

Status and Trends of IT/IS Application in Small and Medium Manufacturing Enterprises in China

Fang Wang, Xunhua Guo

School of Economics and Management, Tsinghua University, Beijing 100084, China
Email: wangf.09@sem.tsinghua.edu.cn, guoxh@sem.tsinghua.edu.cn

Abstract

With the rapid development and profound changes in the Chinese economy, the early stage growth patterns which largely depended on low labor costs are facing serious challenges. Small and medium manufacturing enterprises (SMEs) are upgrading management and service to improve productivity efficiency and market reaction speed. In this process, information technologies and systems inevitably play an important role. Based on a survey among 105 companies, we examined the competitive situation, status and trends of IT/IS application in Chinese SMEs. Starting with analyzing the competition environment, we investigated the current situation of IT/IS application with the “diffusion-infusion” framework and provide some discussion about future development.

Keywords: IT/IS application, manufacturing, SME, information systems, competitiveness

1. Introduction

Since 1980s, information technology has brought unprecedented impacts on enterprises operation and the business world. Informationization became a major theme related to survival for enterprises^[10]. In China, informationization has always been an

important part of national strategy. Many enterprises effectively used the applications of IT and created lots of application model and management tools with Chinese cultural characteristics. However, the level of IT/IS is still relatively low, comparing with that of developed countries. How to improve the competitive strength and close the gap, is an urgent task facing Chinese enterprises.

Small and medium manufacturing enterprises (SMEs) are an important force in the national economy. In the early time of Reform and Opening-Up, Chinese manufacturing enterprises, especially SMEs, established competitive advantage by low labor costs^[5]. With rapid development and profound changes in the Chinese economy, more and more SMEs hope to improve productive efficiency and market reaction speed by promoting management and service. In this process, information technologies and systems inevitably play an important role.

In this situation, scholars in China actively explore informatization issues of Chinese enterprises including SMEs, such as critical factors^[12], internal and external environment, existing problems and suggestions^[13], status and developing mode^[14], evaluation index system^[9] and so on. However, there is still a lack of systematic analysis of overall situation of Chinese SMEs informationization and discussion about future development.

Based on the data collected from a survey conducted in Chinese small and medium manufacturing enterprises, this paper starts with discussing the competitive environment, competitiveness, and competitive strategy of the companies, and then evaluates the status of IS application in enterprises using the framework of “diffusion-infusion”, and analyzes the trends of development in the future. Analysis shows that Chinese SMEs are facing a market stage, during which the companies have a strong demand for IT/IS application to significantly promote management and service, effectively control costs, and comprehensively consolidate cooperation with supply chain partners. However, with the lag of IT related elements such as strategy, management, users, there is still a high level of risk in the informationization of SMEs.

The rest of this paper is organized as follows: in section 2, the theoretical basis of this paper is given. The research methods are explained in section 3. Section 4 describes the results analysis and section 5 includes our conclusions have achieved so far.

2. Theoretical basis

We use “diffusion-infusion” model^[8] to analyse informationization status of SMEs. This model emphasizes interaction between bottom-up diffusion and top-down management control, and the promoting effect of these two force^[4], and is usually regarded as a basic tool to evaluate informationization status. Generally speaking, infusion means the dependence, importance, or effect of IT/IS to enterprises. Diffusion is the prevalence or coverage of IT/IS in enterprises. Using these two demensions, enterprises can be roughly divided into four categories, namely L-L, H-L, H-H, L-H (H represents high, and L represents

low), as Fig.1 shows. It is generally believed that, with the development of IT, all enterprises will become H-H style enterprises. Degree of infusion and diffusion can not simply used as a measurement of the level of informationizaion, but as a description or a view of the status.

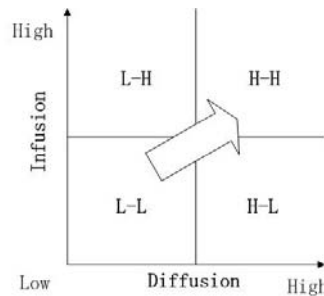


Fig. 1: “Diffusion-Infusion” model.

Relevant research has proposed a six-dimensional index system, as Fig. 2 shows, including the application portfolio (indicators related to IS applications' content & form), technology (indicators related to IT), organizational (indicators related to IT construction and organizational structure), IT strategy (indicators related to IT strategic planning & development), IS management (indicators related to IS construction and management), users (indicators related to user attributes and user behavior). This comprehensive framework can be used to study the status of enterprise informationizaion. Managers should effectively make investment to balance the six dimensions, to avoid excessive backward or forward^[7].

3. Research methods

Research questionnaire was designed refer to related findings including of enterprises informationization process mode^[2,4], IT adoption^[6] and other key issues of information management^[1]. The

questionnaire was composed of three parts, namely enterprises' competitive environment and competitiveness, the application status of information systems, and IS demands & critical issues.

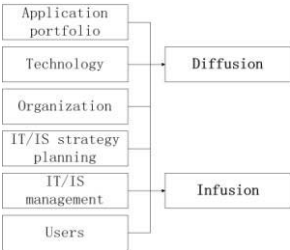


Fig. 2: Six-dimension index.

The respondents of the questionnaire are senior managers. We suppose that the cognition of senior manager and the objective status of the enterprise are of high consistency, while senior managers' knowledge, attitude and intention significantly affect enterprises' decision-making and developments. As to SMEs, this assumption is reasonable because of the high concentration of management. Apart from demographic questions, questionnaire were designed via a Likert question (1=strongly disagree; 5=strongly agree). Some questions were asked from multi-angle to test the reliability and validity. From September to November, 2009, 300 enterprises were randomly selected from the database contains information of about 2000 SMEs. The survey were sent by telephone or mail, and a total of 105 valid questionnaires were collected. And the data meets the requirements of analysis, according to the reliability and validity test.

The majority of enterprises in the sample were typical manufacturing enterprises (see Table 1). The sample included machinery manufacturing, electronics, energy, chemical, food, clothing, medicine and health enterprises, all of which accounted for more than 80%

of the sample. And there were a few integrated groups, trade and service enterprises and other enterprises. All the enterprises were SMEs and had less than 5000 employees. The profitability of sample enterprises was measured by the "umber of years profitable over the past five years". Most enterprises were profitable. Enterprises which profited in all the last five years account for more than 70%, and there were very few ones that continually lost in the last five years.

	Item	N	%
Industry	Machinery manufacturing	53	50.48
	Electronics	18	17.14
	Energy chemical	5	4.76
	Food, clothing, medicine	9	8.57
	Integrated group	5	4.76
	Trade and consulting	7	6.67
	Other	8	7.62
Scale	less than 100 people	12	11.43
	100-500 people	57	54.29
	500-1000 people	24	22.86
	1000-5000 people	7	6.67
	Missing data	5	4.76
Number of years profitable	0	2	1.90
	1	1	0.95
	2	3	2.86
	3	10	9.52
	4	10	9.52
	5	70	66.67
	Missing data	9	8.57

Table 1: Sample distribution (Total=105).

4. Result Analysis

To start our analysis, we firstly examined the current competitive situation, self-recognition of competitive abilities, competitive strategy and the status of information construction, application and management of enterprises, in order to

get an overview of the business environment and informatization of SMEs, and to discuss the success and the deficiency of their informatization.

A. Competitive environment & competitiveness

Fig. 3 shows the sample enterprises' evaluation of their competitive environment. The indicators reflect the competition, the market size growth, the stability of competitive structure and the pace of technological innovation. We can see the following distinctive features:

The market competition is very fierce. Most of the sample enterprises believe that the manufacturing market they faced existed fierce competition and the competitors who left behind will soon be eliminated. Meanwhile, products and services between competitors tended to be homogeneous. Thus, the primary task enterprises faced is how to deal with the pressure of survival.

The market is still expanding. Most enterprises believed that the manufacture industry developed very fast and the market needs increase rapidly in recent years. Thus, how to get greater share in the growing market is a key issue.

The market has come into a knockout stage. Sample enterprises did not think there would be many new competitors to join in, as the industry had entry barriers. Therefore, market competition was mainly made by the existing competitors. This result clearly reflected the present situation of manufacturing industry in China. Scattered small manufacturers are nearing an end; elimination and scale development has become a dominant theme.

The pace of technological innovation is relatively slow. Technology of traditional manufacturing industry had been mature, and updating of products was not quickly. Relatively speaking, upgrading the level

of operation and management were more urgent and meaningful.

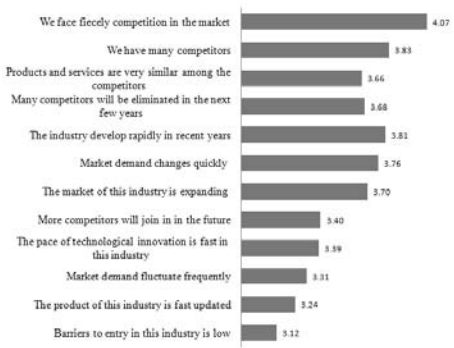


Fig. 3: Competitive environment.

As to the self-evaluation of competitiveness, many sample enterprises regarded the “Reputation in a particular user group” as an important competitive advantage (see Fig. 4). This phenomenon reflected in the early stages of development, stable social relations meant significant to SMEs. Many businesses rely on this to maintain a relatively stable market segments. But this competitive advantage will meet tough challenges as the competition become fierce and the market come into scale developmen stage. On the other hand, most businesses did not have cost competitive advantage. They also lacked the ability of operating management, investment analysis and risk control, etc. It is reasonable to believe that the focus of development in the future will be upgrading the level of operational management and controlling cost.

As to competitive strategy, the improvement of product quality was certainly the most improtant problem SMEs concerned (see Fig. 5). This shows a highly level of consensus with the characteristics of the market. Competitive advantage established by social relationships in sub-market will gradually be broken. The trend of integration is

clear. The focus on quality of products reflected the change of concern of enterprises in this process.

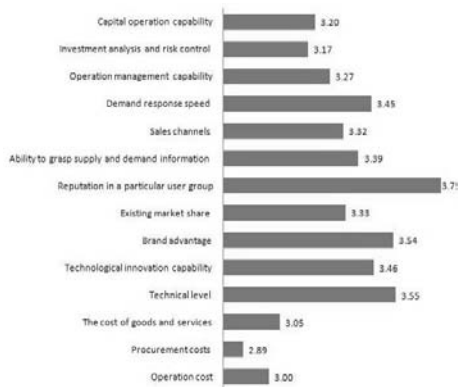


Fig. 4: Competitive situation.

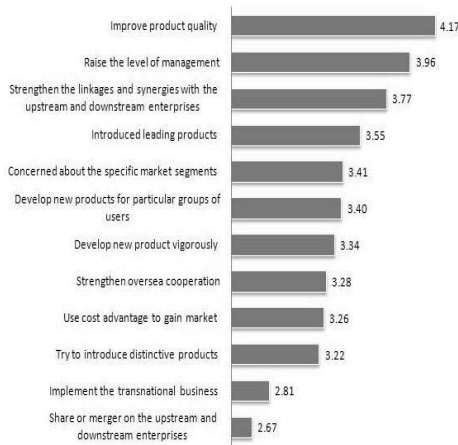


Fig. 5: Competitive Strategies.

It is worth noting that although most companies did not choose “cost leadship” (using the cost advantage to win the market) as their competition policy, management issues closely related to cost control were emphasized. From this we can predict that, in the current market, it is really difficult to establish and maintain cost advantage, but the effective control of cost is essential to avoid being eliminated in the competition.

At the same time, “Strengthening the linkages and synergies with the upstream and downstream enterprises” also received high attention. Enterprise did not hope to access to such linkages and synergies through sharing or merging into the upstream and downstream enterprises. This indicated promising prospects of electronic, IS and e-business applications among these enterprises.

B. Status of Informationization

Table 2 shows sample enterprises’ IT diffusion and infusion profile. The mean value of diffusion is significantly higher than that of infusion. This is consistent with conclusion of related research of general status of Chinese enterprises’ informatization process.

	Min	Max	Mean	Std.
Diffusion	1.33	5	3.66	0.99
Infusion	1.4	5	3.06	0.79

Table 2: Sample Enterprises IT diffusion and infusion profile (Total=105).

However, the value of diffusion and infusion of SMEs is lower than those of other research results^[7]. This reflects there is still a gap between SMEs and enterprises of other industries in informationization. Low value of diffusion may relate to characteristics of manufacturing industry itself. But the lower value of infusion highlights the lack of penetration.

If we use diffusion and infusion as two dimensions and set 3.5 as a threshold value, we can divide all the 105 SMEs into four categories, as Fig.6 shows.

Enterprises of low infusion occupy nearly 70% of the sample. And enterprises of low diffusion account for a large proportion, too. Different from general Chinese enterprises, among which H-L type enterprises occupy 50%-60%, the proportion of this kind is not

high. In contrast, the proportion of L-L type is 35.2%, which is the highest among the four types.

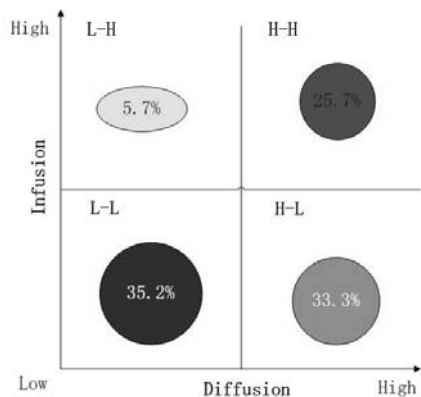


Fig. 6: Diffusion and infusion of sample enterprises.

Surprisingly, enterprises with high scores in both dimensions (H-H style) occupy as much as 25.7%, higher than the general level of Chinese enterprises (about 20%). Meanwhile, the ratio of L-H companies of sample enterprises reaches as high as 5.7%, which is higher than general companies.

The results clearly show that SMEs are largely in the early stages of development, and they have some distinctive features. As labor-intensive industry, the coverage of IT/IS is not as comprehensive as that of financial and services industries. IS in core business is more likely to contribute to their business.

C. Investment and management of IT/IS

We use the six-dimension framework, to study the development status of SMEs, and compare them with that of the Chinese Enterprises, to find the difference in investment and management between them. As is shown in Fig.7, there exists a rather obvious gap.

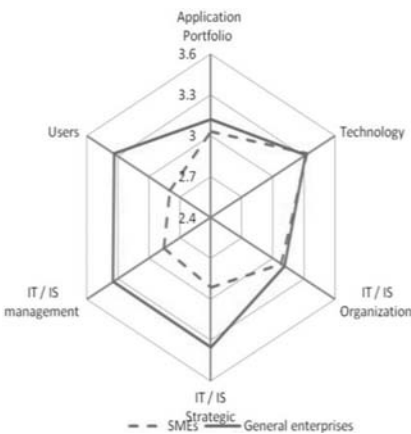


Fig. 7: Comparison of Inputs and management conditions.

It is noteworthy that in technical and organizational dimensions, the sample shows no big difference with other enterprises. So we can draw a conclusion that the development of infrastructure made IT no longer the main obstacle of informationization. Meanwhile, as the enterprises are small, there is no particularly backward in organizational dimension. As to the application portfolio dimension, the difference between sample enterprises and other business is not significant. It may because Chinese companies generally are not mature in this aspects; it may also because the lag of strategic and management makes the application portfolio demand not really emerged. So it is reasonable to believe that to SMEs, the major short dimensions of informationization are strategic, management and user. The development of these three dimensions will have an important driving force in promoting the whole portfolio.

In strategic dimensions (see Fig. 8), the weak point of SMEs is the lack of centralized, standardized IT strategic planning, in other words, the construction of IT lacks overall long-term consideration. To implement informationization from the view of

operation and strategy is the prior task to perform in the future.

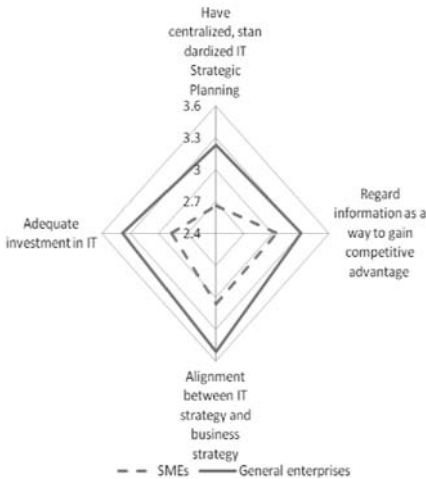


Fig. 8: Comparison of IT strategic planning.

As to information management dimension, as Fig. 9 shows, the biggest gap between SMEs and general business is IT project management capabilities. How to establish a standardized and effective project management system is a significant issue that cannot be ignored. In the user dimension, as Fig. 10 shows, the difference lay in users' participation in the process of construction.

If we investigate the values of Six-dimension index of four categories of SMEs, as Fig.11 shows, we can find enterprises with high diffusion have no obvious advantage, while enterprises with high infusion have (see Fig. 11). This also points out that for the SMEs, the infusion of information technology is more meaningful than diffusion. Therefore, the informationization of SMEs does not necessarily first diffuse then penetrate just as other industries usually do. They should focus on core business related applications.

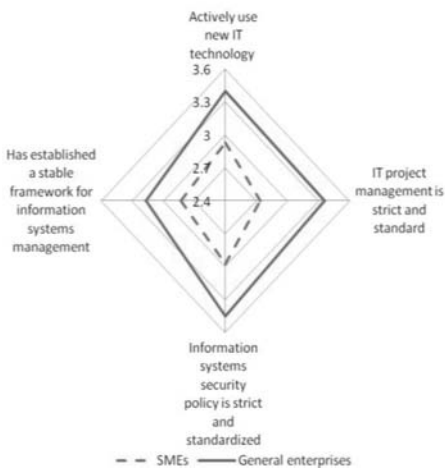


Fig. 9: Comparison of information management.

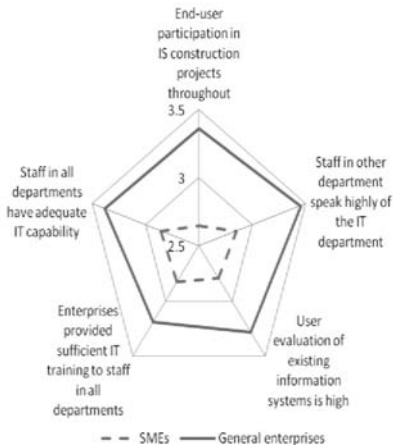


Fig. 10: Comparison of user dimension.

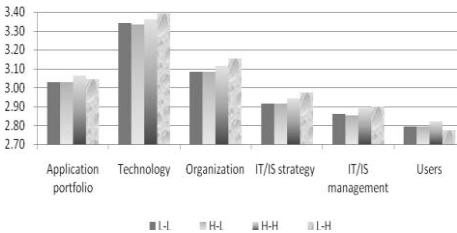


Fig. 11: Comparison of four types of SMEs in six dimensions.

5. Conclusion

This paper analyzes SMEs' competitive environment, competitiveness, competitive strategy, and the statues of IT/IS application. SMEs in China are facing a knockout stage market. Although the market is still expanding, eliminating and scale concentration has become the dominant trend. At this moment, the direction and focus of competitiveness is the improvement of operational management and controlling of cost. In addition, to enhance the upstream and downstream business linkages and synergies with the aid of electronic system is an important direction to enhance the competitiveness. The values of SMEs' diffusion and infusion are both lower than general Chinese enterprises, which means there is a gap between them and enterprises of other industry or larger scales. Considering the manufacturing characteristics, the requirement of coverage is relatively low, and the meaning of universal application is not high, either. While, the value of informationization for such enterprises exists in core business activities related applications.

In the 6 dimension of IT investment and management, there is no big difference between SMEs and general Chinese enterprises in technology, organization and application portfolio. The apparent difference exists in IT strategy, information management and user dimension. If SMEs try to make up these three shortcomings, the demand for IT maybe more released, and IT may play a more significant role in the future.

Acknowledgement

The work was partly supported by the National Natural Science Foundation of China (70972029/70890081/70831003) and the Research Center for

Contemporary Management of Tsinghua University.

References

- [1] Chen, G, Wu, R, Guo, X. Key Issues in Information Systems Management in China. *Journal of Enterprise Information Management*, 2007, 20(2): 198~208.
- [2] Guo, X, Chen, G. Internet Diffusion in Chinese Companies. *Communications of the ACM*, 2005, 48(4): 54~58.
- [3] He, X J. The ERP Challenge in China: A Resource-based Perspective. *Information Systems Journal*, 2004, 14(2): 153~167.
- [4] Reimers, K, Guo, X, Chen, G. Do IT-Managers Learn How to Control Spending on New Information Technology? A Study of IT-Budget Growth in Chinese Companies. *Database for Advances in Information Systems*, 2009, 40(1): 20~37.
- [5] Zhang, M, Sarker, S, Sarker, S. Unpacking the effect of IT capability on the performance of export-focused SMEs: a report from China. *Information Systems Journal*, 2008, 18(4): 357~380.
- [6] Zhang, N, Guo, X, Chen, G. Why Adoption and Use Behavior of IT/IS Cannot Last? -- Two Studies in China. *Information Systems Frontiers*, 2010: (in press).
- [7] Chen, G., Guo, X. *Information Systems Management*, Beijing: Renmin University Press, 2005. (in Chinese)
- [8] Chen, G., Lei, K. *Information Systems organization, management and modeling*, Beijing: Tsinghua University Press, 2002. (in Chinese)
- [9] Jing, J., Liu, L. Research on the Measurement and Advices to the Informationization of the Small and Middle-sized Enterprises in the Mechanical Industry of Jilin Province. *Informa-*

tion Science in China, 2005 (1). (in Chinese)

- [10] Wang, Z. Information technology and management transformation. *Journal of Management Science in China*. 2000,3(2):1-8 (in Chinese)
- [11] McFarland, F. W., Nolan, R., Chen, G. Seizing Strategic IT Advantage in China. Beijing: Higher Education Press, 2003. (in Chinese)
- [12] Chen, G., Wu, R., and Guo, X. Key Issues in Information Systems Management in China. *Journal of Enterprise Information Management*, 2007, 20(2), pp. 198-208.
- [13] Yang, J. The Research on SME Informatization Strategy Based on Informatization Environmen. *Science Technology and Industry*, 2009, (12). (in Chinese)
- [14] Zhang, S., Huang, Y., Zhao, S. Status and Approaches of SME Informatization. *China Management Informatization*, 2008, (12). (in Chinese)