

ICT ADOPTION IN CHINA

*Hazbo Skoko: Charles Sturt University & Alfaisal University, Riyadh, 11533, Ksa,
Bathurst, Australia*

~

Contact: Hazbo Skoko, Charles Sturt University & Alfaisal University, Riyadh, 11533, KSA,
c/o Charles Sturt University, Panorama Ave, 2795 Bathurst, Australia, Email:
hskoko@csu.edu.au

Abstract:

Chinese SMEs have played an important role in stimulating economic growth, increasing employment, expanding exports and promoting science and technology innovations. 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 by 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, however, their focus has been mainly on developed countries. There are only few studies that shed some light on prescribing strategies of ICT adoption for SMEs in developing countries. 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 China.

Keywords: adoption models, Boolean algebra, SMEs, case studies, ICT, qualitative comparative analysis (QCA).

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 Chinese SMEs is the question that we will try to answer in this paper.

To answer that question the author develops 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 FRAMEWORKS

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; 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. 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 China's case.

There is replete of literature available on the adoption of information technology in small business. Current knowledge in these areas of literature which looked into the necessary and sufficient factors leading to adoption of IS/IT by SMEs formed the basis for the empirical component of this study. Table 1 highlights the findings from some of these studies.

Table 1: IT/ICT adoption models in literature

<i>Study</i>	<i>Technologies/Applications explored</i>	<i>Necessary factors</i>	<i>Sufficient factors leading to adoption</i>
Kirby and Turner (1993)	Inventory control, sales, purchasing, and others	Perceived benefits CEO's IT knowledge CEO's attitude towards adoption of IT	Perceived usefulness of the technology, external pressure to adopt IT
Julien and Raymond (1994)	Internet access and EDI and others	The level of assertiveness, rationality and interaction of business decision processes, structural sophistication of the firm	Rationalisation, benefits and uses of the technology to an organisation, centralisation and complexity
Iacovou et al (1995)	Sales, purchasing, personnel and payroll, CAD/CAM, EDI, MRP, and others	Perceived benefits CEO's IT knowledge CEO's attitude towards adoption of IT	Perceived ease of use and/or usefulness of the technology, organisational readiness/benefits
Thong and Yap (1996)	Accounting, Inventory control, sales, purchasing, personnel and payroll, CAD/CAM, EDI, MRP, and others	Size, CEO's innovativeness Employee's IT knowledge Attitude towards IT	Employee's IT knowledge Information intensity
Premkumar and Roberts (1999)	Email, Online data access, Internet access and EDI	Relative advantage Top management support Size, Competitive pressure	Relative advantage

Adapted from Rashid Al-Qirim (2001, pp. 66-67); Van Akeren and Cavaye (2000).

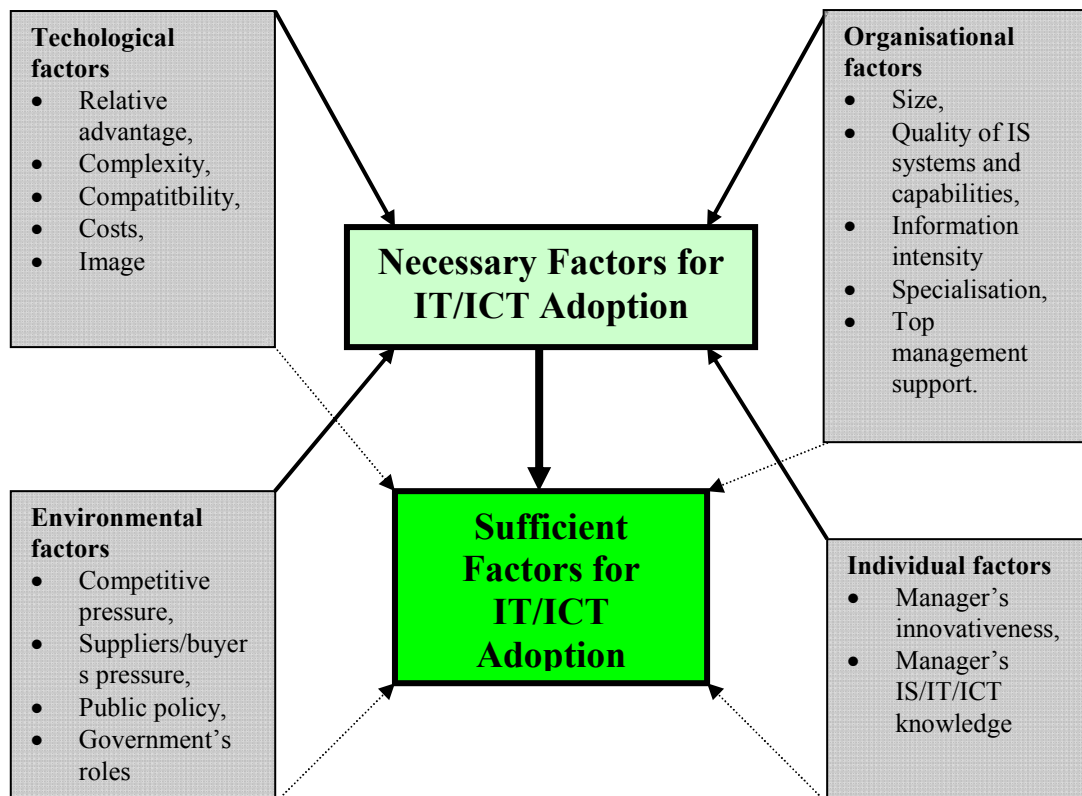
Many different factors have been identified in previous studies as impacting on IT/ICT adoption by small businesses, and all use differing models in determining factors of adoption. For this study the factors of adoption IT/ICT in SMEs have helped in identifying contexts that influence ICT adoption. These contexts can be categorised

into (a) technological, (b) organisational, (c) environmental, and (d) individual contexts.

Based on Rashid and Al-Qirim (2001) we selected five technological (innovation) factors, together with five organisational factors which were selected for testing the framework. Poon and Swatman (1999) emphasised the importance of the individual characteristics of the manager such as education, age, experience, and psychological traits have been found to strongly influence innovation adoption. They found that manager’s innovativeness and IT knowledge has positive effect on IT adoption. The framework, therefore, includes manager’s innovativeness and IT knowledge factors grouped under the individual factors.

The external environment should play a significant role in the adoption of new technologies process but was not included in many IT empirical studies. One study that has included them was research done by Premkumar and Roberts (1999) who found that competitive pressure was the only factor influencing IT adoption. However, they found external support to be insignificant. Following these considerations the framework includes four environmental factors for the study.

Figure 1 A conceptual framework for IT/IC technology adoption by SMEs



Adapted from Rashid and Al-Qirim (2001, p.68)

Summing up, the four contexts along with their factors would depict the IT/ICT adoption framework shown in Figure 1. The framework portrays the various factors and their effect on the adoption decision for IT/ICT as the first level – necessary factors. Whether such relationships would lead to IT/ICT adoption is depicted as the second level of effects – sufficient factors. The proposed framework is expected to highlight the impact of the various contexts and their factors on IT/ICT adoption in SMEs.

Therefore, based on the literature reviewed, we have selected factors for each contexts for testing the framework using the QCA (Ragin, C., 2000, Krivokapic-Skoko, 2002, 2003). Those four contexts along with their factors should depict the IT/ICT adoption framework and their effect on the adoption decision for IT/ICT as necessary and sufficient factors.

3 METHODOLOGICAL CONSIDERATIONS

Qualitative Comparative Analysis (QCA) is a case-oriented approach to comparative research with an explicit goal to provide causal explanations. QCA is also a variable-oriented approach since each case is transformed into a configuration of selected causal/independent and outcome/dependent variables. These causal configurations are first presented as nominal data with a yes/no or presence/absence dichotomy, and then holistically compared by using the principles of Boolean logic. As a result, QCA offers deterministic causal explanations for the presence/absence of some outcomes (Ragin 1987, 2000).

The method builds on the strengths of the explanatory and interpretive research by primarily bringing complexity, intensity of in-depth investigation to a moderate number of cases, while maintaining rigour, replicable procedures and the use of formal logic. The dialogue between theory and evidence is well structured. Starting from theoretical arguments that determine the minimum set of case attributes, QCA proceeds indicatively by simplifying the complexity of the evidence in a systematic, stepwise manner. To apply QCA cases are transformed into the unique combinations of selected causal conditions and associated outcomes, and then compared and interpreted holistically focussing on their attributes. Thus, in applying QCA each case remains contextualised as a whole – meaningful, interpretable and specific configuration of causal conditions/attributes and outcome variables. The focus is

primarily on comparing and interpreting these unique configurations of attributes not cases per se. QCA appears to be of a substantial utility in research sites with contextual and multiple causal relations. The method assumes that causal variables are effective only when operated in conjunction with each other, and consequently the impact of each causal variable should be discussed only in a particular context (Krivokapic-Skoko 2003).

The QCA is based on Boolean algebra. There are two conditions or states in Boolean logic, and these are generally referred as 1 which indicates presence, and 0 indicates absence. In Boolean logic (+) addition is equivalent to the logical operation 'or'. In Boolean logic (x) multiplication is equivalent to the logical operator 'and', where a product is a specific combination of causal conditions.

The method systematises and transforms empirical evidence into algebraic forms suitable for the data reduction process and represents the attributes of the cases into presence-absence dichotomies. These dichotomies are then included in a truth table - a raw data matrix which comprises causal conditions and outcomes across the cases - as a tool for data reduction while maintaining the integrity of each case. Each row in a truth table represents either a logically possible or an empirically observed configuration of attributes- causal and outcome conditions. The truth table is completed when all the cases and codes on the causal and outcome conditions are displayed using binary mathematical forms. This matrix of binary data is then subjected to a procedure of Boolean minimisation. The procedure involves comparing groups of the cases based on the presence/absence of the outcome conditions and the presence/absence of the selected causal conditions. These logical combinations, as represented in Boolean primitive equations, are compared with each other and then logically simplified. The comparison ends up with a logically minimal Boolean expression as an output of the analysis. This provides logically minimal configurations or the most parsimonious description of the combinations of causal conditions that produce a given outcome.

4 EMPIRICAL CONSIDERATIONS

Structural characteristic of the Chinese 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 semi-structured questionnaire 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 (see Table A1) we have explained characteristics of Chinese SMEs (Table 2), which will be further analysed using QCA and Boolean algebra.

Table 2. Characteristics of Chinese (randomly selected five cases) 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 A1) 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 (three times factor four 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 planning 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 planned none of those firms have had e-commerce introduced, mainly because there were no legal and infrastructural foundations for it.

Table 3. Boolean Truth Table of casual variables and outcomes

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 the QCA process of minimization (Table 3) and by applying Boolean logic in this section, for the randomly selected five (out of 35) Chinese SMEs case studies the results (the research questions, hypotheses which will be tested on the remaining 30 cases later on) are presented as follow:

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

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

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

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_4) 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, Chinese SMEs are adopting it with the influence of technological factors (X_1). Together, (marked with a star *) 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, some form (basic online link between few suppliers and manufacturers) of the 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 China 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.

Finally, with regard to the last step in the application of QCA process using remaining 30 case studies, it is necessary to map Areas of Agreement between theoretical (first five randomly selected case studies) and empirical findings (remaining 30 case studies), which is presented in the Table 4.

Table 4. Map of Areas of Agreement

Form of IT	Theoretical	Empirically confirmed
------------	-------------	-----------------------

	influencing factors (T)	influencing factors (R)
<i>C(1)</i>	<i>TEH</i>	<i>TEH</i>
	<i>env</i>	-
	<i>org</i>	-
	<i>IND</i>	<i>M</i>
<i>CI (2), HS(4), NCI(3)</i>	<i>TEH</i>	<i>TEH</i>
	<i>env</i>	-
	<i>org</i>	-
	<i>IND</i>	-

After applying the QCA method rules and the logic of its formal language - Boolean algebra on the remaining 30 case studies and comparing the results with the first five cases, I have found that Chinese SMEs are adopting (Table 4) basic forms of IT/ICT under presence of technological and individualistic factors, that is, it is confirmed (the area of agreement) that for adopting IT/ICT in China there is no political support and that 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.

In addition the content analysis of the remaining 30 case studies highlighted additional concerns and issues in Chinese SMEs. Below I list some of the main issues gathered from the administered questionnaires and interviews;

- *Financing issues*

It is the most reported problem of SMEs in China. Some analysts said the most seriously thing is that SMEs cannot get the financing on the market. Most of SMEs get loans from government, from public finance agencies; however, these funds are limited

An interesting response was good illustration about the financial issues. When a SME wants to get loan, only 14% of funds requested they can get it from banks 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*

Another interesting note was that the ability to compete in the market depends on the owner's personal ability, connections and social relationship. Although the enterprise has latest technology and other resource, most of the enterprise cannot go far because the market in majority cases is biased towards the big enterprises. So the SMEs have no chance to get the same opportunity and compete with the large scale enterprises.

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

With the developing of SMEs, the team who started the business cannot do all jobs required. However, they cannot attract talented workers they need for further development due to their inability to pay high salaries to the most suited persons for the job and to retain them. Once employees acquire skills most of them are 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 larger scale, the household type business management style still stays the same; it has not been changed in most analysed cases, what was found to be the main obstacle to the further development.

5 CONCLUDING REMARKS

In this article, the author developed a model of sufficient and necessary factors for ICT adoption in Chinese SMEs. After applying the QCA method rules and the logic of its formal language - Boolean algebra on 35 case studies the author have found that Chinese SMEs are adopting basic forms of IT/ICT under presence of technological and individualistic factors, and that for adopting IT/ICT in China there is no political support and that 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.

6 REFERENCES

- APEC, (2001) *SME Business Forum*.

- Brooksbank, R., Kirby, D., and Kane, S. (1992) "IT adoption and the independent retail business: The retail newsagency" *International Small Business Journal*, vol. 10, no. 3, pp. 53-61.
- Information Office of the State Council, (2004) "*China's Social Security and Its Policy*" Information Office of the State Council, 2004.
- Iacovou, C.L., Benbasat, I., and Dexter, A.A. (1995) "Electronic data interchange and small organisations: Adoption and impact of technology" *MIS Quarterly*, vol. 19, no. 4, pp. 465-485.
- Julien, P.A., and Raymond, L. (1994) "Factors of new technology adoption in the retail sector," *Entrepreneurship: Theory and Practice*, vol. 18, no. 5, pp. 79-90.
- Kirby, D., and Turner, M. (1993) "IT and the small retail business" *International Journal of Retail and Distribution Management*, vol. 21, no. 7, pp. 20-27.
- Krivokapić- Skoko, B. (2002) "Qualitative Comparative Analysis (QCA) and its Formal Instrument- Boolean Algebra: "A Middle Road" between Qualitative and Quantitative Comparative Research Strategies" Paper presented at the *Annual Meeting of Australian Association of Social Research (AASR)*, October 2002
- Krivokapić-Skoko, B. (2003) "Boolean Algebra and the Comparative Method: Feature and Applications to Social Sciences". Paper presented at the *Second Workshop on Research Methodology RM 2003 (25-27 June 2003, Amsterdam)*, the Royal Netherlands Academy of Art and Science, 2003.
- National Bureau of Statistics of PRC (NBS), (2001) "*Gazette on Third National Industrial Census*" NBS, Beijing.
- National Bureau of Statistics of PRC (NBS) (2003) "*Gazette on Second National Census of Basic Units*" NBS, Beijing.
- Poon, S. & Swatman, P. (1999) "An exploratory study of small business Internet commerce issues" *Information & Management*, 35, 1999, pp. 9-18.
- Premkumar, G. & Roberts, M. (1999), "Adoption of New Information Technologies in Rural Small Businesses", *the International Journal of Management Science (OMEGA)*, 27, pp. 467-484
- Ragin, C. (1987) "*The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*" University of California Press, Berkeley
- Ragin, C. (2000) "*Fuzzy-Set Social Science*" The University Of Chicago Press, Chicago.
- Rashid, M.A., and Al-Qirim, A. (2001), E-commerce Technology Adoption Framework, *RLIMS Vol 2*, 2001, 63-70 massey.ac.nz/wwiims/-rlims
- Ratnasingham, P. (1997), "EDI security - Re-evaluation of controls and its implications on the organisations" *Computers and Security*, vol. 16, no. 8, pp. 650-656.

- Skoko, H. (2003) “*Strateški tehnološki menadžment malih i srednjih preduzeća podržan informacionim tehnologijama*” Doktorska disertacija odbranjena na Fakultetu Organizacionih Nauka u Beogradu 2003.
- Skoko, H. (2004) “*Modeli usvajanja ICT u australijskim i jugoslovenskim MSP*”, Zadužbina Andrejević, Beograd 2004.
- Skoko, H., Krivokapic-Skoko, B., Škare, M. and Ceric, A. (2006) “ICT Adoption Policy of Australian and Croatian SMEs”, *Managing Global Transitions* 4 (1): (2006) 25–40
- Thong, J. & Yap, C. (1996) “Information Technology Adoption by Small Business: An Empirical Study” in Kautz, K. & Pries-Heje, J. (Eds), *Diffusion and Adoption of Information Technology*, 1996, 160-15, London, Chapman & Hall
- Van Akeren, J.K. and Cavaye, L.M.A. (2000) “*Factors impacting on entry-level electronic commerce adoption in the automobile industry in Australia*”. Presented at ICSB World Conference 2000, June 7-10, 2000, Brisbane, Australia.
- UN (2006) *Economic and Social Commission for Asia and Pacific Report*; 2006.

Table A1. Coding system used in the analysis of SMEs

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

Adjusted from: Skoko (2003 p. 119).