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Abstract:

Chinese SMEs have played an important role in stimulating economic growth, increasing employment, expanding exports and promoting science and technology innovations. In 2005 there were more than 10 million SMEs registered in the Industry and Commerce Department, accounting for 99 per cent of all registered corporations (UN Economic and Social Commission for Asia and Pacific; China Council for the Promotion of International Trade, 2006).

Further development of the Chinese as well as of all modern economies is dependent on the speed and effectiveness of the implementation of ICT based solutions in businesses. While large companies have been quick to adopt ICT solutions and technologies, small and medium-sized enterprises (SMEs) have had more serious problems with the requirements and challenges of e-business.

A number of ICT, e-commerce adoption methodologies have been suggested through literature most of this research, has however, focused on developed countries where the structure of the economy is common. There are only few studies that shed some light on prescribing strategies of ICT adoption for SMEs in developing countries, especially Chine.

Furthermore, despite the enormous attention given to encourage SMEs to adopt ICT there has been little systematic research into the factors influencing, enabling and inhibiting the adoption of ICT within SMEs.

In this article, author developed a model of ICT adoption of Chinese SMEs, founded on premises that the adoption and the use of ICT represent the fundamental source of competitiveness and the basis for firms' survival in the world market. By applying the Qualitative-Comparative Analysis (QCA) method and Boolean algebra, author proposed a model of necessary and sufficient factors for ICT adoption by SMEs in Chine.

Key words: adoption models, Boolean Algebra SMEs, case studies, ICT, qualitative comparative analysis (QCA).

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1 Introduction

Over the last decade the business world has changed so rapidly, that one can no longer imagine managing in a *steady state*. In no other domain has this observation been more relevant than in the field of information communication technology (ICT), which has become a major catalyst and enabler for organisational change. Thus, emerging small and medium-sized enterprises (SMEs) find themselves in an environment of constant technological change and the need to adopt those changes in their businesses as well as supporting IC technologies. Because these changes may become a significant threat when ignored by the company, but they may as well become valuable opportunities when anticipated and where appropriately adopted. How they respond to this challenge and how they adopt IC technologies in Chines SMEs is the question that we will try to answer in this paper.

To answer that question authors develop an adoption model of ICT by applying the Qualitative Comparative Analysis (QCA) and its formal language - Boolean algebra. QCA is a relatively new method for providing causal explanations in the IT management area. QCA is essentially case-oriented comparative research that provides a systematic, holistic analysis of a moderate number of cases. The method is designed to draw causal inferences from comparing configurations of the selected causal variables across cases included in analysis. QCA holistically compares these configurations to discover necessary and sufficient conditions for the emergence of an outcome.

2. Conceptual Framework

Chinese SMEs have played an important role in stimulating economic growth, increasing employment, expanding exports and promoting science and technology innovations. In 2005 there were more than 10 million SMEs registered in the Industry and Commerce Department, accounting for 99 per cent of all registered corporations. [15]

Further development of the Chinese as well as of all modern economies is dependent on the speed and effectiveness of the implementation of ICT based solutions in businesses. While large companies have been quick to adopt ICT solutions and technologies, small and medium-sized enterprises (SMEs) have had more serious problems with the requirements and challenges of e-business. In the literature there have been discussions on the topic but mainly from the big businesses points of view. Furthermore studies which were concerned how

SMEs are coping with IT/ICT challenges were based on developed economies. However, none addressed it in developing in particular Chine's case.

In addition, there is also replete of literature available on the adoption of information technology in small business from many aspects (see 8, 10, 13, and 14]. Current knowledge in these areas of literature which looked into the necessary factors leading to adoption of IS/IT by SMEs formed the basis for the empirical component of this study.

Many different factors have been identified in previous studies as impacting on IT/ICT adoption by small businesses, and all use differing models in determining factors of adoption. For this study the factors of adoption IT/ICT in SMEs have helped in identifying the contexts only that would influence its adoption by the SMEs. These contexts can be clustered by factors relating to (a) technological, (b) organisational, (c) environmental, (d) economic and (e) individual contexts.

Based on the literature reviewed (in particular 8, 10, 13], we have selected five factors for each contexts for testing the framework using the QCA and its formal language Boolean algebra [9]. Those five contexts along with their factors would depict the IT/ICT adoption framework and their effect on the adoption decision for IT/ICT as necessary and sufficient factors.

3. Empirical Considerations

Structural characteristic of the Chines economy highlighted the critical need for SMEs support and their further development; as well as the importance of adopting and using ICT. To assess the adoption process in Chinese SMEs we have developed structured questionnaires and conducted face to face interviews with a number of Chinese companies in the region of Jiangsu Province. Out of 125 questionnaires sent out and 25 interviews conducted we have selected 35 case studies for this research.

Based on the content analysis and using the coding system developed in [11 p119 see table A.Table 1] we have explained characteristics of Chinese SMEs which will be further analyses using QCA and Boolean algebra. The following section presents it.

Table 1. Characteristics of Chinese (first five case studies) SMEs

01	02	03	04	05	06	07	08	09
1	1	4	4	-	2,4	1,5,2	1	1
2	2	3	1	3	3,4	1,5,2	1	1
3	1	2	1	3	3,4	1,5,2	2	1

4	2	1	4	2	3,4	1,5,2	2	1
5	2	3	4	1	1,2	1,5,2	-	1

Based on the empirically based coding of the causal and outcome variables (Table 1) it can be concluded that analysed firms are small and medium in size (column 2), from different industrial sectors (column 3), which were adopting ICT (column 4) mainly under the impact of individualistic (3x4), and technological (2x1) essential influencing factors. While organizational and environmental factors played no role in the process.

In addition it is worth noting that one small firm and one medium firm have had high (RNB 90,000 ~A$15,000) investment costs (column 5), while one medium firm has had small to medium high investment costs i.e. from RNB 30,000 (~A$ 5,000) to RNB 90,000 (~A$15,000). The main form (column 6) of adopted ICT were 3,4 that is installation of more than one computer (Intranet) connected to the Internet, as well designed home site (3x3,4) followed by (2, 4) one computer connected to Internet and designed Web site, while one firm has had one computer.

The most significant hurdles for businesses adopting ICT were evenly spread amongst (column 7) 1,5,2, that is technical problems, infrastructural issues, (bad connections) limited human resources, as well as (5) problems linked to the current economic situation and lack of the legislative and governmental support. In addition several firms reported problems with business partners which have not installed any form of ICT resulting in the under usage of their own IC technologies.

In regard of benefits (column 8), one can conclude that an even number of firms reported that ICT investment were good and bad decisions. Finally, it is important to note that all firms reported optimistic attitudes towards future development of ICT and that all firms are planing to extend the use and further their investment in these technologies.

From the above it can be concluded, that in those firms the ICT adoption depends on initiatives of managers/owners alone.

These factors led to the introduction of computers connected to the Internet (column 6), as well as to the designed Web presentation in most cases for marketing and promotional purposes. One small firm had one computer connected to the Internet. Two medium firms had installed both the Intranet and Internet, while one medium firm had only one computer connected to the Internet. However, although planed none of those firms have had e-commerce introduced, mainly because there were no legal and infrastructural foundations for it.

Table 2. Boolean truth table of causal variables and outcomes for Chinese SMEs

SME	Causal factors (variables)							*Outcomes*				
	X_1	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**	**X_7**	***Y_1***	***Y_2***	***Y_3***	***Y_4***	***Y_5***
1	1	0	0	0	0	1	0	*1*	*1*	*0*	*1*	*0*
2	1	0	0	0	0	1	0	*1*	*1*	*1*	*1*	*0*
3	1	0	0	0	0	0	0	*1*	*1*	*1*	*1*	*0*
4	1	0	0	0	0	1	0	*1*	*1*	*1*	*1*	*0*
5	0	0	0	0	0	1	0	*1*	*0*	*0*	*0*	*0*

Based on (Table 2) the QCA process of minimization and by applying Boolean logic in this section [4], for the randomly selected five (out of 35) Chinese SMEs case studies the results are presented as follow:

$$Y_1 = Y_2 = Y_4 = [X_1 *(X_2 *X_3 *X_4)] + [X_1 *(x_2 *x_3 *x_4)*(X_6 + X_5* x_6)+ (x_1*X_6)] \quad \textbf{(1)}$$

$$Y_3 = [X_1 *(x_2 *x_3 *x_4)* X_6) + (X_2 *X_3 *X_4)] + (x_1 *X_5 *X_6) \quad \textbf{(2)}$$

$$Y_5 = [(X_2 *X_3 *X_4) (x_5*X_6 + (X_1 *x_6)] + [X_1* X_6 *(x_5 + x_2* x_3 * x_4* X_5)] \quad \textbf{(3)}$$

Firstly, Chinese SMEs are adopting IT/ICT in a form of computers (C/Y_1) and connection to the Internet (CI/Y_2). They also designed their home sites (HS/Y_3) mainly by the influence of technological (X_1) and to the certain extent factors of support by the government's policy ($X_{2,3,4}$), or (+) by the influence of technological factors (X_1) together with individualistic factors (X_6) and (*) in combination with organisational factors (X_5) (equations $Y_{1,2,4}$).

As to the Intranet (NCI/Y_3) form of IT/ICT, Chines SMEs are adopting it with the influence of technological factors (X_1). Together, (marked as *) with the absence of the government's support policy ($x_2 *x_3 *x_4$), but with individualistic factors present (X_6) (equation Y_3); or (+) this form is adopted by the environmental factors ($X_2 *X_3 *X_4$) alone; or (+) by the individualistic factors, with an absent technological factor ($x_1 *X_5 *X_6$).

Finally, E-commerce is adopted by Chinese SMEs with the influence of environmental support policy factors ($X_2 *X_3 *X_4$). Together with individualistic technological factors but with absence of organisational factors (x_5*X_6 + ($X_1 *x_6$) or (+) by the influence of technological and individualistic factors ($X_1* X_6$) and (*) absence of environmental/support factors ($x_2* x_3 * x_4$) (equation Y_5).

From the equations above, we can conclude that adopting basic forms of IT/ICT are conducted under presence of technological and individualistic factors, that is, it is confirmed that for adopting IT/ICT in Chine there is no well development infrastructure and political support. That is process is left for individualists and their knowledge and IT skills to do it on their own. As to adopting other higher forms of IT/ICT it is introduced by the influence of technological factors with obvious absence of all other factors.

4. Concluding remarks about Chines SMEs

In conclusion we list some of the main issues gathered from the interviews:

- *Financing issues*

It is the most reported problem of SMEs in China. Some analysts said the most seriously thing is that SMEs can not get the financing on the market. Most of SMEs get loans from government, from public finance agencies; however, this money is in limited amount.

An interesting response was good illustration about the financial issues. When a SME wants to get loan, only 14% of all amount requested can get its from bank and credit cooperatives; 8% from private finance agencies, 24% inter-enterprises borrowings, and 54% money from other sources.

- *Strategy issues*

After the SMEs survived, the speed of developing is very quick, but during this process their business strategy and aims are not so clear, some of them even have no strategy. Since most the owners of SMEs are with no formal education in general business area and/or management.

- *Market related issues*

The ability to compete in the market depends on the owner's personal ability and social relationship. Although the enterprise have lots of good technology and other resource, most of the enterprise can not go far because the market always emphasize and its biased towards the big enterprises. So the SMEs have no chance to get the same opportunity and compete with the large scale enterprise.

- *HR issues and the - lack of skilled labour force;*

With the developing of SMEs, the team who started the business can not do all jobs required. However, they do not attract talented workers they need for further development due to different reasons; one of them they can not pay good salaries to the most suited persons for

the job. So they have to train themselves their employees but when they acquire skills they are most likely inclined to leave for the better paid jobs in big companies.

- *Management issues*

Most of the SMEs belong to household type business enterprise. At the beginning when the enterprise has been established, they have the household business enterprise management style. However, when they attained some scale, the household type business management style still stay the same, it has not been changed in most analysed cases, what is the main obstacle to the further development.

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A. Table 1. Coding system used in the analysis of case studies (SMEs)

(1.0) Firm	(2.0) Size	(3.0) Activity	(4.0) Idea/ Influence	(5.0) Invest-ment Size (000 RNB)	(6.0) IT Form	(7.0) Problems	(8.0) Results	(9.0) Future expectations
1 Art Galleria	1 Small	1 Trade	1Technological factors	1.Up to 5	1 Computer	1 Technical	1 Better than expected	1 Optimistic
2 Courier	2 Medium	2 Other service	2 Business environment	2. 5-15	2 One computer connected to the Internet	2 Human resources	2. As expected	2 Pessimistic
3 Engineering	3 Large	3 Manufacturing	3 Organisational factors	3. Over 15	3 Intranet and Internet	3 Financial	3	
4 Architects		4 Professional service	4 Individualistic factors		4 Home site	4 Time needed for adoption		
5 Restaurant		5 Tourism restaurants			5 E-commerce	5 Other		

Source: (11 p. 119)