL INNOVATION CAPABILITY ON FIRM PERFORMANCE

Improving TIC can be beneficial to the firm and leads to enhanced competitiveness [8]. The importance of a firm's innovation capability has been confirmed by many studies (e.g. [9] – [11]). However, different researchers pinpointed different capabilities as major determinants of technological innovation performance. Teece [12] stressed that innovation is an interactive process characterized by technological interrelatedness between sub-systems. Evangelista et. al. [13] regard R&D activities as a central component of the technological innovation activities of firms and as the most important intangible innovation expenditure. Danneels [10] emphasized the importance of customer competence and

technological competence on product innovation. Galende and Fuente [11] affirmed the impact of commercial resources, organizational resources and internationalization on innovation. A comprehensive study on the interrelationship between each TIC and the firm's innovation performance still needs further exploration. As a result, it creates difficulties for firms to implement actions in enhancing their TICs effectively. The current study attempts to fill this gap.

III. SCOPE OF RESEARCH

The manufacturing collaboration between Hong Kong and China started in the early 1980s and now the majority of Hong Kong manufacturing firms have relocated their production facilities to China particularly in the Pearl River Delta (PRD) region [14]. Hong Kong manufacturers provided capital, technical and management know-how while the Chinese partners provided cheap land, labour and local knowledge. This strategy seemed to work in maintaining the global competitive advantage of Hong Kong in the past two decades [15].

With the increase in labor costs, land prices, rental and other production costs in China, HK/PRD region is now again losing its competitive advantage in terms of product innovativeness and technology sophistication. In order for Hong Kong to regain its global competitiveness, it is urgent for Hong Kong to transform to a high value-added design-intensive manufacturing base through enhancement of its technological innovation capabilities of manufacturers in HK/PRD region. In lacking of technological innovation, the innovation system of the HK/PRD region is a market-oriented rather than science-oriented system. Hence, it is possible that HK/PRD region requires a different combination of TICs compared with other regions that are more science-oriented. This paper attempts to develop an auditing framework for Chinese firms in the studied region that can help to determine the subtle links between innovation capabilities and business performance; and to enable the auditor to determine whether good practice is in place.

IV. MEASURING TECHNOLOGICAL INNOVATION CAPABILITY (TIC)

The measurement scales of TIC were adopted from Guan and Ma [5] and Yam et. al. [8]. The functional approach used by these two studies has the advantage of easy to understand. The seven capability dimensions are described as follows.

1) *Learning capability* is a firm's ability to identify, assimilate, and exploit knowledge from the environment.
2) *R&D capability* refers to a firm's ability to integrate R&D strategy, project implementation, project portfolio management, and R&D expenditure. Five items were employed to measure the R&D capability.
3) *Resources allocation capability* ensures that a firm has enough capital, professionals and technology in the innovation process.
4) *Manufacturing capability* refers to a firm's ability to transform R&D results into products, which meets market needs, accords with design request and can be manufactured in batches.
5) *Marketing capability* is a firm's ability to publicize and sell products on the basis of understanding consumer needs, competition situation, costs and benefits, and the acceptance of innovation.
6) *Organizing capability* refers to a firm's ability in securing organizational mechanism and harmony, cultivating organization culture, and adopting good management practices.
7) *Strategic planning capability* is a firm's ability to identify internal strengths and weaknesses and external opportunities and threats, formulate plans in accordance with corporate vision and missions, and acclimatize the plans to implementation.

The items for measuring these seven dimensions are shown in Appendix 1. Seven-point scales were used. A higher score denotes a higher ability in that capability.

V. MEASURING TECHNOLOGICAL INNOVATION PERFORAMANCE (TIP)

After reviewing the literatures about TIP [5], [8], [16] – [19], four performance indicators were found to be appropriate: sales performance, innovation performance, product performance and sales growth. Except product performance, the other three measurement scales were also used in different innovation studies [17], [19]. Product performance relates to the competitiveness of a firm's new products. Product competitiveness is a portfolio concept encompassing various aspects, such as average concept-to-launch time, quality level, cost, market competitiveness, uniqueness of product, uniqueness of the process technology employed, etc. It is believed that most TICs could be associated with product competitiveness [16], [18].

Sales performance, innovation performance and sales growth were each measured by a single item while product performance was measured by multi-items. The items for measuring these four types of performance are shown in Appendix 2. Seven-point scales were used. A higher score denotes a better performance.

VI. RESEARCH METHODOLOGY

The proposed model is shown in Figure 1.

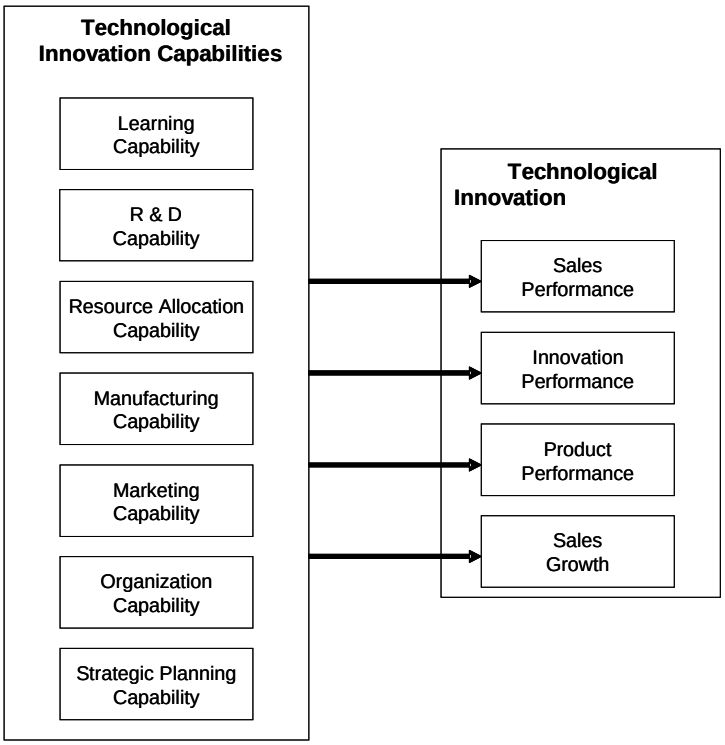


Fig. 1 The Audit Framework

Control Variable

Company size was adopted as a control variable in this study. Previous studies indicated that there could be a positive relationship existed between company size and technological innovation performance [20], [21]. Large-sized companies tend to have complementary resources like the headquarters' support for the business operations to enhance their own innovation capability and performance [22]. However, recent studies revealed that company size has no direct influence on the technological innovation performance [19], [23]. Pavitt et. al. [21] commented that the size distribution of innovating firms is a function of technological opportunity, appropriability and demand. Since most of the Hong Kong manufacturers are engaged in OEM/ODM business, the technological opportunity, appropriability and demand are mainly commanded by the customer rather than themselves. Hence, it is possible that size of company does not have a significant effect on TIC and TIP.

Pilot Study

In order to ensure a high level of content validity, three scholars in the field of technological innovation and four industrial executives were primarily consulted for improving the survey instrument. A pre-test was then carried out with a convenience sample of 30 managers working in manufacturing industries in the HK/PRD region. They were asked to complete the questionnaire and comment on the clarity and appropriateness of the items in the questionnaire. Simple statistical analyses were used to test the reliability of the scales and the revised questionnaire was sent to the sampled firms through mail.

Sampling

Manufacturers from electronics, electrical appliances, toys, machinery and watches & clocks industries in the studied region were selected as the sample frame in this survey. These industries were chosen for two reasons. First, these industries are the representative of the interest of this study. The manufacturers in these industries have developed a variety of complex and advanced products in which they actively participate in technological and process innovation for maintaining their competitiveness [24], [25]. Second, these industries contributed to over 40% of the value of total exports of all manufacturing industries. Studying technological product and process innovation in these industries is thus of great significance.

A mail survey was used to collect the data. The sample was drawn from firms listed in the Directory of Hong Kong Industries published by the Hong Kong Productivity Council (HKPC). The targeted respondent was the president, general manager, director of engineering, R&D manager or engineering manager. Follow-up faxes and telephone interviews were conducted to ensure data quality. The survey questionnaires were mailed to the selected 1,200 firms and 1,153 were reached (47 letters were undelivered because of changed address or the contacted person had left the firm) of which 12 firms were not in the targeted industries. Out of these 1,153 successfully contacted firms, 202 firms responded

to the survey. This contributed a response rate of 17.7%. After data cleaning process, 2 incomplete responses were deleted. Finally, 200 effective questionnaires were analyzed in this study. The sample profile is shown in Table 1.

TABLE I DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLED FIRMS (N=200)

	N	Percentage
Type of Industry		
Electronics	41	20.5
Electrical Appliance	83	41.5
Toys	26	13.0
Watch and Clock	39	19.5
Machinery	11	5.5
Company Size		
1 – 100	21	10.6
101 – 500	53	26.8
501 – 1000	14	7.1
1001 – 3000	58	29.3
> 3000	52	26.2

VII. DATA ANALYSIS

Non-response bias

To detect the non-response bias, a test was conducted to determine if significant differences existed between the late respondents and early respondents in terms of variables relevant to the research hypothesis [26]. The average values of measurement items from the first 10% of respondents were compared with the last 10% of respondents using t-tests. The result showed no statistical significant between the means for the items across the two groups, indicating that non-response bias might not be a problem in this study.

Validation of measures

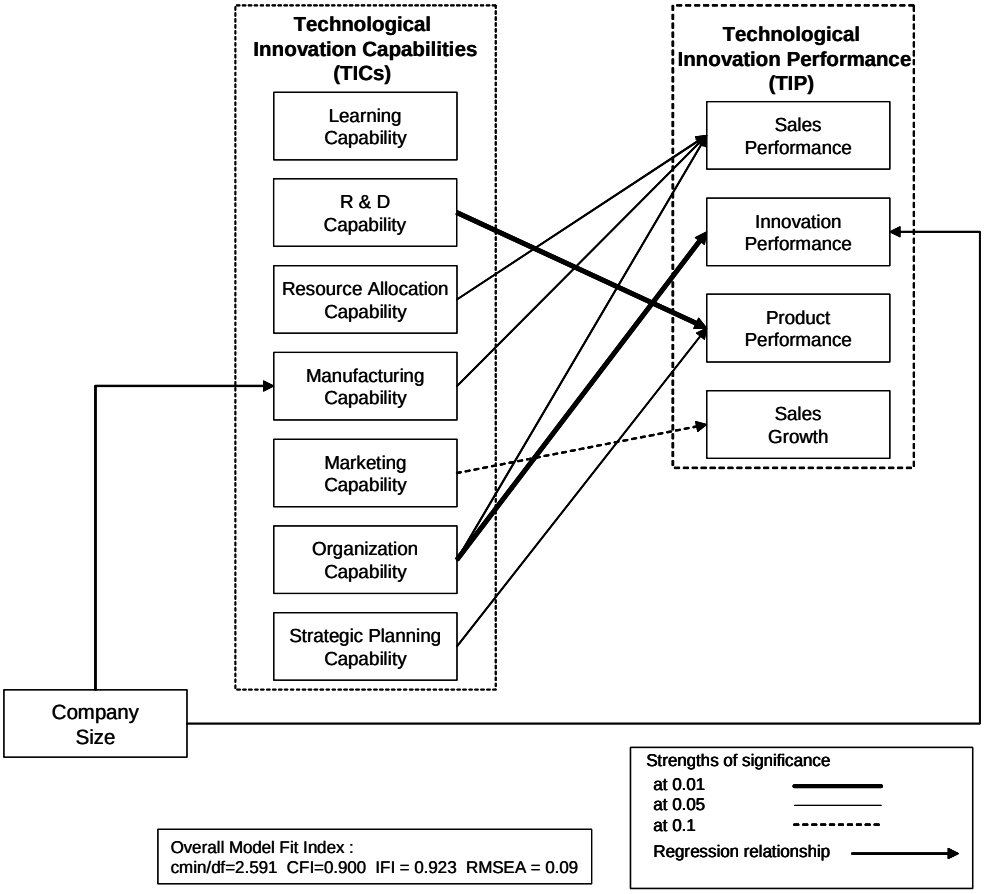
Before conducting the hypotheses testing, a thorough measurement analysis was conducted to verify the survey instruments [27]. The analysis included the assessment of scale reliability, convergent validity, discriminant validity and unidimensionality of the research constructs. Cronbach's Alpha was used to assess the scale reliability of each construct in the research model (Figure 1). Alpha of every factor was greater than the suggested threshold value of acceptable reliability of 0.7 [28]. The convergent validity of research constructs were assessed using exploratory factor analysis. The results showed that all research constructs were with eigen values exceeding 1.0 and all the factor loading of them exceeding 0.3. The convergent validity, discriminant validity and unidimensionality were assessed using confirmatory factor analysis. The measurement model constructed had a relative chi-squared (cmin/df) of $2.665 < 3$, a corresponding incremental fit index (IFI) and comparative fit index (CFI) of $0.926 > 0.9$ and $0.926 > 0.9$ respectively. The standardized loading (λ) for all constructs were high (i.e. $\lambda > 0.5$) and the corresponding t-values were statistically significant. Upon checking the modification indices of the measurement model, no significant cross-loadings among the variables were found. These results indicated the validity and unidimensionality of the research constructs [28].

Exploring the Relationship between TICs and TIPs

The relationships between TICs and TIPs were examined by structural equation modeling using AMOS 7.0. In the model analysis, maximum likelihood estimation and standardized regression weighting were used for interpretation. Multiple indices of fit were used to specify the overall model fit, including IFI, CFI and λ^2/df. The values of both IFI and CFI over 0.9 and λ^2/df below 3 refer to a good model fit [29]. The research hypotheses were tested by the significant of t-test in each path with parameter estimates ($p <$ 1.0) from the model.

TABLE II DESCRIPTIVE STATISTICS OF TIC AND TIP

Assessment items	Minimum	Maximum	Mean	S.D.
TICs				
Learning capability	2.00	7.00	4.8325	1.0128
R&D capability	1.33	6.67	4.2567	1.1405
Resource allocation capability	1.00	6.50	4.3200	1.0971
Manufacturing capability	1.67	7.00	4.5067	1.1575
Marketing capability	2.5	7.00	4.8075	1.0232
Organizing capability	2.00	7.00	4.3200	1.0604
Strategic planning capability	1.40	7.00	4.5200	1.1205
TIPs				
Sales performance	1.0	7.0	2.9900	1.7250
Innovation performance	1.0	7.0	3.1600	1.7980
Product performance	2.8	7.0	4.6110	0.8420
Sales growth	1.0	7.0	3.1200	1.633



Note: The 7 TICs are highly correlated with each other with p-value <0.01.

Fig. 2 SEM Results of the audit framework

VIII. RESULTS AND DISCUSSION

Table 2 reports the minimum value, maximum value, means and standard deviations of TIC and TIP in the model.

The Structural equation modeling results were presented in Figure 2. The unidirectional arrows represented the regression relationship of the two connected variables. A note was added to describe the addition of the significant correlation among TICs during SEM test. The model yielded a λ^2/df of 2.591 < 3, CFI of 0.900 > 0.9 and IFI of 0.923 > 0.9, which indicated a good model fit [30].

In the model, all the TICs were highly correlated with each other. The study suggested that enhancement of one capability will enhance other capabilities simultaneously. For example, learning capability was a firm's ability to identify, assimilate and exploit knowledge from the environment. Firms with better learning capability might learn quickly to enhance other TICs. In addition, four TIPs were also highly correlated with each other. Sales growth was affected by the performance of both new and existing products. Sales performance, innovation rate and product performance were solely affected by either new or improved products. Firms with good product performance and innovation rate would have a higher possibility of creating excellent sales performance due to the availability of a sufficient number of high quality new or improved products. With increase in sales amount (ie. good sales performance), the sales growth of a company would increase accordingly.

According to a similar study in Beijing, China [8], the most influential factor on innovation rate was R&D capability. The authors also found that the most influential factor on sales growth was resources allocation capability. The most influential factor on product performance varied according to the size of the firm. Large firms were R&D and resources allocation capabilities; Medium-sized firms were R&D and strategic planning capabilities; Small firms were resources allocation and marketing capabilities. Due to different industrial characteristics of manufacturers in the region, we expected that different patterns might be explored.

A. Relationship between TICs and Sales Performance

Sales performance was found to be affected by capabilities in resource allocation, manufacturing and organization.

Resources allocation capability measured how well a firm manages its human and capital investments in supporting innovation activities. Manufacturing capability measured how well a firm employs manufacturing methods and personnel to transform R&D output into production. Organization capability referred to the capability of a firm to coordinate functional departments including R&D, marketing and manufacturing to handle innovation projects in parallel. As the sales performance measured the percentage of sales generated from technological new or improved products in the past three years, it assessed not only the design and manufacture a new or improved product but also a marketable new or improved product. Therefore, the industry with strong resource allocation, manufacturing and organizing capabilities can transform the innovative ideas into commercial products, leading to excellent sales performance.

B. Relationship between TICs and Innovation Performance

Only organization capability is found to be associated with innovation performance which measured the number of commercialized new products as percentage of all products in a firm per year during the past three years. The sample in this study had around 80% firms with less than 20 employees who were responsible for the development of technologically new or improved products or processes. With limited human resources, the ability to manage several projects simultaneously should be very important in the HK/PRD region. Hence, strong organization capability was especially critical for innovation rate.

C. Relationship between TICs and Product Performance

Product performance measured the performance of the new product on the dimensions of quality of product, cost advantage, market competitiveness, uniqueness of the product and/or process technology employed and average product concept-to-launch time. It is found to be affected by capabilities in R&D and strategic planning. Strategic planning capability measured a firm's ability to identify internal strength and weakness and external opportunities and threats, formulate plans in accordance with corporate vision and missions, and modifies the plans of implementation. R&D capability measured how well a firm turns market ideas into manufacturable products. It was important to note that what type of new products a firm should develop depends on how well it bridges the market needs with its internal product development abilities. A manufacturer with strong strategic planning and R&D capabilities could properly match its innovation, technological and marketing strategies so as to develop a new product with excellent product performance that met market needs.

D. Relationship between TICs and Sales Growth

Marketing capability was the only factor affecting sales growth. It was a firm's ability to publicize and sell products on the basis of understanding customers' needs, the competitive environment, costs and benefits, and the acceptance of the innovation. It measured how well a firm provides pre- and post- sales services in identifying customer needs and maintaining good customer relationship. Sales growth measured the annual growth rate of the firm during the past three years. In fact, the sales growth rate was an indicator affected by both the sales of new and existing products from new and existing customers. The critical factor was how well a firm lures new or existing customers to buy additional products from them whether the customers purchased new or existing products. This implied the need for strong marketing capability.

E. Control Variable

Company size was used in this study as control variable. According to the analysis result, it was found that company size had no direct relationship with TICs except the manufacturing capability. It was possible that as most Hong Kong manufacturers are still operating in the low-cost labor-intensive manufacturing mode, their manufacturing capability was largely dependent on the number of workers they have. Company size and TIP are not associated.

F. Consolidated findings

The relationships among TICs and TIPs are summarized in Table 3.

The findings of the study showed that organization capability can improve sales performance and innovation rate. R&D and strategic planning capabilities lead to better product performance, whereas resource allocation and manufacturing capabilities would enhance sales performance. Marketing capability has a positive effect on sales growth. The study further found that sales performance, innovation rate, product performance and sales growth were positively correlated with each other (Table 4). Hence, a firm gets better sales performance if the firm adds new or improved products with good product performance. A firm would have a better sales growth rate if the firm has better sales performance.

Besides, learning capability did not directly correlated with any of the TIP indicators. However, learning capability was highly correlated with the other six TICs as shown in Table 5. Thus, this study argued that, although learning capability is not directly related to the enhancement of TIPs, it may enhance the ability of the other six TICs. An organizational unit with strong internal learning capability can help absorb new knowledge from other units and to develop complementary capabilities to improve product innovation [31].

Among the seven TICs, only organization capability has a direct relationship with two TIP indicators, i.e. sales performance and innovation rate. Other capabilities have a direct relationship with one TIP indicator only. It reveals the importance of organization capability among manufacturers in the region.

Recently, the customer orders have gradually changed from low-mix-high-volume to high-mix-low-volume in the region that the order size is continuously reducing while the product mix is increasing.

TABLE III RELATIONSHIPS AMONG TICS AND TIPS

Technological Innovation Capabilities (TICs)	Technological Innovation Performance (TIP)			
	Sales Performance	Innovation Rate	Product Performance	Sales Growth
Learning capability				
R&D capability			✓	
Resources allocation capability	✓			
Manufacturing capability	✓			
Marketing capability				✓
Organization capability	✓	✓		
Strategic planning capability			✓	

Only those columns with "✓" show positive relationships among that pair of TIC and TIP.

TABLE IV CORRELATION AMONG TIP MEASURES

	Product Performance	Sales Growth	Innovation Performance	Sales Performance
Product Performance	1			
Sales Growth	0.2968**	1		
Innovation Performance	0.2264**	0.2789**	1	
Sales Performance	0.1972**	0.1737**	0.5688**	1

** Correlation is significant at the 0.01 level

TABLE V CORRELATIONS BETWEEN LEARNING CAPABILITY AND OTHER TICS

Other TICs	Correlation ratio with Learning capability
R&D capability	0.555**
Resources allocation capability	0.583**
Manufacturing capability	0.497**
Marketing capability	0.591**
Organization capability	0.591**
Strategic planning capability	0548**

** Correlation is significant at the 0.01 level

In order to cope with this change, manufacturers must have a strong capability in organizing different activities among various departments.

The technological innovation performance of a firm is highly determined by the commitment of the top management or the owner [32]. Once the top management has committed to technological development, the most critical success factor is the ability of the company to manage the development projects properly and effectively for meeting the constraints on time, budget and product specification, which is highly related to how well various departments' activities in new product development are organized and managed (i.e. the organization capability of a firm) [33].

IX. CONCLUSION

The greatest concern for most Hong Kong manufacturers is what types of distinctive technological innovation capabilities are needed for competitive advantage and how to acquire them? This paper sheds some light on this question. For a science-oriented innovation system such as China, R&D capability is more important than other capabilities. For a market-oriented innovation system such as Hong Kong, organization capability seems to be more important.

In order to better understand the findings from the survey follow-up interviews with a few prominent companies were conducted. The conclusions are:

- The current innovation policy seems to be ineffective in enhancing the TICs of Hong Kong manufacturers;
- It is difficult to recruit experienced R&D professionals in Hong Kong;
- Short-term-focus mindset and limited resources of Hong Kong SMEs are the major barrier for technological

innovation;
- There is a lack of sufficient know-how and knowledge to start and sustain the technological development within the companies.

APPENDIX I

MEASUREMENT SCALES FOR TECHNOLOGICAL INNOVATION CAPABILITIES

Constructs and items

Learning capability
- Your company encourages work teams to identify opportunities for improvement.
- Your company adopts accessed knowledge into your daily activities.

R&D capability
- Your company has high quality and quick feedbacks from manufacturing to design and engineering.
- Your company has good mechanisms for transferring technology from research to product development.
- Your company has great extent of market and customer feedback into technological innovation process.

Resources allocation capability
- Your company attaches importance to human resource.
- Your company programs human resource in phase.
- Your company selects key personnel in each functional department into the innovation process.
- Your company provides steady capital supplement in innovation activity.

Manufacturing capability
- Your company's manufacturing department has ability in transforming R&D output into production.
- Your company effectively applies advanced manufacturing methods.
- Your company has capable manufacturing personnel.

Marketing capability
- Your company has close relationship management with major customers.
- Your company has good knowledge of different market segments.
- Your company has highly efficient sales-force.
- Your company provides excellent after-sale services.

Organization capability
- Your company can handle multiple innovation projects in parallel.
- Your company has good coordination and cooperation of R&D, marketing and manufacturing department.
- Your company has high-level integration and control of the major functions with the company.

Strategic planning capability
- Your company has high capability in identifying internal strengths and weaknesses.
- Your company has high capability in identifying external opportunities and threats.
- Your company has clear goals.
- Your company has a clear plan —a road map of new product and process with measurable milestones.
- Your company is highly adapted and responsive to external environment.

APPENDIX II

MEASUREMENT SCALES FOR TECHNOLOGICAL INNOVATION PERFORMANCE

Sales Performance

Sales ($) due to technologically new or improved products as a percentage of total sales ($) during the past three years:

i) < 5%	ii) 5 - 10%	iii) 10 - 15%	iv) 15 - 20%
v) 20 - 25%	vi) 25-30%	vii) >30%	

Innovation Performance

Number of commercialized new products as percentage of all products in company per year during the past three years:

i) < 5%	ii) 5 - 10%	iii) 10 - 15%	iv) 15 - 20%
v) 20 - 25%	vi) 25-30%	vii) >30%	

Sales Growth

Company's annual sales growth rate during the past three years:

i) < 5%	ii) 5 - 10%	iii) 10 - 15%	iv) 15 - 20%
v) 20 - 25%	vi) 25-30%	vii) >30%	

Product performance

Performance on the following parameters as compared with competitors during the past three years

	Compared with Competitor						
Product Performance Parameters	**Poor**						**Better**
a. Product quality	1	2	3	4	5	6	7
b. Cost advantage	1	2	3	4	5	6	7
c. Market competitiveness	1	2	3	4	5	6	7
d. Uniqueness of the product and/or process technology employed	1	2	3	4	5	6	7
e. Average product concept-to-launch time	1	2	3	4	5	6	7

REFERENCES

[1] Lawless, M.J. and Fisher, R.J. (1990). Sources of Durable Competitive Advantages in New Products, *Journal of Product Innovation Management*, Vol. 7, No. 1, pp35-43.
[2] Guan, J.(2002), Comparison Study of Industrial Innovation between China and Some European Countries, *Production and Inventory Management Journal*, Vol. 43, No.3
[3] Lall, S., (1992), Technological Capabilities and Industrialization, *World Development*, Vol. 20, No. 2, pp165 – 168
[4] Burgelman, R., Maidique, M. A. and Wheelwright, S.C. (2004). *Strategic Management of Technology and Innovation*, McGraw Hill, New York
[5] Guan, J. and Ma, N. (2003), Innovative Capability and Export Performance of Chinese Firms, Technovation, Vol. 23, pp737-747.
[6] Christensen, J.F. (1995). Asset Profiles for Technological Innovation, *Research Policy*, Vol. 24, pp727-745
[7] Chiesa, V., Coughlan, P. and Voss, C.A.(1996). Development of a Technical Innovation Audit, *Journal of Product Innovation Management*, Vol. 13, pp105-136
[8] Yam, C.M, Guan, J.C, Pun, K.F. and Tam, P.Y. (2004). An Audit of Technological Innovation Capabilities in Chinese Firms: Some Empirical Findings in Beijing, China, *Research Policy*, Vol. 33, No. 8, pp1123-1250
[9] Bougrain, F. and Haudeville, B. (2002). Innovation, Collaboration and SMEs Internal Research Capacities, *Research Policy*, Vol. 31, pp735-747
[10] Danneels, E. (2002). The Dynamic of Product Innovation and Firm Competences, *Strategic Management Journa*l, Vol. 23, pp1095-1121
[11] Galende, J. and Fuente, J.M. (2003). Internal Factors Determining a Firm's Innovative Behavior, *Research Policy*, Vol. 32, pp715-736
[12] Teece, D.J. (1996). Firm Organization, Industrial Structure, and Technological Innovation, *Journal of Economic Behavior & Organization*, Vol. 31, pp193-224
[13] Evangelista, R. Perani, G., Raptit, F. and Archibugi, D. (1997). Nature and Impact of Innovation in Manufacturing: Some Evidence from the Italian Innovation Survey, *Research Policy*, Vol. 26, pp521-536
[14] Yam, C.M. R., Lo, W., Tang, P.Y. and Sun, H.Y. (2003), Enhancement of Global Competitiveness for Hong Kong/China Manufacturing Industries through i-Agile Virtual Enterprising, *International Journal of Technology Management*, Vol. 26, No. 1, pp88-95
[15] Lo, W.L., Naidu, G.M. and Yam, C.M. (2001). Dynamic and Responsive Firm Strategy : A Case Study of Hong Kong and China Collaborations in Pearl River Delta, *Journal of Global Marketing*, Vol. 14, No.4 .
[16] Fu, J and Shi, P (1995). Technological accumulation versus technology innovation a new approach of Chinese firms; technological innovation form technological accumulation dimension, *Sun-Yat-Sen Management Review*, Vol. 3 No 4 pp112-121
[17] Evangelista, R. Iammarino, S. Mastrostefano V. and Silvani A.(2001), Measuring the Regional Dimension of Innovation: Lessons from the Italian Innovation Survey, *Technovation*, Vol. 21 No 11, pp733-745.
[18] Wu, G. (2001). *Technological Innovation Management*, Tsinghua University Press, Beijing (in Chinese)
[19] Wan, D., Ong, C.H. and Lee, F. (2003). Determinants of Firm Innovation in Singapore, *Technovation*, Vol. 25, No. 3, pp261-273
[20] Rothwell, R. (1983), Innovation and Firm Size: A Case of Dynamic Complementarity; or, Is Small Really so Beautiful?, *Journal of General Management*, Vol. 8 No.3, pp.5-25
[21] Pavitt, K., Robson, M. and Townsend, J. (1987). The Size Distribution of Innovating Firms in the UK 1945-1983, *Journal of Industrial Economics*, Vol. 35, pp279-315
[22] Tsai, Wenpin (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance, *Academy of Management Journal*, Vol. 44, No. 5, pp996-1004
[23] Caloghirou, Y., Kastelli, I. and Tsakanika, A. (2004). Internal Capabilities and External Knowledge Sources: Complements or Substitutes for Innovative Performance?, *Technovation*, Vol. 24, pp29-39
[24] Hong Kong Trade Development Council, HKTDC (2000). *Challenges and Opportunities for Hong Kong's Electronics Industries: Current Status and Future Prospect*s, Hong Kong Trade Development Council, Hong Kong
[25] SQW (Asia) Ltd, Rapra International Limited, Hong Kong Plastics Technology Centre (2001). Techno-economic and market research study on Hong Kong's Plastics Industry, 1999/2000, Hong Kong Trade Development Council, Hong Kong
[26] Armstrong, J. and Overton, T. (1977). Estimating Nonresponse Bias in Mail Surveys. *Journal of Marketing Research*, Vol. 14, No. 3, pp396-402
[27] Churchill, G.A. (1979). A Paradigm for Developing Better Measures of Marketing Constructs, *Journal of Marketing Research*, Vol. 16, No. 2, pp64-73
[28] Kline, R.B. (1998), *Principles and Practice of Structural Equation Modeling*, The Guilford Press, New York
[29] Bentler, P.M. (1990). Comparative Fit Indexes in Structural Models, *Psychological Bulletin*, Vol. 107, No. 2, pp238-246
[30] Byrne, B.M. (2002). *Structural Equation Modeling with AMOS: Basic Concepts, Applications and Programming*, Lawrence Erlbaum Associates, London
[31] Cohen, W.M. and Levinthal, F.A. (1990). Absorptive capacity a new perspective on learning and innovation, *Administrative Science Quarterly*, Vol. 35 No. 1, pp128-152
[32] Carmen, C.O, María de la Luz, F.A and Salustiano, M.F. (2006). Influence of top management team vision and work team characteristics on innovation: The Spanish case, *European Journal of Innovation Management*, Vol. 9, No. 2; pp179-202
[33] Dosi, G., Faillo, M., and Marengo, L. (2008). Organizational Capabilities, Patterns of Knowledge Accumulation and Governance Structures in Business Firms: An Introduction, *Organization Studies*, Vol. 29, No. 8/9, pp1165-1211