

THE MODEL OF IT INFUSION  
IN SMALL AUDIT FIRMS IN THAILAND

---

A thesis submitted in partial fulfilment of the requirements for  
the Degree

of Doctor of Philosophy

in Accounting and Information Systems

by Dichapong Pongpatrachai

University of Canterbury

2010

---

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS.....</b>	<b>X</b>
<b>ABSTRACT.....</b>	<b>XI</b>
<b>CHAPTER 1 - INTRODUCTION.....</b>	<b>1</b>
1.1 Research Background.....	1
1.2 The Research Gap and Research Questions .....	3
1.3 Research Contributions and Implications .....	4
1.4 The Research Methodologies .....	5
1.5 Research Context, Assumptions, and Limitations .....	5
1.6 Conclusion .....	6
<b>CHAPTER 2 - LITERATURE REVIEW .....</b>	<b>8</b>
2.1 IT Infusion .....	8
2.2 Organizations and Innovations .....	22
2.3 IT Infusion as a Final Stage of Organizational Innovation Process .....	25
2.4 IT Infusion Enablers .....	31
2.5 Auditing and Technology .....	44
2.6 Conclusion .....	55

<b>CHAPTER 3 - RESEARCH OBJECTIVES, RESEARCH QUESTIONS, AND RESEARCH DESIGN .....</b>	<b>56</b>
3.1 Research Gap .....	56
3.2 Research Objectives and Research Questions .....	59
3.3 Research Methodology .....	60
3.4 Research Design .....	63
3.5 Research Context and Site Selection Process .....	67
3.6 Conclusion .....	68
 <b>CHAPTER 4 - THE PILOT CASE STUDY AND DEVELOPMENT OF IT INFUSION MEASURE .....</b>	 <b>69</b>
4.1 The Pilot Firm .....	70
4.2 Technology Used During the Audit Process in the Pilot Firm.....	72
4.3 IT Infusion Enablers and Inhibitors in the Pilot Firm.....	77
4.4 The Lesson from the Pilot Case .....	81
4.5 The Concept of Audit Task Complexity .....	81
4.6 The Proposed IT Infusion Measure .....	83
4.7 Conclusion .....	88
 <b>CHAPTER 5 - WITHIN-CASE ANALYSIS .....</b>	 <b>89</b>
5.1 Case A .....	91
5.2 Case B .....	97
5.3 Case C .....	111
5.4 Case D .....	118

5.5 Case E.....	125
5.6 Case F.....	140
5.7 Case G .....	150
5.8 Conclusion .....	157
 <b>CHAPTER 6 - CROSS-CASE ANALYSIS: MEASURING IT INFUSION ....</b>	<b>159</b>
6.1 The Case Firms .....	159
6.2 Measuring IT Infusion .....	161
6.3 Conclusion .....	177
 <b>CHAPTER 7 - CROSS-CASE ANALYSIS: IT INFUSION ENABLERS.....</b>	<b>179</b>
7.1 Organizational Characteristics of the Case Firms.....	180
7.2 IT Infusion Enablers and Inhibitors .....	184
7.3 Cross-case Analysis and a Model of IT Infusion.....	205
7.4 Conclusion .....	214
 <b>CHAPTER 8 - THE PROPOSED MODEL OF IT INFUSION AND THE SURVEY QUESTIONNAIRE .....</b>	<b>215</b>
8.1 The Adapted Model of IT Infusion .....	216
8.2 Developing an Instrument .....	217
8.3 Measuring Variables.....	219
8.4 Measuring IT Infusion through Three Pathways of Use .....	226
8.5 Other Measures .....	230
8.6 Survey Design .....	234
8.7 Conclusion .....	236

<b>CHAPTER 9 - SURVEY RESULTS.....</b>	<b>237</b>
9.1 Survey Questionnaire and the Responses .....	237
9.2 The Responses and Their Characteristics .....	240
9.3 The Use of Spreadsheets and Spreadsheet Infusion .....	241
9.4 Results of the Constructs Measured.....	249
9.5 Results of the Global Measures.....	253
9.6 Results of IT Impacts.....	256
9.7 Conclusion .....	257
 <b>CHAPTER 10 - SURVEY RESULT ANALYSIS .....</b>	 <b>258</b>
10.1 Reliability and Convergent Validity of the Instruments .....	258
10.2 The Partial Least Square Regression of IT Infusion Enablers .....	271
10.3 The Partial Least Square Regression of the Three Pathways of Use .....	281
10.4 Conclusion .....	290
 <b>CHAPTER 11 - DISCUSSION OF RESEARCH RESULTS .....</b>	 <b>292</b>
11.1 IT Infusion .....	293
11.2 Measuring IT Infusion .....	295
11.3 Analysis of IT Infusion Process and Enablers .....	295
11.4 Analysis of the IT infusion Model and the Three Pathways of Use .....	310
11.5 Conclusion .....	315

<b>CHAPTER 12 - CONCLUSIONS, CONTRIBUTIONS, AND FUTURE RESEARCH DIRECTIONS .....</b>	<b>317</b>
12.1 Research Summary .....	318
12.2 Summary of Findings .....	320
12.3 Research Contributions .....	328
12.4 Implications of Practitioners.....	335
12.5 Limitations and Implications for Future Research .....	339
12.6 Conclusion .....	343
 <b>APPENDIX A - INTERVIEW PROTOCOL .....</b>	 <b>345</b>
 <b>APPENDIX B - SURVEY QUESTIONNAIRE.....</b>	 <b>348</b>
 <b>APPENDIX C - ADDITIONAL RESULTS FROM THE OPEN-ENDED QUESTIONS OF THE SURVEY: IT INFUSION ENABLERS AND INHIBITORS .....</b>	 <b>364</b>
 <b>REFERENCES .....</b>	 <b>369</b>

## LIST OF TABLES

Table 2.1A: Dimension of IT infusion used in prior studies .....	14
Table 2.1B: Dimensions of IT infusion, IT penetration, IT sophistication, and IT assimilation.....	15
Table 2.1C: IT infusion levels .....	20
Table 2.4A: Determinants empirically tested and unexamined factors in prior studies .....	42
Table 3.1A: Critique of prior studies and research gap .....	57
Table 4.2A: Summary of IT used in four audit phases.....	77
Table 4.6A: The score of extended use .....	86
Table 5A: The staff members who participated in the interviews .....	90
Table 5.4A: The uses of spreadsheets in Firm D .....	121
Table 5.5A: The uses of spreadsheets in Firm E .....	128
Table 6.1A: The case firms' profiles .....	160
Table 6.2A: The case firms' spreadsheet use in audit work.....	164
Table 6.2B: Comparisons between percentage of task integrations based on existing tasks and designated tasks .....	169
Table 6.2C: The summary of extended and integrative use scores .....	171
Table 6.2D: Emergent use of spreadsheets in the case firms .....	175
Table 6.3A: Extended use, integrative use, emergent use, and infusion from the case studies .....	178
Table 7.2A: IT infusion enablers and inhibitors in the case firms .....	184
Table 9.1A: Summary of survey responses .....	239
Table 9.2A: Characteristics of the respondent firms .....	240
Table 9.3A: IT infusion scores of the respondent firms .....	242
Table 9.3B: The use of spreadsheets in various audit phases.....	243
Table 9.3C: Means and standard deviations (SD) of integrative use scores .....	247
Table 9.3D: The survey results - objectives of spreadsheet use .....	248
Table 10.1A: Measuring internal consistency of the survey instruments .....	259
Table 10.1B: Rotated component matrix of independent variables .....	261

Table 10.1C: Summary of indicators used .....	265
Table 10.1D: Concurrent validity of the proposed IT infusion measure .....	270
Table 10.2A: Beta Coefficient and collinearity statistics of independent variables ..	275
Table 10.2B: Collinearity statistics - condition index and variance proportion .....	275
Table 10.2C: Pearson correlations among dependent and independent variables ....	276
Table 10.2D: Factor loadings, weights, and residual variances of laten variables ...	277
Table 10.2E: Correlations of laten variables.....	278
Table 10.2F: PLS results (dependent variable - IT infusion) .....	279
Table 10.3A: PLS results (dependent variable - extended use).....	282
Table 10.3B: PLS results (dependent variable - integrative use) .....	284
Table 10.3C: PLS results (dependent variable - emergent use) .....	286
Table 10.4A: Summary of the results.....	291
Table 12.2A: Summary of findings.....	321
Table 12.3A: The contributions of the study to the existing literature.....	332



## LIST OF FIGURES

Figure 2.1A: Dimensions of IT infusion .....	11
Figure 2.3A: The innovation process in an organization.....	26
Figure 2.3B: A six-phase view of the IS implementation process .....	28
Figure 2.3C: IT adoption/implementation .....	29
Figure 2.4A: Factors impacting IT infusion in small business.....	32
Figure 2.4B: Internal characteristics of organizational structure.....	33
Figure 2.4C: Perceived attributes of innovations.....	36
Figure 2.4D: Factors leading to infusion of sales force automation (SFA) .....	40
Figure 2.5A: Major steps in auditing .....	45
Figure 3.3A: Core research process .....	61
Figure 3.4A: The overall research process and research questions .....	63
Figure 4.1A: The pilot firm's organizational structure.....	71
Figure 4.2A: Major steps in auditing .....	73
Figure 5.1A: The relationship of Firm A's clients and IT infusion.....	97
Figure 5.2A: Firm B's organizational structure as independent profit centers .....	98
Figure 5.2B: The infusion process within Firm B .....	106
Figure 5.2C: Factors contributing to IT infusion in Firm B .....	109
Figure 5.3A: Factors contributing to IT infusion in Firm C .....	115
Figure 5.4A: Firm D's organizational structure .....	118
Figure 5.5A: IT infusion enablers in Firm E.....	134
Figure 5.5B: A revised model of IT infusion in Firm E .....	137
Figure 5.6A: Factors contributing to IT infusion in Firm F.....	148
Figure 5.6B: Factors contributing to current and future level of IT infusion .....	148
Figure 5.7A: Factors contributing to current and future level of IT infusion in Firm G.....	155
Figure 5.7B: IT infusion enablers in Firm G .....	156
Figure 7.2A: Hierachy of spreadsheet infuison enablers in the case firms.....	186
Figure 7.2B: Centralized and decentralized diffusion systems.....	201
Figure 7.2C: Diffusion process within Firm B .....	202
Figure 7.2D: The innovation value chain.....	204

Figure 7.3A: The model of IT Infusion from the case studies .....	206
Figure 8.1A: The proposed model of IT infusion .....	216
Figure 8.2A: Construct development methodology .....	218
Figure 8.6A: Steps in survey questionnaire administration .....	235
Figure 9.3A: Firms' experience in using spreadsheets.....	241
Figure 9.3B: Extended use scores during the audit planning phase.....	243
Figure 9.3C: Extended use scores during the control testing phase.....	244
Figure 9.3D: Extended use scores during the substantive testing phase.....	244
Figure 9.3E: Extended use scores during the audit report phase .....	245
Figure 9.3F: A comparison of integrative use scores in four audit phases .....	246
Figure 9.3G: Integrative use scores across audit phases .....	247
Figure 9.3H: Audit tasks which cannot be done without spreadsheets.....	249
Figure 10.2A: The simple structure model of IT infusion .....	273
Figure 10.2B: The proposed model of IT infusion .....	273
Figure 10.2C: Results - the simple structure model of IT infusion.....	279
Figure 10.2E: Results - the model of IT infusion .....	280
Figure 10.3A: Results - the simple structure model of extended use .....	283
Figure 10.3B: Results - the model of extended use .....	283
Figure 10.3C: Results - the simple structure model of integrative use .....	285
Figure 10.3D: Results - the model of integrative use .....	285
Figure 10.3E: Results - the simple structure model of emergent use .....	287
Figure 10.3F: Results - the model of emergent use .....	287
Figure 10.3G: Relationships among the three pathways of use .....	288
Figure 10.3H: The integrated model and the three pathways of use.....	289
Figure 11.4A: Results - the model of IT infusion .....	300
Figure 12.2A: Results - the model of IT infusion .....	325
Figure 12.2B: The integrated model and the three pathways of use.....	326

## **ACKNOWLEDGMENTS**

I would like to sincerely thank people who provide me with care, support, and assistance while researching and writing this thesis.

First, I wish to express gratitude to my supervisors, Professor Paul Cragg and Mr Richard Fisher for their committed assistance in the preparing this thesis. I would also like to thank Dr Annette Mills and Professor June Pallot for great support. I really appreciate the time they spent guiding me through the research process, commenting on my work, and providing guidance from start to finish.

Special appreciation goes to the interview participants who took their time to talk to me and who willingly shared with me information about their work.

On a more personal note, I am indebted to a number of friends who helped me during the research period and provided important support during the last year. In particular, I would like to thank Santana Rattanapichetchai, Korbchol Songsri, Alicia Cavan, Andrew Wong, and David Wong who assisted me with commenting and editing this study.

## **ABSTRACT**

For decades, organizations have used information technology (IT) to support their operational and managerial work. However, the use of IT varies considerably from one firm to another. Successful IT implementation occurs when IT is diffused to all organizational members and is used to the fullest potential (infusion). Prior studies tested several IT infusion enablers. However, they did not yield statistically significant results. These studies hypothesized IT diffusion enablers as IT infusion enablers. The lack of existing literature on IT infusion made theory-testing research rarely yield a reasonable result. In addition, the definitions and measures of IT infusion offered by existing literature are not validated. This study aims to identify factors that contribute to the different levels of IT infusion in the context of spreadsheet use in small audit firms and to offer a definition and measure of IT infusion. While prior studies have discussed several enablers of IT infusion, they have typically proposed enablers of IT diffusion rather than IT infusion.

IT infusion is defined in this study as the use of IT to its fullest potential within a particular industry. Three aspects of infusion were identified in the prior literature. First, IT infusion refers to IT use within and across different business processes (extended use). For example, spreadsheets can be used to help auditors plan an audit, analyze data, and later create an audit report. Second, IT infusion refers to IT use in ways that establish the work-flow linkages within the work process (integrative use). For example, spreadsheets can be used to record data and the data is carried over for analysis and reporting. Third, IT infusion refers to IT use in tasks that could not be performed without IT (emergent use). For example, spreadsheets can be used to perform statistical analysis which cannot be done manually.

The mixed methods research approach was chosen in order to provide a better understanding of the under-researched area of infusion. Use of theory-building approach from cases is likely to produce theory that is accurate and testable. Case studies are used for identifying IT enablers in real business settings. Quantitative data is collected using the survey questionnaire approach.

In the first phase, a series of case studies were used to explore the concept of IT infusion in the audit context. All seven case firms were independent audit firms in Thailand with less than 100 employees. The firms helped identify a number of enablers of spreadsheet infusion. This study found infrastructure flexibility and training to be critical infusion enablers at an early implementation stage. At later stages, an IT champion, certain psychological factors, and social networks were found to be more important. The new measure was proven to incorporate all important IT infusion dimensions and to yield a reasonable range of scores enabling a complex statistical analysis.

The study also used a questionnaire survey to gather data on spreadsheet infusion from 203 audit firms in Thailand. Partial least squares (PLS) regression was used to test a research model that was based on the earlier case studies. The analysis confirmed the relationships among IT infusion enablers and the three pathways of use which formed the concept of IT infusion. Task variety, an IT champion, and routinization were found to be directly related to IT infusion. Infrastructure flexibility, social networks, and management support were also found to contribute to IT infusion through other enablers.

It is recommended that future studies use the concept of task complexity when examining IT infusion. In addition, future studies should extend investigations on psychological factors of individuals that may affect organizational IT infusion.

# **CHAPTER 1**

## **INTRODUCTION**

In this chapter, the overview of this research is introduced. Referring to previous literature and practitioner relevance, the research gap and research focus are identified and research questions are established. The outline of the major theoretical and practical contributions of this research is shown in the third section of this chapter. The fourth section describes the research methodologies which are suitable for the context of this research. Then the research context, necessary assumptions and limitations are outlined. An outline of this chapter is presented as follows.

- 1.1 Research background
- 1.2 The research gap and research questions
- 1.3 Research contributions and implications
- 1.4 The research methodologies
- 1.5 Research context, assumption and limitations
- 1.6 Conclusion

### **1.1 RESEARCH BACKGROUND**

Information Technology (IT) has been integrated into business operation and management for decades. Investments in IT have become crucial organizational strategies for survival and competitive advantage (Melville et al., 2004). One of the most common questions when utilizing IT in business operation is when the business is considered to be successful at using IT or what determines the stage of success. According to DeLone and McLean's (2003) IS/IT success model, the success has been measured in term of technical success, semantic success, and effectiveness success. Some studies have tried to measure the effectiveness success by examining the impact of IT on organizational performances (e.g. Devaraj and

Kohli, 2003). However, the “use” dimension still plays one of the most important roles in determining IT success, since it is hard to isolate the impacts of IT on the organizational performances from impacts of other factors.

The system use construct has played a critical role in the IS/IT literature; particularly in an organizational innovation process (Zaltman et al., 1973; Kwon and Zmud, 1987; Fichman & Kemerer, 1997; Rogers, 2003) and technology adoption models (Davis et al., 1989; Venkatesh et al, 2003). This study focuses on the IT use as a success factor at an organizational level of analysis. However, contextual factors from other levels of analysis are taken into account, in order to broaden perspectives or yield a deeper understanding in the area, as suggested by Burton-Jones and Gallivan (2007).

The success in IT/IS use has been defined in a variety of ways by many scholars. Generally, the success in IT/IS use is explained as the final stage in an innovation process. The selected definitions of the success in IT/IS use are presented as follows.

*“Incorporation can be included as a final implementation process.” [...] “Incorporation occurs when an innovation becomes embedded within an organization’s routine and when an innovation is being applied to its fullest potential within an organization”* (Kwon and Zmud, 1987, pp. 233).

*“Routinization occurs when an innovation has become incorporated into the regular activities of the organization and has lost its separate identity. At that point, the innovation process is completed”* (Rogers, 2003, pp. 428-429).

Rogers states another word as *“sustainability, a closely related concept to routinizing, defined as the degree to which an innovation continues to be used after initial efforts to secure adoption is completed”* (pp. 429).

*“An innovation adoption process can be deemed to be successful when an innovation is successfully adopted and used by most, or all, of the adopting units within the community of potential adopters. This process success is termed ‘success*

*of adoption.’ On the other hand, designers of an innovation design the innovation with the hope that its adoption by potential adopters will provide them with some desired benefits. Realization of these potential benefits (outcomes) of an innovation by the adopting units can be termed ‘success from adoption’” (Kishore and McLean, 1998, pp. 732).*

From the stage of IT/IS success above, this study follows the idea of an organizational innovation process where IT is embedded into an organizational work process and is used to its fullest potential. The focus of this study is on the final stage where IT is used to its fullest potential. This stage is called “*infusion*” (Cooper and Zmud, 1990; Zmud and Apple, 1992).

The importance of integrating IT and using it to the fullest potential is because the investment in IT is significant. The under-utilization of IT may lead to negative impacts (due to the cost of IT investment over realized benefits) or negative attitudes of users toward IT in the future. Finding enablers that lead to a successful use of IT is, therefore, very crucial to a business; especially to a small business which cannot risk a big, unsuccessful investment on technology.

## **1.2 THE RESEARCH GAP AND RESEARCH QUESTIONS**

Prior studies have proposed models of IT infusion by reviewing existing IT diffusion and implementation literature (Winston and Dologite, 1999) and testing those factors as determinants of IT infusion at either an organizational level of analysis (Cooper and Zmud, 1990; Zmud and Apple, 1992; Saga, 1994) or at an individual level of analysis (Jasperson, 1999; Moore, 2002; Jones et al., 2002; Kishore and Mclean, 2007; Sundaram et al., 2007). A detailed review of existing literature can be found in Chapter 2 of this study.

The discussion in section 1.1 suggests that it is very important for an organization to realize the fullest potential of any IT investment. However, existing literature does not offer a clear understanding of IT infusion. A few factors have been found to have effects on IT infusion. Some studies failed to yield significant statistical



results. This is either because prior researchers assumed that factors which were associated to IT infusion were similar to those of IT diffusion or because they failed to use or construct a valid measure that can measure IT infusion.

This study aims for a deeper understanding of IT infusion as an IT success concept. A new valid measure is also needed for future study. A research methodology grounded in the field is also required in order to find IT infusion enablers which have not been completely identified by prior studies.

From the research gap above, the primary objectives of this study are to investigate an organizational IT infusion process, to construct a valid measure, and to model IT infusion in a context of small business. The following research questions are proposed for this study.

1. What is IT infusion?
2. What are IT infusion enablers (particularly for small firms)?
3. How can IT infusion be measured with validity and consistency?

### **1.3 RESEARCH CONTRIBUTIONS AND IMPLICATIONS**

At theoretical level, this study aims at a deeper understanding of an organizational IT infusion process. A valid construct for IT infusion that can be used for future research in IT/IS field is also a key contribution. Finally, this study aims to identify IT infusion enablers and to model IT infusion for small firms.

The rich qualitative nature of the first part of the study also aims to help practitioners strategically manage facilitating conditions during various steps of an organizational IT infusion process so that an organization can utilize IT to the fullest potential. The measurement concept also helps practitioners monitor the current IT infusion level of their organization.

#### **1.4 THE RESEARCH METHODOLOGIES**

Research methodologies for this study are developed with a focus on the research questions. The mixed methods type of research is used in this study. Mixed methods research refers to research that collects and analyzes a mixture of qualitative and quantitative data (Cresswell, 2003).

As shown in section 1.2, this study believes that there are IT infusion enablers that have not been identified in previous literature. Grounded qualitative research is required to identify these factors and gain a more in-depth understanding of how an innovation journeys through an organizational innovation process. A case study research method is used in order to answer these questions, since it is the most suitable research strategy for an early stage research with questions of what, why, and how (Yin, 2003). A survey questionnaire gives a quantitative approach, results of which are connected to the qualitative data for a better understanding in the subject.

#### **1.5 RESEARCH CONTEXT, ASSUMPTIONS AND LIMITATIONS**

This research focuses on studying IT infusion within a context of small audit firms in Thailand. Small audit firms are chosen in order to control some variables that are not of interest of this study. Since auditors and audit firms usually follow similar work processes, cultures, and behaviors, it is assumed that organizational cultures and work process are controlled factors. This leads to a better understanding of all other independent variables. Spreadsheets have been chosen as the context of this study. This is explained in detail in Chapter 4 (findings from the pilot case study).

The study also makes another assumption as to how organizational IT infusion is measured. An organizational IT infusion represents the highest infusion level found in the organization. The IT assimilation gap, defined as the difference between the cumulative adoption and cumulative deployment technology by firms' members (Fichman and Kemerer, 1999), is outside of context of this study.

Since this study is of small audit firms in Thailand, the generalization of the results is limited. However, the results may indicate IT infusion enablers that future studies must take in to account. In addition, the measurement concept proposed by this study should be applicable within the contexts of other business types.

## **1.6 CONCLUSION**

This chapter introduced the overview of this research study. The primary objective of this study is to contribute into the literature the unified concept of IT infusion, the model of IT infusion and IT infusion enablers, and a measure that is valid and consistent. A mixed methods research is used as a main research method. The study is conducted in the context of small audit firms in Thailand. Therefore, generalization is limited, as this study controls some factors such as work processes and organizational cultures.

In addition to this chapter, this thesis is organized into eight more chapters as follows:

- Chapter 2: A review of relevant literature. This chapter reviews the related previous theoretical and empirical studies. This includes the organizational innovation process, IT infusion, and related audit technologies.
- Chapter 3: The research objectives, research questions, and research design. This chapter shows the how research objectives and research questions are developed. A discussion of the mixed method approach as an appropriate research methodology is included.
- Chapter 4: The pilot case study, and the development of an IT infusion measure. This chapter reports findings from the pilot case study which is used to construct the IT infusion measure that is used in this study.
- Chapter 5: Within-case analysis. This chapter presents the results from seven case firms along with the analysis of each case.

- Chapter 6: Cross-case analysis: IT infusion measure. This chapter presents the application of the proposed IT infusion measure in seven case studies. The analysis shows that the proposed measure capture most important dimensions of IT infusion and yield a range of results that can be analyzed statistically.
- Chapter 7: Cross-case analysis: IT infusion enablers. Using a qualitative research design, this chapter reports in-depth findings about IT infusion enablers from the seven case studies. The IT infusion enablers are used for constructing a model of IT infusion.
- Chapter 8: Development of a survey instrument. This chapter shows how a survey instrument is developed in order to test the research model and IT infusion enablers found during the qualitative studies. This survey instrument is also aimed at testing the proposed IT infusion measure.
- Chapter 9: Survey results. This chapter reports results and descriptive statistics from the survey questionnaire.
- Chapter 10: Survey results analysis. This chapter reports the analysis of the survey results. Instruments are tested for validity and reliability. Partial least square (PLS) regression is used for evaluating the proposed model.
- Chapter 11: Discussion of research results. This chapter integrates qualitative and quantitative data and discusses the findings.
- Chapter 12: Conclusion, contribution, and future research direction.

# **CHAPTER 2**

## **LITERATURE REVIEW**

In this chapter, the previous theoretical and empirical literature relevant to this study is reviewed. The review focuses on information technology (IT) infusion in organizations. The infusion stage is claimed to be a conclusion of an organizational innovation process. In addition, this chapter presents literature related to small businesses and auditing which is specific to the context of this study. An outline of this chapter is presented below.

- 2.1 IT infusion
- 2.2 Organizations and innovations
- 2.3 IT infusion as a final stage of organizational innovation process
- 2.4 IT infusion determinants
- 2.5 Auditing and technology
- 2.6 Conclusion

### **2.1 IT INFUSION**

Technology infusion has been studied by many scholars, primarily in two contexts (Kishore and McLean, 1998). In the first context, IT infusion is studied in terms of the application of IT to its fullest potential: in other words, depth of use. In the second context, it is studied in terms of an adoption or introduction of technology into a particular area; for example, an adoption of technology in teaching and educational studies (e.g. Collier et al., 2004; Rowley et al., 2005) and engineering studies (e.g. Cornford and Hicks, 2000). This study follows and extends the definition of the first context which is the utilization of IT to its fullest potential to support operational and managerial work.

Prior IT infusion studies have identified factors affecting infusion levels and/ or propose models of IT infusion and its determinants at a conceptual level. Some

studies have proposed measurement tools for IT infusion. However, the opinions concerning IT infusion and its measurement are not unified. The definitions of technology infusion in previous studies have varied and some are rather abstract. This section begins with a review of the definitions of technology infusion and then looks at the process of technology implementation that leads to the final stage called infusion. The last part presents how prior studies measured IT infusion and their implicit dimensions in the measures.

### **2.1.1 Defining IT infusion**

Prior studies have defined IT infusion in two levels: conceptual and operational. The original context is defined conceptually from a strategic-focused perspective. At the conceptual level, IT infusion is the degree of importance, significance, and impact on an organization. At the operational level, IT infusion is defined as an integration of IT into operational and managerial work. An organization reaches an infusion stage when IT is applied to its fullest potential.

#### *2.1.1a IT infusion: a strategic-focus perspective*

IT infusion is a part of information systems planning strategies in organizations. The goal is to integrate information systems to create strategic advantages for business. IT infusion is defined as “*the degree to which Information Technology (IT) has penetrated a company in terms of importance, impact, or significance*” (Sullivan, 1985). Sullivan gave examples of how to distinguish infusion levels in organizations by referring to the strategic integration of technology into a business. At a low degree of infusion, IT is used for day-to-day operations such as payroll and accounting functions. The degree of infusion increases when business finds IT becoming more crucial to its operation. The infusion reaches the highest level when IT becomes a major driver (backbone) of the business. IT is used strategically in order to rival competitors.

As stated earlier, by Sullivan’s definition, IT infusion can be identified as a degree of IT penetration. In another article, Damsgaard et al. (1993) proposed an IT penetration model which seeks to understand why and how organizations adopt,

accommodate and transform IT. Damsgaard et al.'s model seeks answers for the following questions: 1) What is the IT used for? 2) How critical is the IT for the operations of the organizations? And 3) for what organizational tasks and functions, and on what levels of operation is the IT used?

#### *2.1.1b IT infusion: an organizational work-integration perspective*

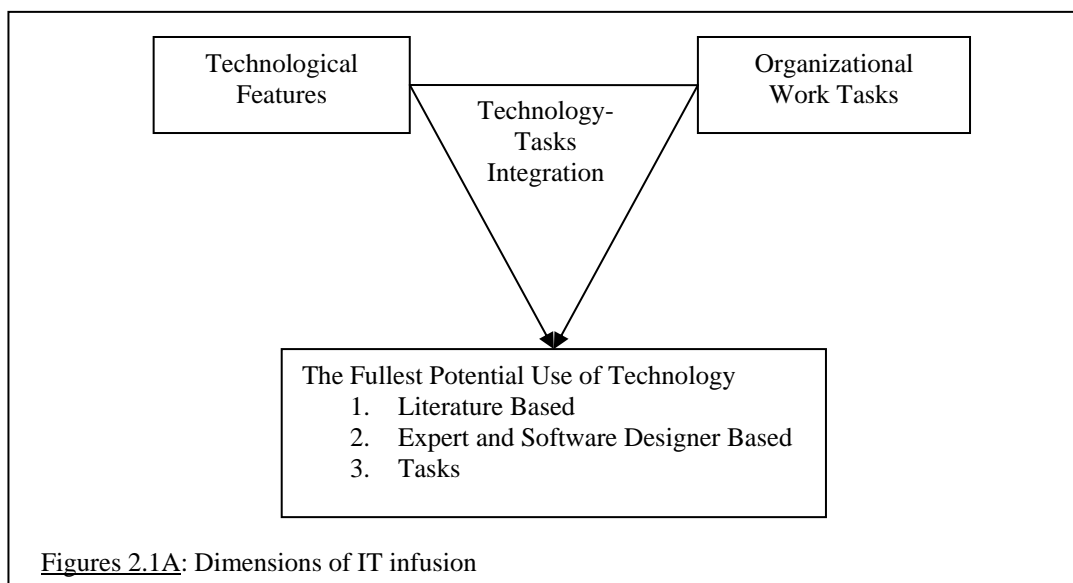
Kwon and Zmud (1987) proposed a six-phase model of the IS implementation process. The final stage of the model, incorporation, occurs when *“the innovation becomes embedded within an organization’s routine and when the innovation is being applied to its fullest potential”* (pp.233). The incorporation stage consists of two parts: routinization and infusion. Routinization refers to a permanent adjustment of an organization’s governance system to incorporate an innovation into the organization. Infusion refers to the extent to which the full potential of the innovation has been embedded within an organization’s operational and managerial work systems (Zmud and Apple, 1992).

In an earlier work of Cooper and Zmud (1990), the IT infusion definition is operationalized as a process and a product. The IT infusion process is where *“increased organizational effectiveness is obtained by using the IT application in a more comprehensive and integrated manner to support higher level aspects of organizational work”* (pp.124). A product is when *“IT application is used within the organization to its fullest potential”* (pp.124-125).

The organizational work-integration perspective which is adopted by this study has been a major pathway of many IT infusion studies. The successive researchers who follow this definition include Zmud and Apple (1992), Saga (1994), Jasperson (1999), Winston and Dologite (1999), Chin and Marcolin (2001), Eder and Igbaria (2001), Jones et al. (2002), Moore (2002), Sundaram et al. (2007), and Kishore and McLean (2007). Some other scholars mixed both perspectives when they developed research instruments. Those scholars include Hann and Weber (1995) and Caster and Ferguson (2000).

### 2.1.2 IT infusion and its dimensions

As explained in the previous section, IT infusion is originally defined as the degree to which an innovation has penetrated a firm in terms of importance, impact, or significance (Sullivan, 1985). The study of Material requirement planning (MRP) systems infusion of Cooper and Zmud (1990) implies many dimensions to their definition and measures of IT infusion. The definition gives three dimensions of IT use in an organization. The first is the use of IT in a more comprehensive manner; second, the integration of IT to support higher aspects of organizational work; and third, the use of IT to its fullest potential within an organization (Figure 2.1A). The first dimension implies that a higher level of infusion requires a more comprehensive use of IT (features/ sophistication of use). This dimension is also emphasized by Zmud and Apple (1992) as a sequential level of technological configurations. For example, a low-level of spreadsheet use may involve typing which require simple keystrokes where a higher level of use may involve calculating features and commands. In the second dimension, the higher level of infusion requires an application of IT to a higher level of work. For example, a low level of spreadsheet may involve documentation work where a higher level of use may involve decision-making work. It is assumed that the complexity of features used is positively associated with the complexity of organizational work.





The last dimension is “the fullest potential” use of IT. There are three different perspectives in defining a stage of “fullest potential” use of technology in literature. The first perspective develops “*the fullest potential use*” stage based on literature. Cooper and Zmud (1990) referred their fullest potential stage to a combination of earlier works on MRP systems and the original definition which stated the importance, impact, or significance of IT features to the organization. Saga (1994) and Moore (2002) followed this idea by referring to the list of features of the technology and determining if a specific feature of the technology was used to perform a particular task. However, this approach limits the scope of a complete set of tasks to the researcher’s knowledge. The second perspective for defining the fullest potential use is the use of industry experts (Zmud and Apple, 1992) and the software designer (Kishore and McLean, 1998; Eder and Igbaria, 2001). In this perspective, the fullest potential use definition ignores an organizational-specific context. The use of innovation to a higher level may not give a positive result to the organization since use of a higher feature may yield higher implementation costs than benefits. If the technology is designed specifically for the organization or for specific tasks, the designer approach is the most appropriate. The last perspective, task specific, is based on the limitation of the organization or the users (depending on the level of analysis). This last perspective takes into account the organizational or individual environments. The infusion levels are, therefore, rated relative to the firm’s or individuals’ perception of the highest use. The likert-scale approach is generally used in this kind of measure. A study that takes this perspective is usually conducted at individual level analysis (Jones et al., 2004; Sundaram et al., 2007), by asking many individuals to rate their uses of IT within the firm (Kishore and McLean, 2007), or in a context of general software such as spreadsheets (Hann and Weber, 1995; Castner and Ferguson, 2000).

Zmud and Apple (1992) added an additional dimension of infusion; the interconnectedness of organizational work. They gave an example of higher levels of technology infusion considering work-flow linkages established by the successive microcomputer uses as follows:

1. Users use microcomputers in a stand-alone manner.

2. Users connect microcomputers to organizational networks in order to access and process necessary transactions.
3. Users establish work flow linkages with others via organizational networks
4. Users develop more integrated and collaborative systems within the organization.

Saga and Zmud (1993) and Saga (1994) unified IT infusion dimensions and suggested three pathways of use that exhibit IT infusion: extended, integrative, and emergent use. Extended use is the extent to which the technology has been integrated into organizational work. Integrative use is the extent to which the technology increases the interconnectedness of the organizational workflows. Emergent use is the application of IT to a process or task that could not previously have been performed without the availability of technology. Other researchers may give slightly different perspectives on IT infusion. For example, the degree of integration of IT into business activities and/or processes (Winston and Dologite, 2000; Eder and Igbaria, 2001), the extent to which an organization relies on a particular application (Castner and Ferguson, 2000), and the depth dimension of IT implementation success (Kishore and McLean, 1998). Analysis of IT infusion dimensions is done based on the definitions given and the measurement instruments of prior literature by referring the most original sources. Summaries of IT infusion dimensions given by prior studies are provided in Table 2.1A.

### **2.1.3 IT infusion, IT penetration, IT sophistication, and IT assimilation.**

In the IT/IS research area, the term of IT infusion overlaps with some other terminology. These terms include IT penetration, IT sophistication, and IT assimilation. However, the similarities and differences amongst these terms are not usually examined. The relationships between the terminologies for IS studies with IT infusion are summarized in Table 2.1B.

Researchers and Technology studied	Dimensions – Organizations reach an infusion stage when the innovations are used						
	Integration into an organization's work	Interconnectedness of organizational workflows	Important/significant impacts of using the innovations	A sequence of configurations across discreet levels of use	Emergent use	Importance to the organization	Higher technology features
Cooper & Zmud (1990) MRP systems	For priority and capacity planning	As a closed loop system.	For running business				
Zmud & Apple (1992) Supermarket scanners	As front-end control, sales analysis, and inventory management	For increasing Interconnectedness of work flows		As a sequence of configurations across discreet levels of use			
Saga (1994) Technology in veterinary clinics	For supporting all possible tasks (Extended use)	For increasing Interconnectedness of work flows (Integrative use)			For supporting new tasks which are not possible without technology		
Castner & Ferguson (2000) Spreadsheets	For supporting work tasks (measured by percentage of tasks that have been supported)					For penetrations of the firm in term of importance and significance	Additions to the software that were not included with the original

Table 2.1A: Dimensions of IT infusion used in prior studies

IT infusion dimensions	IT Penetration	IT Sophistication	IT Assimilation
Integration into an organization's work	Yes	Yes	Yes
Interconnectedness of organizational workflows			
Important/ significant impacts of using the innovations			
A sequence of configurations across discreet levels of use			
Emergent use			
Importance to the organization	Yes		
Higher technology features			

**Table 2.1B:** Dimensions of IT infusion, IT penetration, IT sophistication, and IT assimilation

### *2.1.3a IT infusion and IT penetration*

According to Damsgarrd et al. (1994), an IT penetration model seeks to explain and understand why and how organizations adopt, accommodate and transform IT. The successive IT penetration levels are examined by measuring the level of absorbed IT in an organization at a certain time point. The level of penetration can be measured from three perspectives: resources allocated to IT, the importance of IT to the organization, and the organizational scope of IT use. The IT infusion concept treats an IT resource separately as an independent variable, two other parts of IT penetration model overlap with the dimensions of IT infusion. The indicators of the latter two dimensions are slightly different. The similarity of the first refers to how critical IT is to an organization. Damsgarrd et al. measure this dimension by the number of period to which operations within an organization could be sustained at the normal level if IT service was not available. For the second dimension, the penetration model focuses on which levels of operation the IT is used, while IT infusion focuses on what levels of IT the organization uses.

Although some dimensions of IT penetration overlap with IT infusion dimensions, the focus is different. While the IT penetration model tries to explain the actions of an organization, an organizational innovation model, on which the concept of IT infusion is based, seeks actions that contribute to IT success. This study is, therefore, seeking an appropriate set of factors and actions that facilitate the organizational innovation process.

#### *2.1.3b IT infusion and IT sophistication*

IT sophistication has two important aspects; technological sophistication and end users sophistication. The concept of IT infusion overlaps with IT sophistication in some aspects. They both measure the level of IT use in an organization. The primary difference is the focus on breadth versus depth of how IT is used. The measurement of technological sophistication levels focuses on the breadth of IT use such as the number of technologies used in a unit, or the number of units that use a particular technology (Pflughoeft et al., 2003). On the other hand, depth of use is a primary concern for IT infusion. The IT infusion model measures the extent to which a particular IT is used in a sequential order (Zmud and Apple, 1992). In another aspect of IT sophistication, Magklaras and Furnell's (2005) study of end users computing (EUC) sophistication looks at the sophistication of end users by measuring the breadth and depth of the users' knowledge and the fitness of the users. However, the results of the study do not discuss the depth dimension of the end-users. Meanwhile, IT infusion studies treat user's sophistication as an independent variable which may affect IT infusion.

#### *2.1.3c IT infusion and IT assimilation*

Armstrong and Sambamurthy (1996) defined IT assimilation as "*the effective application of IT in supporting, shaping and enabling firms' business strategies and value-chain activities*" (pp. 306). They further proposed two IT-assimilation dimensions which were the use of IT in value-chain activities and the use of IT in competitive strategies. Most scholars pay more attention to the first dimension which involves the deployment of IT in the business (Fichman and Kemerer,

1999). The Fichman and Kemerer's study of assimilation gap shows that IT assimilation partly overlaps with the study of IT infusion. The assimilation gap is defined as *"the difference between the pattern of cumulative acquisitions and cumulative deployments of an innovation across a population of potential adopters"* (pp.258).

The first dimension of IT assimilation is similar to that of IT infusion in respect to the integration of technology into organizational work and value-chain activities. However, IT assimilation focuses on the number of integrated tasks and ignores depth of use, the sequential technological configurations of the technology, and the full potential of IT in business activities and strategies. Despite the integration of IT to value-chain activities, the measure of IT assimilation, used by Armstrong and Sambamurthy, also ignores the linkage within those activities. The potential of IT in business activities, although mentioned in their abstract of study, is not covered by the study either. The second dimension of IT assimilation is similar to a dimension of IT infusion where IT is used as a strategic tool for organizations. However, IT infusion suggests a deeper understanding of how IT can be used strategically.

#### **2.1.4 Synthesizing the definition of IT infusion**

From the definition of IT infusion given by prior studies, this study synthesizes and proposes that IT infusion is viewed through three pathways of use: extended use, integrative use, and emergent use. These three pathways incorporate all important IT infusion dimensions as shown in Table 2.1B. The three pathways of use form the concept of IT infusion. Therefore, the fullest potential use of IT can be achieved when IT has been integrated into organizational work tasks (extended use), when IT has increased interconnectedness of organizational work flows, and when IT has been used strategically in the business.

At an organizational level of analysis, the fullest potential use is viewed as the best practice in the industry. The highest level of use within the industry serves as a benchmark for all organizations when they implement the same technology. In this

case, future researchers can compare infusion levels across organizations. The benchmark approach promotes the objectivity of future infusion studies.

### **2.1.5 IT infusion measures**

Prior studies have tried to find determinants of IT infusion; however, they have rarely yielded statistically significant findings. A possible explanation for this lack of significant results is that previous studies (e.g. Cooper and Zmud, 1990; Zmud and Apple, 1992) have tended to classify IT infusion into three or four broad levels that each take into account too many aspects of IT infusion. The following section reviews the measures of IT infusion in prior studies in chronological order. The measures are grouped by their similarity and the underlying concepts on which they are based.

#### *2.1.5a Cooper and Zmud (1990)*

The first attempt to measure IT infusion incorporated all possible dimensions of IT infusion to study materials requirement planning (MRP) systems. A four-tier measurement system was used to define different levels of infusion. Respondents were asked to classify their firm, based on the following four descriptions:

*“Class A – A closed loop systems, used for priority planning and capacity planning. The master production schedule is leveled and used by top management to run the business. Most deliveries are on time, inventory is under control, and little or no expediting is done.*

*Class B – A closed loop system with the capability for both priority planning and capacity planning. In this case, the master production schedule is somewhat inflated, top management does not give full support, and some inventory reductions have been obtained, but capacity is sometimes exceeded, and some expediting is required.*

*Class C – An order launching system with priority planning only. Capacity planning is done informally, typically with an inflated master production schedule.*

*Expediting is used to control the flow of work and a modest reduction in inventory is achieved.*

*Class D – The MRP system exists mainly in data processing. Many records are inaccurate. The formal system is largely used to run the company. Little benefit is obtained from the MRP system”.* (Cooper and Zmud, 1990, pp.129-130).

As shown in Table 2.1C, Cooper and Zmud incorporated too many dimensions of IT infusion at the same time. The description of each level was read to the respondents over the telephone survey. The respondents may have found it hard to fit their organizations into a particular infusion level when their organizations had mix characteristics from more than one level. In addition, some of the dimensions included in Cooper and Zmud’s descriptions indicated IT infusion enablers (eg. management attitudes toward IT) and IT impact. The coding from the study was reduced from four levels to two levels (0 and 1) which may have seriously affected the statistical analysis.

#### *2.1.5b Zmud and Apple (1992), Eder and Igbaria (2001)*

In 1992, Zmud and Apple measured IT infusion using the functionality of supermarket scanners, based on three levels of scanner application. Zmud and Apple proposed that the higher level of application also involved interconnected information flows. A Guttman-scaled measure was used to differentiate the levels of use among 8 supermarket chains. Eder and Igbaria (2001) adopted the same three-tier approach to measure IT infusion. Their measurement incorporated IT integration and interconnectedness dimensions to the study of the intranet implementation. However, the three-tier measure was too broad to be analyzed statistically.



Infusion level				
Highest ←————→ Lowest				
	<b>Class A</b>	<b>Class B</b>	<b>Class C</b>	<b>Class D</b>
<b>Connectivity</b>	Closed loop	Closed loop		
<b>*Tasks used</b>	Strategic planning Priority planning Capacity planning	Priority planning Capacity planning	Priority planning	Data processing
<b>Effects on Master production schedule</b>	Master production Schedule used	Master production schedule is somewhat inflated	Master production schedule is inflated	
<b>**Supported by</b>	Fully supported by Top management	Partial supported by top management		
<b>**Used for</b>	Running the business			Very little. Mainly run by informal systems
<b>**Results</b>	<ul style="list-style-type: none"> <li>- Most deliveries are on time.</li> <li>- Inventory is under control</li> <li>- Little or no expediting</li> </ul>	<ul style="list-style-type: none"> <li>- Some inventory reduction</li> <li>- Some over capacity</li> <li>- Some expediting</li> </ul>	Modest reduction of inventory  Expediting is used to control the flow of work.	Little benefit is obtained
<b>Infusion level (Coding)</b>	1	1	0	None

Table 2.1C: IT infusion levels (adapted from Cooper and Zmud (1990))

\*Technology key features should be employed to measure the level of that technology's usage.

\*\* Infusion should be related to the importance, impact, or significance of these features to the company. (Sullivan, 1985)

#### *2.1.5c Saga (1994)*

Saga identified all possible tasks in veterinary clinics and classified them using three pathways of use: extended, integrative, and emergent use. The respondents were asked whether they used IT to do each task. For example, “The computer systems are used to generate client invoices. Yes, no, or unsure.” Lists of tasks in the questionnaire include tasks that indicate work-flows based on single entries (integrative use) and tasks that indicate competitive advantage to the organizations (emergent use). Responses were counted to reflect the infusion score across the three pathways of use. This method relies on having a complete set of tasks, including tasks at higher levels of use. A major concern over Saga’s method is whether the researcher knows all possible tasks. The specific boundaries of task application used by the research may overestimate the infusion level.

#### *2.1.5d Castner and Ferguson (2000), Jones et al. (2002), and Sundaram et al. (2007)*

While earlier studies used an operational level of IT infusion measurement, Castner and Ferguson (2000) and Jones et al. (2002) used global measures based on the original definition of IT infusion given by Sullivan (1985). Sundaram et al. (2007) fully adopted the instruments developed by Jones et al. (2002). This measurement focused on the overall perceptions of the respondents. They used seven-point Likert scales or percentage measurements to ask how important technologies were to the firms. They compared how much the users agreed on the fullest potential use of the technologies. Their measures focused on individual-level of analysis and “perceived” constructs. The individual level self-report measures make it difficult to compare and study IT infusion at an organizational level since there are no identical benchmarks for the samples.

#### *2.1.5e Kishore and McLean (2007)*

The study of secondary IT adoption by Kishore and McLean (2007) follows their proposed definition in 1998 where IT infusion was measured in terms of the breadth and depth of use. They measured infusion behavior of organizational staff

by asking respondents to report on a five-point Likert scale their frequency of reuse of eight selected HPS (a computer-assisted software engineering application) object types (components, rules, views, windows, files, fields, sets, and values) for creating new HPS objects. The frequency of reuse captured the regular use aspect of the infusion phenomenon while the eight HPS object types, spanning four major software object categories (logic, interface, entity data, and constructor data objects), captured the comprehensive and sophisticated use aspects of developers' reuse practices in the context of the HPS technology. This study focused on organizational-level of analysis by asking individuals to rate their uses. Although the comprehensive use of software features were taken into account when they operationalized the infusion behavior variable, neither the sequential level of features-used nor number of tasks into which HPS had been integrated was used as an operational dimension of the construct.

#### *2.1.5f Other studies*

A study by Chang and Lung (2002) surpassed the measure of infusion by proposing that IT infusion should be measured by its results. However, the study does not consider other factors that may affect the results. The studies conducted by Moore (2002) and Jaspersen (1999) followed Cooper and Zmud's (1990) and Saga's (1994) concepts, but they simply measured only one IT infusion aspect, the integration of IT into work tasks. This study, therefore, follows the main stream idea that IT infusion is measured by its multi-dimension constructs and is rated relative to the fullest potential use of the technology. The prior studies show that there is no one universal way to measure IT infusion. The existing studies also indicate a need to develop measures that are specific to the technology.

## **2.2 ORGANIZATIONS AND INNOVATIONS**

This section begins with defining an organization, and continues by describing the specific context of this study which is small audit firms. The review of small organization literature helps this study focus on both general and specific aspects of small business.

### **2.2.1 Defining an Organization**

In Zaltman et al.'s (1973) book of innovations and organizations, an organization is defined as *“a social system created for attaining some specific goals through the collective efforts of its members”* (pp.106). In the definitions given above, there are three tacit dimensions. There is a requirement to have two or more individuals in a system. An organization also requires interactions among members of the system. Finally, the members of the system deliberately seek specific goals or objectives. This definition of an organization helps specify “boundaries” for this study. These boundaries distinguish the organization from its environment.

This study is based on the resource-dependency theory which suggests that organizations attempt to actively manage their environments (Aldrich and Pfeffer, 1976). Innovations are considered a strategic choice which helps organizations increase their effectiveness and efficiency. Organizations manage innovation enablers and inhibitors that affect the use of innovations.

### **2.2.2 Small and medium sized enterprise/organization (SME)**

As stated in chapter 1, this study focus on an organizational innovation process in SME. This section, therefore, details the context of the study, which is small and medium sized audit firms in Thailand.

SME are defined differently within various studies. Some researchers define small by their annual sales figures, which have to be less than USD 10 million. However, most studies define small and medium sized business by the number of employees with less than 250 (Raymond and Bergeron, 1998), or less than 200 (Harrison et al, 1997). Other studies use the combination of several criteria; turnover less than 40 million Euro, balance sheet less than 27 million Euro, employees less than 250, and the owner has full ownership or a majority interest of 75 percent or more (e.g. Loecher, 2000). In New Zealand, several studies, including Zinatelli et al. (1996), follow the definition of 50 or less employees as small, and very small when there

are less than 20 employees. However, in service industries such as accounting firms, following Suraweera's dissertation (2004), the service business is considered small if it employs less than 10 employees. In Thailand, small and medium sized firms are defined by a special law code, where under 50 employees is defined as "small" and not over 200 employees for "medium" for both manufacturing and service sectors.<sup>1</sup> From this definition, except for the big-four audit firms<sup>2</sup>, all other audit firms fall under the definitions of small and medium sized audit firms.

There is much evidence showing rapid increase in technology use in small and medium sized businesses. Pollard and Hayne (1998) indicated that small firms would adopt more information technology, particularly as a management tool and for network purposes. Suraweera (2004) showed significant use of technology within small chartered accountant firms in New Zealand. The significant usage of technology in small and medium sized audit firms is also confirmed by interviews in the early phase of this study.

Small firms tend to adopt technology at a slower than expected rate. Lertwongsatien and Wongpinunwatana (2003) found that e-commerce was slowly adopted in Thailand because small firms give less strategic attention to technology. Cost-benefit is also a major consideration in small and medium size firms. Small firms tend to limit their budgets, investing in technology that gives short-run outcomes, especially when they have little experience of technology. When firms' experience of technology increases, technology adoption factors change to the potential use of the technology under strategic directions (Lefebvre et al., 1991). Harrison et al. (1997) suggested that the barriers of technology adoption in small firms declined when small firms became bigger and when they got more expectation from social environment.

Small businesses have some unique characteristics that are different from other organizations in IT adoption and implementation studies. In addition to traditional factors affecting the organizational innovation process, owners' attitudes toward

---

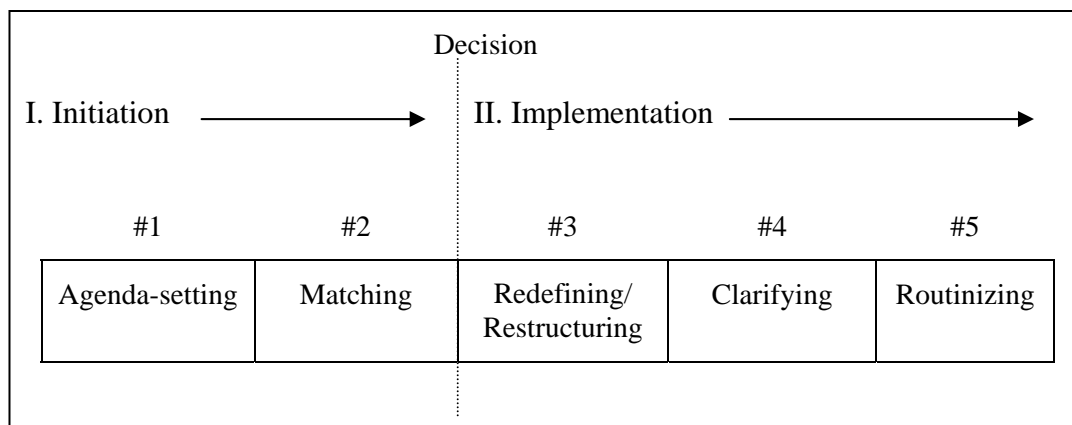
<sup>1</sup> Special law code, SME definition 2002. <http://www.sme.go.th/websme/niyamsme.asp>

<sup>2</sup> The big-four audit firms refer to PricewaterhouseCoopers, Ernst & Young, KPMG, and Deloitte Touche.

technology along with their management style also impacts on the quality of IT implementation (Winston and Dologite, 2000). Small business owners' attitudes also reflect perceptions of a use of IT as a tool to increase effectiveness and efficiency in their firms (Ray et al., 1994). In audit firms, owners refer to partners who share risks and benefits of the firms.

### **2.3 IT INFUSION AS THE FINAL STAGE OF AN ORGANIZATIONAL INNOVATION PROCESS**

An earlier model of organizational innovation, the process of organizational innovation (Figure 2.3A), is divided into two broad stages, initiation and implementation (Zaltman et al., 1973; Rogers, 2003). Rogers suggests that the two stages can be divided into five sub-stages and that *“later stages in the innovation process cannot be undertaken until earlier stages have been completed, either explicitly or implicitly”* (Rogers, 2003, pp. 420). In an initiation stage, organizational problems are defined and perceived needs for innovation are recognized as a solution to the problems. Rogers (2003) called the process of problem identification “Agenda –Setting” and the process of finding an innovation as a solution to the problems “Matching”. Sometimes, knowledge of an innovation may lead to an adoption of the innovation. This process is called a technology-push force. The innovation is, therefore, believed to improve performance in a work process. Whether an organization adopts an innovation in order to solve existing problems or in order to improve its performance, the innovation process involves a significant investment in both the innovation itself and in the necessary resources to facilitate the organizational innovation process.



**Figure 2.3A:** The innovation process in an organization (Rogers, 2003)

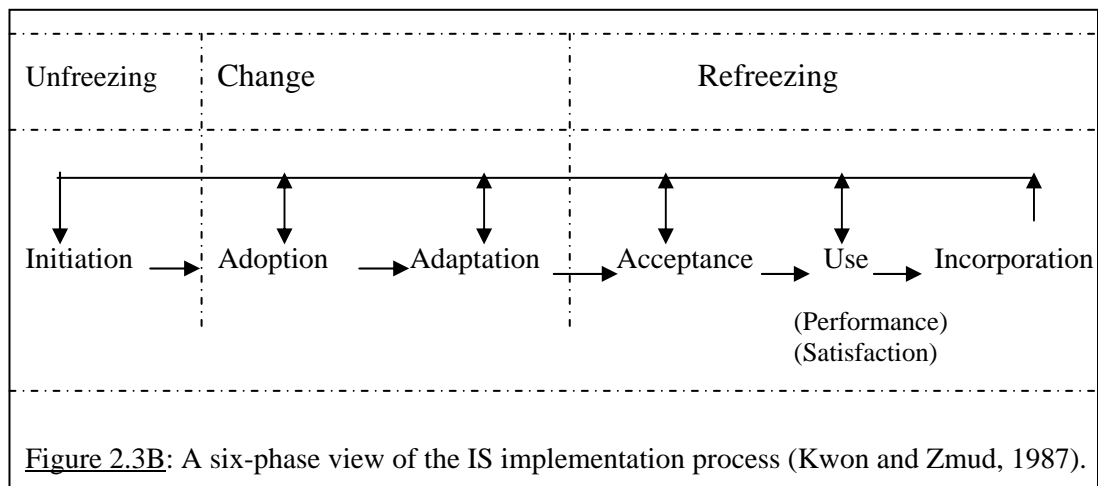
In the latter stage, implementation, focus is more on the fact that the innovation has been used by people in the organization. *“Implementation is defined as an organizational effort to diffuse an appropriate information technology within a user community”* (Kwon and Zmud, 1987, pp.231). Implementation begins after the decision is made to adopt an innovation. Redefining is a process of adapting or re-inventing an innovation to fit with the organization; restructuring is changing organizational structures in order to facilitate the implementation process. When an innovation diffuses throughout the organization, the organization’s members get a clearer picture of how to integrate the innovation in their activities. Rogers suggests that the clarifying stage involves social construction. Careful arrangements are needed in order to help people answer questions through “a social process of human interaction”. The innovation process reaches its conclusion when *“an innovation has become incorporated into the regular activities of the organization and has lost its separate identity”* (Rogers, 2003, pp.428). Rogers calls the final process “routinizing”. Scholars have extended innovation-process studies to cover the continued use of innovation, “sustainability”. Rogers relates the degree of sustainability to several factors such as the extent to which people get involved in the innovation process and how much an innovation is re-invented during the implementation process. Even though an innovation is sustainable in an organization, there is no evidence showing that the organization achieves the highest benefits that an innovation can offer. According to Zaltman et al. (1973), the last stage is the control (feedback) of an innovation. This is where an

innovation is determined whether it should be continued (as it is, or after adaptation) or abandoned.

Both Rogers's and Zaltman et al.'s models do not suggest any further stages in the innovation process. Institutionalization is the last activity in their process model. Institutionalization is the decision made to keep or not to keep an innovation in the organization. From Rogers's perspective, problem solving and performance improvement are goals of the innovation process. However, Rogers ignores the fact that the investment in an innovation process may exceed the benefits. Problems may be solved and/ or performance improvements may be achieved even though an innovation is only partially used. This study believes that the fullest potential use of an innovation helps an organization to achieve the highest goals for performance improvements that it can get from the investment in the innovation.

The very first implementation model that mentioned the word "infusion" is found in Kwon and Zmud (1987). Kwon and Zmud proposed the six-stage model (Figure 2.3B) which an innovation process reaches its conclusion when it has been incorporated into the organization's work processes. The final stage is, therefore, called "incorporation". They state that "*incorporation occurs when the innovation becomes embedded within an organization's routine and when the innovation is being applied to its full potential within an organization*" (Kwon and Zmud, 1987, pp. 233). This implies that routinization and infusion are necessary components of incorporation. However, they do not suggest whether routinization and infusion happen in a specific order or they are independent from each other. For example, the firm may use an IT application to its fullest potential but without integrating it into their operations.

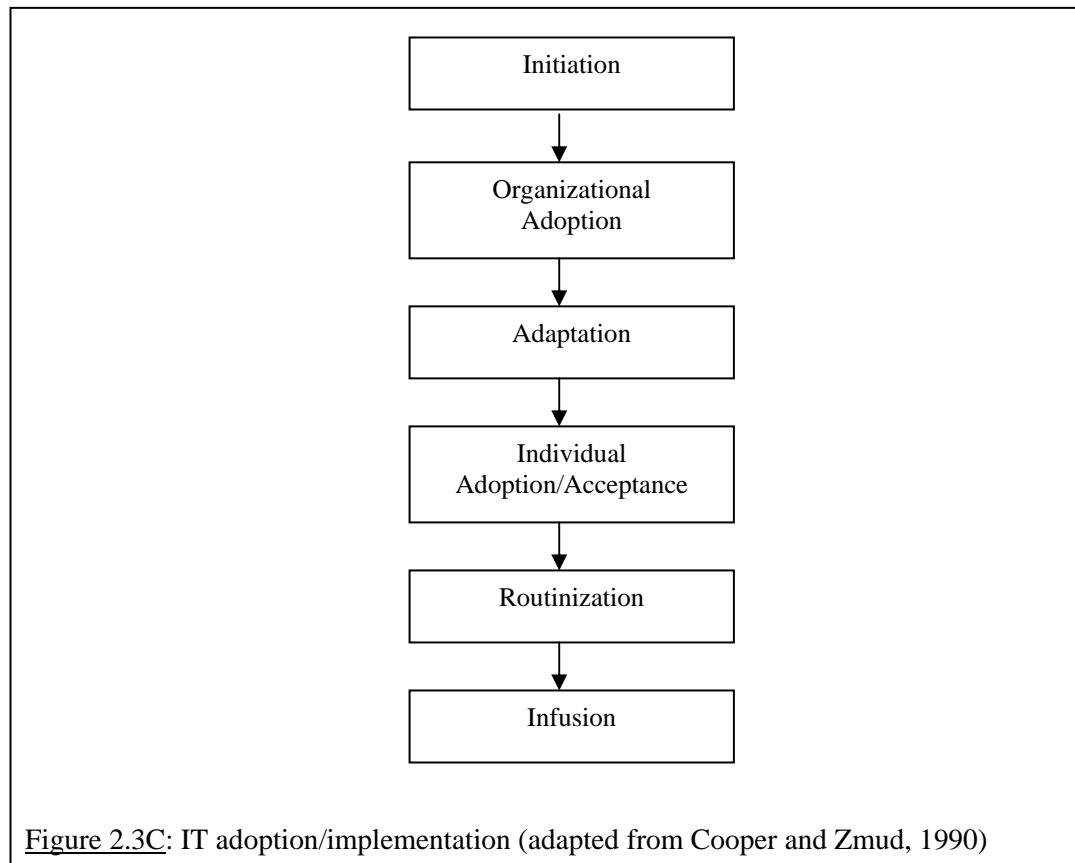




Adapting Kwon and Zmud's (1987) model of the IT implementation process (Figure B), Cooper and Zmud (1990) propose a model that shows an appropriate deployment of IT within an organization (Figure 2.3C). The process includes initiation, organizational adoption, adaptation, individual adoption/acceptance, routinization, and infusion. The first two stages, initiation and adoption, can be explained as a phase where an organization has IT needs and matches the need to an innovation (Rogers, 2003). Cooper and Zmud's explanations of initiation stage are similar to those of Rogers (2003) except that Cooper and Zmud suggest that activities during this stage include matching technology to the organization. Cooper and Zmud separate adoption as a second phase. Adoption is where the decision to implement an innovation is made and the necessary resources have been invested.

Then, the implementation process starts. There are two aspects to the third stage. An innovation is redefined/bundled in order to fit the organization (Bjornenak and Olson, 1999; Rogers, 2003; Ax and Bjornenak, 2005). Alternatively, the organizational structures and operational process are to be changed/ altered/ adapted in order to fit the innovation (Kwon and Zmud, 1987; Cooper and Zmud, 1990). The innovation reaches routinization stage when it is integrated into the organization ongoing governance systems and becomes a normal activity; therefore, losing its identity as an innovation (Cooper and Zmud, 1990; Zmud and Apple, 1992; Rogers, 2003). Infusion is the final stage when an innovation is used to its fullest potential (Cooper and Zmud, 1990).

From Cooper and Zmud's (1990) model, routinization and infusion occur in a specific order. This model contrasts to that of Kwon and Zmud (1987) which suggests only that routinization and infusion are parts of incorporation which is the final stage of an innovation process.



This sequence of implementation stages is confirmed by Zmud and Apple (1992). In their study of the technology incorporation/ infusion of electronic scanners in supermarket chains, they proposed the nature of the relationship between infusion and routinization, an organization might routinize an innovation but still exhibit low level of infusion. However, *“it may not be possible to achieve higher infusion level without simultaneously achieving a high level of routinization”* (Zmud and Apple, 1992; pp.150). They concluded from their survey results that there was an apparent association between routinization and infusion, even though they cited and explained the case where there was a higher infusion level but lower routinization score. The results from another supermarket chain exhibited a higher

routinization score but lower infusion level. Even though they showed that infusion levels in supermarket chains could be differentiated statistically, the contrasting evidence from two subjects might contribute to the reason why Zmud and Apple (1992) did not show a statistical proof of an association between routinization and infusion. Findings only suggested strong statistical associations between earliness of adoption diffusion and infusion, but not between routinization and infusion. Zmud and Apple (1992) limited the research design, so it did not cover an examination of causal relationships. They also claimed that they did not observe an organization that had a low degree of routinization. However, they concluded that routinization was necessary but not a sufficient condition in itself for an organization to achieve advanced infusion level. The previous arguments seem to contradict each other. It is unclear then, which routinization level an organization must achieve before moving to the infusion stage.

A question arises from the innovation process during the early implementation stage. The early implementation activities are redefining or restructuring (Figure 2.2A, 2.2B, and 2.3C). They both involve “changes” in either the innovation itself or in organizational factors. Restructuring involves organizational changes that can lead to a successful implementation. Meanwhile, the success can also be obtained by redefining or bundling an innovation to suit to the organization. The latter changes, however, may result in an addition or a reduction of the features of the innovation in order to fit to organizational needs. An organization that chooses to redefine or bundle an innovation may drop parts of its features. The innovation, therefore, is not used to the fullest potential and it will not reach the stage of infusion.

Reviews of the innovation process studies show that most scholars have been adding to the literature on technology adoption/ diffusion which is the first stage. There is less research focusing on the implementation stage. How an organization can best reach the conclusion of an innovation process remains unclear.

## **2.4 IT INFUSION ENABLERS**

Prior studies of the organizational innovation process center around an adoption phase. Even though there are several studies focusing on implementation, there are not many studies on IT infusion. In addition, prior studies often mix the study of IT diffusion and IT infusion since the researchers believe that it is hard to distinguish IT infusion from IT diffusion. The infusion concept is similar to an integration of technology into organizational work. This meaning is similar to the meaning of IT diffusion. Most available IT infusion studies have proposed IT infusion models at a conceptual level, and have rarely yielded statistically significant findings between IT infusion and its antecedents and/or IT infusion and its impact on a firm/individual's performance. Some studies focus on an individual level of analysis. This study follows the multi-level analysis as suggest by Burton-Jones and Gallivan (2007) in order to provide an advanced understanding of IT infusion in organizations.

There are two research streams of IT infusion models. The first stream, called the factors research stream (Kwon and Zmud, 1987), deals with the antecedents or determinants of the IT infusion level. The second stream is the study of IT infusion and its impact on performance or other decisions. This study will focus on the first research stream.

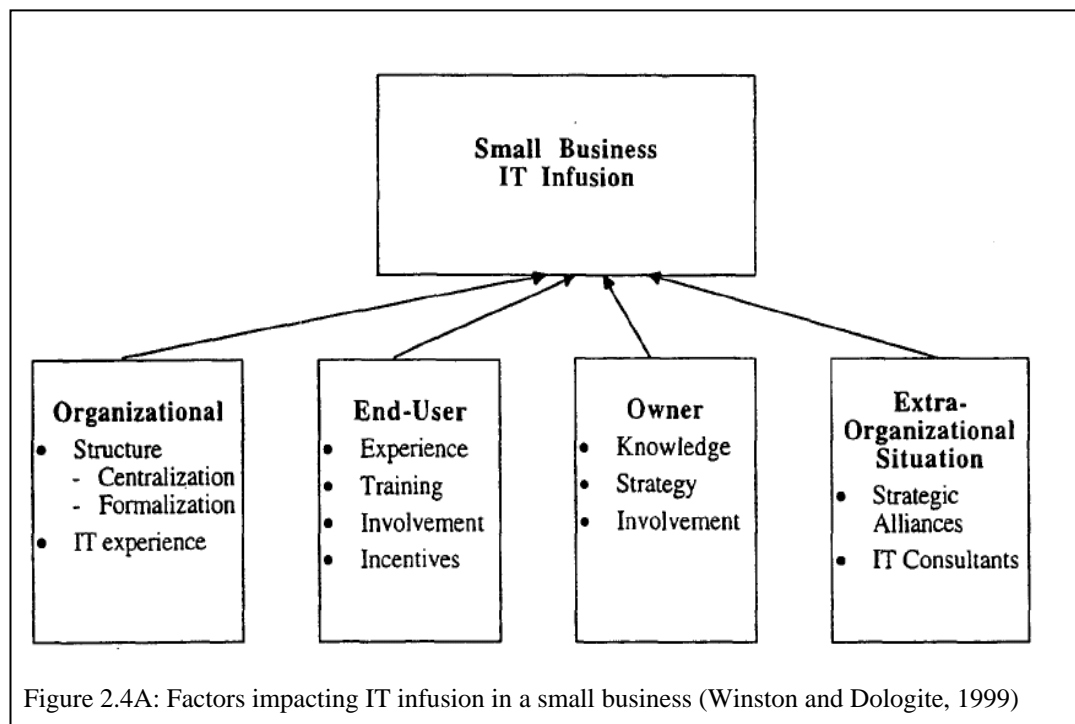
### **2.4.1 Organizational-level infusion enablers**

Winston and Dologite (1999) provided a conceptual model of IT infusion determinants specifically for small businesses (Figure 2.4A). By surveying related organizational innovation process literature, they classified the enablers into four broad categories: organizational, end-user, owner, and extra-organizational situation. Some of these determinants can be controlled by the organization. Even though their work provided more insight into the IT-infusion factor research stream, with a focus on small businesses, the model was at the conceptual level and had not been tested in a real business environment. The authors claimed that they were currently working on an empirical study of the model; however, presently, there is no empirical study using their model on IT infusion. This study uses their

classification to review the previous studies of IT infusion determinants with the support of empirical evidence from other research.

#### 2.4.1a Organizational

The factors include the structural attributes of the organization and organizational IT experience. Winston and Dologite (1999) classified most of these factors (organizational structure and IT experience) as uncontrollable while the organization might partially control the formalization. These factors were summarized as internal characteristics that affect an organizational innovation process.



Internal characteristics include centralization, complexity, formalization, interconnectedness, organizational slack, and size. Rogers defined and gave the directions of effect to each variable as shown in Figure 2.4B. These factors were found to be related to organizational innovativeness and adoption (Premkumar, 2003); however, Rogers claimed that most studies show relatively low correlations.

Other organizational characteristics affecting an innovation process include organization size (Thong and Yap, 1995; Eder and Igarria, 2001; Bajwa and Lewis, 2003), organizational structures (Picot et al., 1993; Damanpour and Gopalakrishanan and Damanpour, 2000; Namwoon, 1998; Chengalur-Smith, 1999; Decanio et al., 2000; Eder and Igarria, 2001; Spanos, 2002), and organizational cultures (Sankar, 1988; Namwoon, 1998)

Even though centralization and organization size are hypothesized and found to be determinants of the innovation process in several studies, Eder and Igarria (2001) find no significant statistical results to support the hypothesis about their effects on the infusion of an intranet. This may imply that those two factors contribute to an earlier phase of the innovation process, but not the infusion.

<i>Centralization (-)</i>	<i>is the degree to which power and control in a system are concentrated in the hands of a relatively few individuals.</i>
<i>Complexity (+)</i>	<i>is the degree to which an organization's members possess a relatively high level of knowledge and expertise.</i>
<i>Formalization (-)</i>	<i>is the degree to which an organization emphasizes its members' following rules and procedures.</i>
<i>Interconnectedness (-)</i>	<i>is the degree to which the units in a social system are linked by interpersonal networks</i>
<i>Organizational slack (+)</i>	<i>is the degree to which uncommitted resources are available to an organization.</i>
<i>Size (+)</i>	<i>is usually represented by number of employees or organizational income</i>
+ Positive association with innovation process	
- Negative association with innovation process	
<u>Figure 2.4B:</u> Internal characteristics of organizational structure (Rogers, 2003)	

Organizational complexity can be divided into many dimensions. In some studies, organization knowledge and experience may be measured in term of IT maturity (Saga, 1994), or earliness of adoption (Zmud and Apple, 1992; Eder and Igarria, 2001). In Saga's (1994) study, the determinants of IT infusion are centralized around task reconceptualization via IT and beliefs about IT usefulness and ease of

use. Organization's and staff members' knowledge and experience is positively associated with users' abilities to reconceptualize tasks via IT. The evidence for the positive effects of the earliness of adoption on IT infusion is strongly supported by the work of Zmud and Apple (1992) and of Eder and Igbaria (2001).

An organization slack is studied in terms of the IT infrastructure flexibility which is empirically tested to be an IT infusion enabler in Eder and Igbaria's study. Other factors, such as formalization and interconnectedness, organization slack in a form of time resource, and IT champions have never been tested in IT infusion studies. One of the reasons that may explain untested determinants are made by Lee and Runge (2001) that small business may not be able to afford an IT champion even though the champion has been found to contribute to IT diffusion process.

#### *2.4.1b End-user*

Characteristics of the end user such as experience, training, and involvement fall into this category. Saga (1994) framed her study on users within an organization even though her study focused on an organizational level of analysis. This suggests that end-user factors cannot be ignored since they are parts of the organization. She also uses "*members' understanding of IT and tasks*" as proxies of organizational knowledge. However, prior studies did not empirically test the association between end-user training and involvement. Cooper and Zmud (1990) suggested that the individual perspectives such as self-interest also outweighed organizational considerations. Political maneuverings that controlled these perspectives might be more important than organizational factors.

#### *2.4.1c Owner*

The owner factor is unique for small business studies. Since the owner of small business usually works on a full-time basis and plays a dominant role in most business decisions, their personal abilities and motivation have significant impacts on the business (Palvia and Palvia, 1999; Walker and Brown, 2004). In addition, small firms have less slack resources, so the success of an innovation process relies heavily on the owners (Lee and Runge, 2001). For small businesses, the owners themselves usually represent their businesses, whilst in a bigger organization an

owner may be separated from the business. In the first case, innovation process determinants may be partly from the owners' personal factors. The study of business owners also includes owner characteristics, owner attitudes and IT-gatekeeper assumption. In the latter case, where the owners are separated from the business, the study focuses on management support and management intervention and involvement.

Regarding business owners, factors contributing to an innovation process in small business include top management involvement (eg. Cragg and King, 1993; Thong et al., 1996; Premkumar and Roberts, 1999), top management's/owner's characteristics such as knowledge, innovativeness (eg. Thong, 1999; Quaddus and Hofmeyer, 2007), and attitudes toward IT (eg. Winston and Dologite, 2000; Quaddus and Hofmeyer, 2007). Eder and Igbaria's study was the only study that paid attention particularly to the IT infusion stage and found that top management support had a strong direct effect on IT infusion.

#### *2.4.1d Extra-organizational situation*

This category captures the rest of the factors or situations that affect an organizational innovation process. Zaltman et al. (1973) refer to this category as an organizational environment. According to Zaltman et al., the organizational environment is a set of physical and social factors that are taken into account in the decision making-behavior. There are two types of organizational environment: internal and external. Internal environment represents related factors within the organization such as organization personnel, staff educational background and skills, conflicts amongst and within departments and/or between individuals. The external environment includes a set of factors outside of the organization such as suppliers, competitors, government, social networks and strategic alliances. Most external environment items are captured by the previous three categories. Therefore, this study refers extra-organizational situations as the external environment.

Extra-organizational situations such as social networks have been left out of IT infusion studies even though most factors are categorized as "*fully controllable*" by



Winston and Dologite (1999). From Saga's (1994) perspectives, organizational knowledge that will help an organization to reconceptualize tasks via IT can be gained both internally and externally. However, she did not examine or suggest the practical approach that an organization can take to increase its IT infusion.

In particular, a small business can improve use of IT by exchanging knowledge with a social network. Research of small businesses (e.g. Cragg and King, 1993; Thong et al., 1996) showed that small businesses relied heavily on external IT consultants. Meanwhile the business can observe how other organizations use their technology in the same business context. A positive impact on IT infusion can come from a strategic alliance of organizations in the same industry and between the organization and IT consultants. Other interactions may also come from business partners and regulators (Premkumar, 2003; Quaddus and Hofmeyer, 2007).

#### *2.4.1e Innovation's characteristics*

Rogers (2003) suggests five perceived attributes of innovations enabling rate of diffusion. Those attributes are shown in Figure 2.4C along with brief descriptions.

<i>Relative advantage</i>	<i>is the degree to which an innovation is perceived as better than the idea supersedes.</i>
<i>Compatibility</i>	<i>is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.</i>
<i>Complexity/</i>	<i>is the degree to which an innovation is perceived as difficult to understand</i>
<i>Ease of use</i>	<i>and use.</i>
<i>Trialability</i>	<i>is the degree to which an innovation may be experimented with on a limited basis.</i>
<i>Observability</i>	<i>is the degree to which the results of an innovation are visible to others.</i>
<b>Figure 2.4C:</b> Perceived attributes of innovations (Rogers, 2003)	

Where relative advantage, compatability, trailability, and observability are generalized to be positively related to the rate of adoption, complexity is generalized to have negative effects (Rogers, 2003). The effects of relative advantage, compatability, and complexity are empirically supported by many prior studies (Premkumar, 2003). Compeau et al (2007) revise these characteristics by adding “image”, “communicability”, “measurability”, and “voluntariness of use”. Image is the extent to which the use of innovations enhance the image of the adopter within a community. Communicability reflects how easily the results of the use can be described to others and measurability reflects the degree to which an impact of innovations can be assessed. However, the last characteristic, voluntariness of use seems to relate more to the implementation process.

These characteristics of innovations were studied by Coopers and Zmud (1990) and Kishore and McLean (2007). Perceived relative advantage, complexity, and compatibility (with tasks) were the main focus of the studies. In Cooper and Zmud’s (1990) study of Material Requirements Planning (MRP) diffusion and infusion, they proposed that MRP diffusion and infusion were likely determined by the level of fit between task and technology and their complexity. Telephone interviews were conducted with production managers and staff in the organizations which were the subjects of the study. The results from the study showed that task-technology compatibility is a major factor in explaining MRP diffusion but not infusion. They claimed that at the latter stage of implementation (infusion), the factors were more of a political and learning model such as uncertainty and equivocality associated with the organizational impacts that accompany high levels of infusion. Therefore, longitudinal study was recommended for a better understanding of the political and learning model and its effects on IT infusion.

In Kishore and McLean’s (2007) study of innovation compatibility, organizational alignment and software reuse infusion, innovation compatibility (in a form of organizational alignment) was related to IT infusion behaviors. However, they found no significant relationship between relative advantage and infusion behavior.

#### *2.4.1f Diffusion and Routinization*

IT diffusion in most implementation studies represents the diffusion within organizations. It is measured by the number of individuals or departments that adopt the innovation. Most prior studies have studied both IT diffusion and infusion at the same time. Some studies find IT diffusion as an antecedent of IT infusion. However, some have not made links between these two variables. For example, Cooper and Zmud (1990) did not test or report the link between IT diffusion and IT infusion while Zmud and Apple (1992) claimed that they did not observe the sites with low diffusion but they believed there were strong relationships between the two variables. Kishore and McLean (1998) reconciled the terms of the final stage of the innovation adoption process and proposed diffusion and infusion as two separate dimensions in determining IT success which is referred as institutionalization, incorporation, or routinization. The empirical evidence of an association between IT diffusion and infusion are given by Hann and Weber (1995), Castner and Ferguson (2000), and Eder and Igbaria (2001). This study argues that IT diffusion and infusion are separate dimensions. An organization can achieve infusion stage without diffusion. For example, a department may integrate an innovation into their work tasks and use it to the fullest potential without diffusing the innovation to other departments. This study, therefore, measures organizational-level infusion at the highest use of the technology within organization regardless of intra-organization diffusion issues. This method seems to be consistent with most studies which usually survey the individuals who are most familiar with the innovation and assume that all other individuals in the organization achieve the same level of infusion. For example, Saga's (1994) respondents were the people who were most familiar with the technology in the organization and Eder and Igbaria's (2001) respondents were the top computer executives.

Routinization is also claimed as a predecessor of IT infusion even though there are no studies with supporting evidence. Zmud and Apple (1992) only claimed that they did not observe firms with low routinization. The only empirical study that shows an association between routinization and infusion was by Sundaram et al. (2007). The study shows that the correlation between the two variables is 0.747;

however, the study did not discuss the implications of this interconstruct correlation. It was also argued that routinization might be associated with infusion but it was not a predecessor as proposed by the organizational innovation process (Kwon and Zmud, 1987; Cooper and Zmud, 1990).

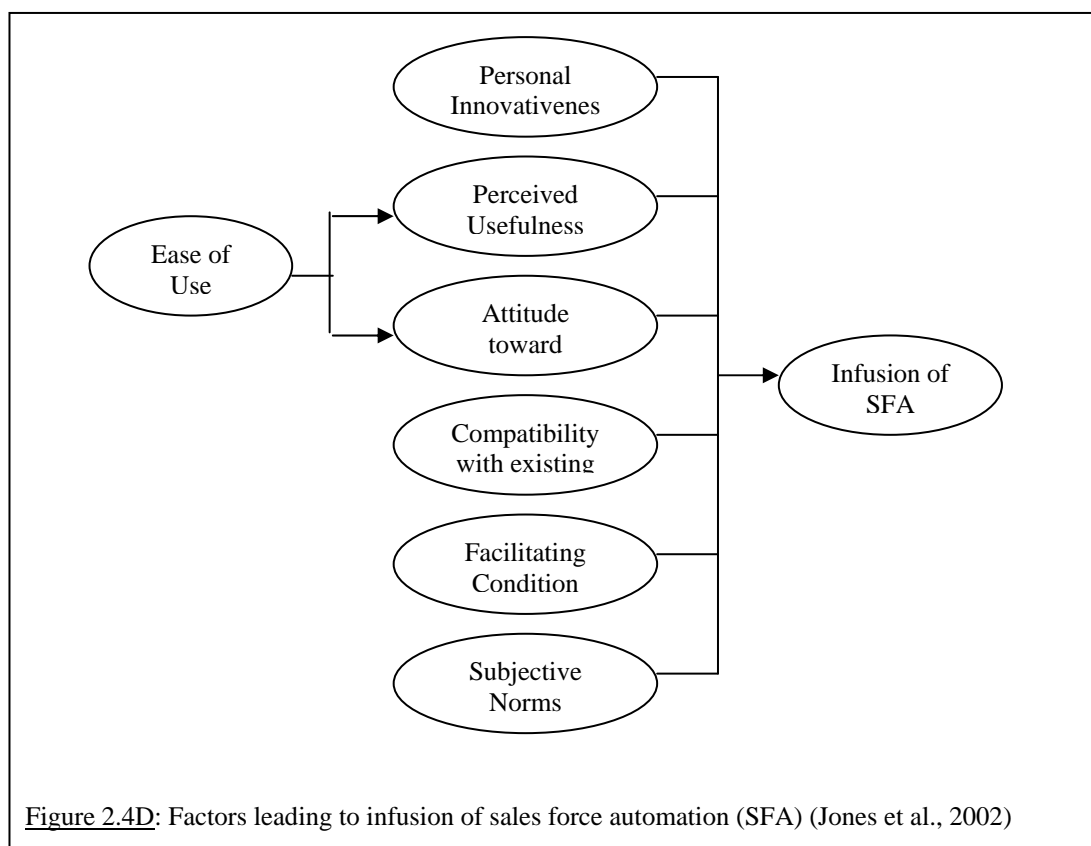
#### **2.4.2 Individual-level infusion enablers**

At an individual-level of analysis, IT infusion determinants have been framed by the Technology Acceptance Model (TAM) (Davis et al., 1999), the Theory of Reasoned Action (TRA), and the Theory of Planned Behavior (TPB) (Ajzen, 1991). These theories deal mostly with behavioral and psychological factors, which explain why individuals adopt and use technology. Scholars that contribute to the IT infusion literature at this level of analysis include Jaspersen (1999), Jones et al. (2002), Moore (2002), and Sundaram et al. (2007).

In 1999, Jaspersen conducted research on socially appropriate actions through which an individual responds to social influence. The research included variations in term of the influence on infusion by mediating antecedents of individual beliefs, IT knowledge, and the ability to reconceptualize work process. Three year later, Moore's (2002) study focused on individual motivation, social cognition attitudes and behaviors that also explained the work process reconceptualization which contributed to IT infusion (Saga, 1994).

Jones et al. (2002) is the first longitudinal study in the literature of IT infusion. The survey data was collected about the IT pre-implementation and post-implementation periods, from salespeople who used sales force automation (SFA) in their work (Figure 2.4D). The technology infusion in this study was considered infusion at an individual level because salespeople in the study were independent and responsible only for their market territories. They voluntarily adopted and used SFA to facilitate their work. Facilitating conditions which include any type of support are also included in the research model. Those facilitating conditions included user experience knowledge and expertise (Ko and Dennis, 2004) and users' training and support (Ahearne et al., 2005). Jones et al.'s study had the advantage of capturing the uses of technology that developed over time because it

was a longitudinal study. The results of the study showed that, at an individual level of adoption and infusion, personal innovativeness, attitude toward the system, and facilitating conditions were factors leading to the IT infusion of SFA. Whilst statistical results showed insignificant effects of perceived usefulness and compatibility, they claimed that it might be because they used samples from a single company and a single industry. The results could not be generalized to all IT. They also stated that self-report measurement might not have captured the real levels of use. The levels of use were judged by the users who might each have given different answers for the same level of use.



Since this study focuses on the organizational level of analysis, the behavioral and psychological factors will not be included in the research. However, this study takes into account facilitating factors at an individual level that may contribute to organizational-level IT infusion in a small business context such as the individual characteristics and attitudes of the business owners/managers that are found to contribute to an organizational innovation process.

### **2.4.3 IT infusion enablers: current findings and unexamined gap**

Based on the review of literature in section 2.4.1 and 2.4.2, this section summarizes the infusion enablers. However, the enablers are selected for an organizational level analysis. Some enablers may be selected from individual-level studies if they are related to the organization. The enablers that were consistently identified in prior studies were management support/intervention, innovation compatibility (to organization or work), and IT knowledge. Even though an association has been found between diffusion and infusion and routinization and infusion, the limitation in the studies (Zmud and Apple, 1992) and that no direct observation is made between two factors (Hann and Weber, 1995; Castner and Ferguson, 2000) make it hard to conclude that diffusion or routinization are determinants of IT infusion. Table 2.4A classifies the determinants into empirically-supported determinants, insignificantly statistically supported determinants, and unexamined factors.

The table shows that IT infusion at an organizational level is an under-researched area. There are many unexamined factors. In addition, associations between some variables remain unclear and some are not supported with sufficient statistical results.

Factors categories	Results found in prior studies		
	Empirically/ statistically supported	Unsupported by sufficient statistics	Unexamined
Organizational	<ul style="list-style-type: none"> <li>- IT experience - in term of earliness of adoption (Zmud and Apple, 1992; Eder and Igbaria, 2001) – in term of IT maturity (with limited support) (Saga, 1994)</li> <li>- IT knowledge (ability to reconceptualize tasks via IT) (Saga, 1994)</li> <li>- IT infrastructure (partially supported) (Eder and Igbaria, 2001)</li> </ul>	<ul style="list-style-type: none"> <li>- Organizational structure (Eder and Igbaria, 2001)</li> <li>- Size (Eder and Igbaria, 2001)</li> <li>- IS structure (Eder and Igbaria, 2001)</li> </ul>	<ul style="list-style-type: none"> <li>- Centralization</li> <li>- Complexity</li> <li>- Interconnectedness</li> <li>- Organizational slack</li> <li>- Organizational cultures</li> </ul>
End-user	<ul style="list-style-type: none"> <li>- Members’ beliefs about IT and tasks (Saga, 1994)</li> <li>- Attitudes (Jones et al., 2002)</li> </ul>		<ul style="list-style-type: none"> <li>- Involvement</li> <li>- Incentives</li> </ul>
Owner/manager	<ul style="list-style-type: none"> <li>- Manager intervention (Saga, 1994)</li> <li>- Management supports and trainings (Eder and Igbaria, 2001; Jones et al., 2002)</li> </ul>		<ul style="list-style-type: none"> <li>- Knowledge</li> <li>- Attitude</li> </ul>
Extra-organizational Situation			<ul style="list-style-type: none"> <li>- Social networks (include strategic alliance, IT consultants, regulators and academic institutes)</li> </ul>

Table 2.4A: Determinants empirically tested and other unexamined factors in prior studies

Factors categories	Results found in prior studies		
	Empirically/ statistically supported	Unsupported by sufficient statistics	Unexamined
Innovation characteristics	<ul style="list-style-type: none"> <li>- Compatibility with organization through Organizational alignment concept (Kishore and McLean,2007)</li> <li>- Compatibility (Jones et al., 2002)</li> </ul>	<ul style="list-style-type: none"> <li>- Compatibility (Cooper and Zmud, 1990), at individual level (Kishore and McLean,2007)</li> <li>- Complexity (Cooper and Zmud, 1990)</li> </ul>	<ul style="list-style-type: none"> <li>- Relative advantage</li> <li>- Trialability</li> <li>- Observability</li> </ul>
Diffusion and Routinization	<ul style="list-style-type: none"> <li>- Diffusion (Zmud and Apple, 1992; Hann and Weber, 1995; Castner and Ferguson, 2000; Eder and Igbaria, 2001)</li> <li>- Routinization (Zmud and Apple, 1992)</li> </ul>		
Other factors			<ul style="list-style-type: none"> <li>- IT champion</li> <li>- Availability of alternative systems</li> <li>- Task variety</li> <li>- Staff turnover</li> </ul>

Table 2.4A: Determinants empirically tested and other unexamined factors in prior studies (Continued)



## **2.5 AUDITING AND TECHNOLOGY**

In this section, the study reviews the existing literature on audit process and how auditors use technology, especially software, in audit work. The existing technology available to auditors is then detailed. The last subsection deals with special considerations about auditors and technology diffusion process.

Rapid increases of IT use in business means that auditors have to keep up with their clients' technology. Information technology can help professional audit firms gain productivity (Banker et al., 2002). Some technologies implemented in audit firms have been unused or ignored, even though they have been proven to improve audit effectiveness and efficiency (Fisher, 1996; Eining et al., 1997; Manson et al., 2001). In this section, technologies available for use and used by auditors in both small and big audit firms are reviewed. The evidence of the current utilization of technology in audit firms is mainly collected from preliminary interview and professional and academic journals in order to show the applications of technologies in the real world, rather than ideal but unused technology. Auditors' attitudes toward technology are also reviewed including part of possible IT infusion enablers.

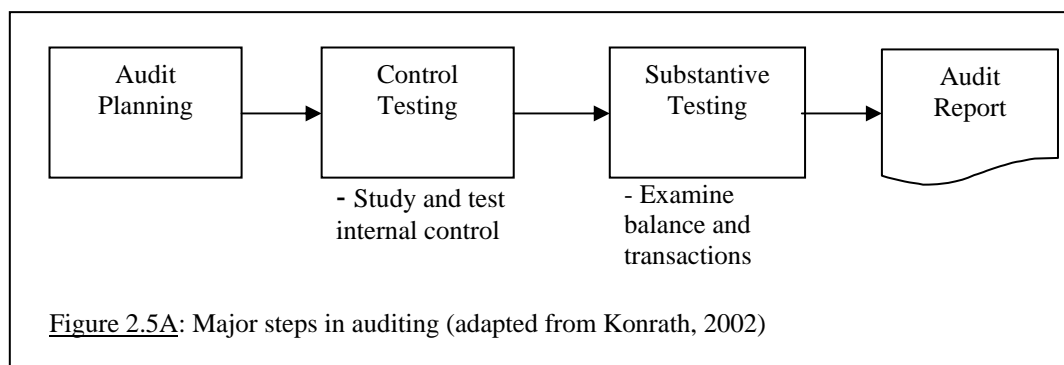
Information technology can be used for computer-based information systems. Information technologies are computer hardware, computer software, telecommunication networks, and data resource management tools (O' Brien, 2005). The primary interest of this study is on the infusion of software and applications in audit firms. From previous surveys and studies, the most commonly used software or applications include MS-Windows, MS-Office, Lotus notes, database management applications, work paper management applications and general audit software (GAS), such as audit command language (ACL) and Interactive data extraction and analysis (IDEA) (Clarke, 1995; Manson et al., 1997; Glover et al., 2000; Kahan, 2001). Two types of technology that are commonly used in audit firms, a spreadsheet application and a collaborative technology, are chosen as subjects of this study. In addition, data about other technologies is also collected and analyzed for advanced understanding of the study.

### 2.5.1 How do auditors use software?

Auditors use information technology to assist in audit tasks such as analytical review, financial ratio tools, internet searches, and to prepare electronic work papers amongst other uses (Janvrin et al., 2008). Computer Assisted Audit Techniques<sup>3</sup> (CAATs) refers to the use of technology to perform audit services. CAATs are widely used for both internal and external audits. Sayana (2003) classifies CAATs into four broad categories; data analysis software, network security evaluation software/utilities, OS and DMBS security evaluation software/utilities, and software and code testing tools. This classification merely considers an internal audit<sup>4</sup> viewpoint; moreover, Sayana only considers software or programs in his categorization.

#### 2.5.1a Audit processes

Auditing is a systematic process which includes audit planning, control testing, substantive testing, and reporting audit opinions (Konrath, 2002) (Figure 2.5A). The current uses of IT in audit work are mainly for number crunching and reporting. Auditors use off-the-shelf software such as MS-Office and GAS for footing and balancing data, stratifying and selecting samples from data for testing, screening and scanning data for errors, and recalculating data fields (Hall, 2000, Janvrin et al., 2008).



<sup>3</sup> Some use Computer Aided Audit Tools and Techniques (CAATTs)

<sup>4</sup> Internal auditing is different from external audit (independent auditing). Internal auditing serves management, while independent auditing serves third-party financial statement users. However, they are similar in that both involve collecting and evaluating evidence relating to audit assertions (Konrath, 2002)

### *Audit planning*

Audit planning involves the preliminary acquisition of a client's information and the assessment of inherent risk and materiality. Most audit planning and risk assessment procedures are done manually. Auditors start with talking with the client's management and others, obtaining the relevant information and recording it in a work paper. Additional analytical procedures, observations, and inspection are also recommended by ISA 315 (2005). Results from the preliminary interviews with audit firms in Thailand are consistent with Manson et al.'s (1997) study. Auditors rarely use IT during the planning process. The only contradiction is for the analytical procedures, which Mason et al. (1997) found a low-level of use whilst the preliminary interview showed a higher level. The uses are still considered low since the auditors insisted that they preferred planning manually. This might be affected by the time period since the preliminary interviews were conducted in 2004. Word-processing applications are the most popular for recording, detailed planning, and preparing documents. In addition, spreadsheets are commonly used for calculating ratios and preparing lead schedule in this audit planning phase. Knowledge database were shown to be the lowest used technology (Manson et al., 1997).

### *Control testing*

Auditors usually obtain information about a client's accounting information systems from interviewing key personnel and from observing how the controls are conducted (ISA 315, 2005). Then auditors record information as a flowchart or using internal control checklists. Internal control testing is done to test whether the client's staff follow the existing controls. IT available to help auditors conduct their study and test of controls include flow-charting applications and testing applications such as ACL. Manson et al. (1997) showed very low uses of flow-charting applications. To date, there is no study or survey which shows usage of these applications. The preliminary interviews showed the rapid increase in the usage of audit applications in Thailand. Auditors enjoy the easy-to-change features of these applications compared to the manual approach. The primary area that

auditors use IT in the controlling phase is transactions testing. Bierstalker et al. (2001, 2003) showed that the use of IT for internal control evaluation and transactions testing increased by 100% from 2000 to 2003.

### *Substantive testing*

Substantive testing is the most important in audit work. Auditors test detailed balances of each account and some transactions in order to ensure that the financial statements are free from material errors. Substantive testing involves massive number crunching work and rigid audit techniques. As part of audit procedures, data mining become an important technique in this phase. The recent studies (Bierstalker et al., 2003) show a dramatic increase in the usage of data mining techniques and related technology by auditors. Even though spreadsheet applications have been adapted and dominate the analysis tool market, they lag behind other applications such as ACL and IDEA in the data extraction tool (Glover et al., 2000).

### *Reporting audit opinions*

During this phase, auditors make a judgment about their opinion of the client's financial statements and prepare the report. A word-processing application has been shown as a primary tool at this phase (Manson et al., 1997, 2000). However, from the preliminary interviews, spreadsheet applications partly replace the word-processing application because of their ability to make calculations and to provide links between the numbers in reports and financial statements.

## **2.5.2 Audit technology**

According to Weber (1999), audit software is classified into 3 broad categories: off-the-shelf software, artificial intelligence, and specialized software. Off-the-shelf software includes generalized audit software (GAS) such as Audit Command Language (ACL) and Interactive Data Extraction and Analysis (IDEA), industry-specific audit software, high-level languages, and utility software. Two types of

software that have their root in artificial intelligence are expert systems and neural networks. Specialized audit software refers to the software developed by auditors to meet their own needs.

Besides types of audit software classified by Weber, auditors have adapted MS-Office tools in their audit procedures. The audit software usage survey (Chapman, 2002; Glover et al., 2000) identified Microsoft Office, Excel and Access, were used as much as general audit software such as ACL and IDEA. While the office suite dominates half of the automated work paper, internally developed software and Teammate dominate the other half. Besides being used as a data extraction and analysis tool, MS-Excel has also been used as a risk analysis tool.

Spreadsheets such as MS-Excel are chosen in this study because most auditors used spreadsheets in their work and Microsoft Office 2003 (and 2007) including an Excel spreadsheet is included as recommended software for CPA firms (Johnston, 2009). A professional journal, the Journal of Accountancy devotes a regular column on how to use Excel for auditors.

#### *2.5.2a Risk Assessment tools*

In the past, audit works mostly involved testing the validity of transactions and balances. Recently, auditors focus more on risk that might lead to errors in financial statements. Risk assessments are conducted throughout the audit processes.

Risk-based auditing refers to the audit approach that focuses on the risks of businesses and their impact on the financial information (Bell and Wright, 1997). Auditing standards require, as part of audit planning, that the auditor assess the risk of misstatement when deciding the audit procedures to be performed.<sup>5</sup> In traditional audit processes, auditors assess risk by inquiring clients' for necessary information, analyzing information, evaluating clients' internal control and testing the control in order to tailor an audit program to ensure that material errors in clients' financial statements. Risk assessment procedures need high audit skills because they deal

---

<sup>5</sup> AICPA Professional Standard, section AU316.

with several variables and factors. Manually, auditors make a judgment based on their own viewpoint. Audit qualities vary depending upon how much experience an audit team has. Making an inaccurate risk assessment might result in over-auditing or under-auditing. Guidelines and checklists have been used as risk assessment tools to help auditors make an accurate judgment.

The decrease of technology costs means most businesses can increase their use of electronics. Technologies such as electronic data interchange (EDI), Internet, and electronic fund transfers (EFT), become common to all business. These technologies eliminate the traditional audit trails. They make risk assessment process more sophisticated. Computerized risk assessment tools have replaced guidelines and checklists which are not effective to deal with complex transactions. Most risk assessment tools fall into the artificial intelligence category. However, there is some off-the-shelf software available such as OptionFinder and Know Risk®.

Decision support systems (DSS) are one of the most computerized audit tools in use. DSS helps a decision-maker decide on a situation that is rapidly changing and not easily specified (Laudon and Laudon, 2007). DSS such as expert systems (ES) and neural networks (NN)<sup>6</sup> enable auditors to incorporate all inter-related variables in assessing risk. Calderon and Cheh (2002) review research in risk assessment using neural networks. They found several researches which studied the application of NN during risk assessment process. An example of how NN is used to support risk assessment is found in Davis et al. (1997). Davis et al. (1997) analyzes the process of building a prototype intelligence-based system for the application to a complex problem within the field of control risk assessment. The system is designed as an expert network that combines ES and NN. Generally, ES incorporates general audit theories using a logical set of explicit rules. NN is used to recognize the patterns among the large number of inter-related variables. These variables were collected from the experiences of audit managers and partners who perform auditing for several years. By combining the deductive reasoning approach

---

<sup>6</sup> Neural network (NN) is a model that uses complex algorithms to evaluate many pieces of information simultaneously when making classifications or predictions.

of an ES with the inductive approach of NN, an expert network is able to assist auditors in assessing clients' internal control risk.

In many audit firms, computers are used to generate control templates which help auditors identify the strengths and weaknesses of a client's internal control. Auditors simply input data into DSS, DSS then generates sets of report showing the control that is present or absent from the client's systems. The systems store industry benchmarks or best practices for comparison to the set of data input by auditors. The major advantage of the systems is that instead of relying on an audit teams knowledge or expertise, the systems gather knowledge or expertise from audit partners and managers globally and make them accessible to everyone using the software. (Bierstaker et al., 2001) Another advantage is their efficiency and their abilities to quantify results which would otherwise be rather subjective when using a single team judgment (Glover et al., 2000).

A survey conducted by Glover et al. (2000) of 2,700 internal auditors who use technology in their work reports that more than 36 percent of respondents used internally-developed decision-support software which was more suitable for their operation than an off-the-shelf product. Most audit firms collect their knowledge from experienced partners and managers and develop the application from system shells. This kind of software includes Risk Control Workbench (PricewaterhouseCoopers LLP), Information and Control Understanding System; Infocus (Grant Thornton) and Visual Assurance (Deloitte & Touche LLP). OptionFinder is reported as the most used software in a survey of Glover et al. (2000) Some firms have taken knowledge management to a more advanced level by developing a database that can be used at all stages of the audit.

#### *2.5.2b Testing applications*

Testing applications refer mostly to data extraction and analysis software. In a traditional audit approach, testing transactions and balances involves vouching and tracing. Auditors begin their tests by conducting some mathematical and statistical analysis of the entire data. Then analytical review and scanning techniques are used to identify possible exceptions. The tremendous amount of data makes this work

very difficult. Auditors rely on sampling techniques to draw conclusions by examining only a portion of an organization's transactions and events.

Identified as one of the most important technologies in 2004 (AICPA, 2005), Data mining is the act of searching through databases for relationships that might help when making business decisions. Online analytical processing (OLAP) is the ability to extract data from a database and view it from different perspectives (AICPA, 1999). Using technology, auditors can conduct auditing over the entire population. The technique can be applied to other functions such as monitoring slow-moving inventory.

Data extraction and analysis tools allow auditors to use data mining techniques by going through the clients' systems to collect electronic audit evidences (EAE) instead of asking clients to deliver printouts in MS-Excel format. The software can also manipulate data and conduct various types of analysis using a data mining technique. Most software also includes an analysis tool such as Benford's law<sup>7</sup> which helps alert auditors to possible errors, potential fraud, manipulative biases, costly processing inefficiencies or other irregularities. (Drake and Nigrini, 2000)

Sampling is another area that has mostly been done by a manual approach. Dealing with data counts and statistical calculations sampling procedures take lots of time. However, a computerized system can complete a sampling procedure in a few seconds.

#### *2.5.2d Audit work papers management*

Audit work papers constitute the principal record of the evidence that the auditor has gathered and evaluated in support of the audit opinion.<sup>8</sup> Generally, audit work papers consist of two types, permanent files and current files. Permanent files contain papers that have ongoing significance; while current files support only the period being audited (Konrath, 2002). All of the work papers are linked by indices.

---

<sup>7</sup> Benford made some physics-related assumptions about the distribution of naturally occurring data and, using integral calculus, he computed the expected frequencies of the digits and digit combinations in order to identify possible errors in the data

<sup>8</sup> AICPA, Professional Standards. Section 339.



Traditionally, auditors prepare work papers, index them, and gather them together in the proper audit files. Clients' important documents are photocopied and kept for future reference. This approach creates large amounts of papers and a storage problem.

Audit work papers management is used widely in audit firms. Sometimes, it is referred as a paperless audit if all the papers are stored electronically. Most of the paperless management applications come with files organizing function and database management systems. Software in this category includes ACL, IDEA, Pro system fx (formerly ePace), TeamMate, Lotus notes, and other Office suites (such as MS-Excel, MS-word). Electronic work papers have several advantages. The work paper information can be shared via network and communication software. Moreover, audit firms can save storage space, which is becoming more critical (Bierstaker et al., 2001). The work papers allow auditors to download files and review them whenever and wherever they want (Kahan, 2001).

Glover et al. (2000) found that more than 20 percent of their survey participant reported no use of electronic work papers; meanwhile, 46 percent adapt Office suites for audit documentation purposes. Spreadsheets and Word Processing were the most commonly used for electronic work papers.

#### *2.5.2e Other technologies used in auditing*

The study of Manson et al. (2001) showed that technologies were also used as a control within audit organizations. AICPA Professional Standards require audit firms to design and implement a quality control system. A quality control system is the firms' organizational structure and the policies adopted and procedures established provide the firm with a reasonable assurance of conforming to professional standards.<sup>9</sup> Audit automation enhances the control of the audit process. It is used to ensure that audit staff follow the procedures laid down by completing a checklist. Computers can be programmed easily to check whether audit staff follow the audit program and all the work is completely done. Tools such as E-mail and internal communication tools like Lotus-Notes enable various

---

<sup>9</sup> AICPA Professional Standard, section QC 10.

communication channels among audit teams. This communication ensures that staff work closely under a partner's supervision. The study also finds that the use of audit automation as a control within the quality assurance process would inhibit the use of auditor judgment that is so highly valued by audit firms.

Computer-mediated communication technology (CMC), such as Lotus Notes and Microsoft networks, are also used to share files and knowledge and to communicate between staff in audit firms especially when the firm use the bulletin board feature since it is highly organized (Murthy and Kerr, 2004).

### **2.5.3 Technologies in big firms and small firms**

Big audit firms utilize their own knowledge by using internally developed technologies; while small firms mostly pick off-the-shelf software for their use (Bierstaker et al., 2003). PricewaterhouseCoopers also sells such technologies to their clients (Bierstaker et al., 2001); while Deloitte Touche and Intacct Corp. teams up with their clients to develop E-Practice, an online auditing systems based on Deloitte's content and auditing tools for small and medium size CPA firms Rezaee et al. (2001). For an enterprise-wide system, such as CMC, Menezes (1999) and Lamont (2000) report evidence of it being used by large public audit firms, but small firms. CMC is a tool that facilitates work and knowledge sharing among firm members.

Even though cost is a big concern, small firms do not hesitate to implement the latest technology when they find that the technology can improve their effectiveness and efficiency. Several examples of the uses of technology especially audit workpaper management systems have been given (Pheland, 2003; Lombado, 2002; Kahan, 2001; Stevens, 2003 and 2000). In some case, the firm also markets its product, Secure Information Available Now (SIAN)<sup>10</sup>, to other audit firms.

---

<sup>10</sup> SIAN is software based on the requirements of Habif, Arogeti, and Wynnee LLP's (an audit firm in Atlanta, GA) technology committee and is developed by an external developer.

#### **2.5.4 Auditors and technology**

Even though auditors realize the importance of technology in audit work, auditors are still slow to adopt technology into their work (Janvrin et al., 2008). The first reaction of auditors to technology was suggested by the study of Cash et al. (1977). Auditors choose audit-around over audit-through system. Audit-around-computer means that auditors do their work by examining the source documents and reports for the system instead of by examining the reliability of the computer systems. Psychological factors were examined by Davidson and Hart (1995). They found that auditors have the psychological resources necessary to accept change and innovation in their profession, and thus that the personality profile was not responsible for the slow adoption of new audit technologies. Johnston et al. (2005) commented in their article that the major obstacle to the electronic work papers was not technology; rather, it was the resistance to the re-engineering of business processes and the mind-set of the users. There were also studies that paid attention to a particular software such as ACL and Decision Support Systems (DSS).

Even though DSS has been proven to increase the efficiency of audit judgments, the study of Abdolmohammadi and Usoff (2001) showed that for the majority of audit tasks, highly-experienced auditors completed them manually. Eining et al. (1997) examined the influence of the use of DSS on audit assessment of the risk of management fraud and the appropriate selection of action by conducting a control experiment. They found that auditors who used the systems were able to make decision regarding the additional audit actions that were more consistent with their assessment of risk than the auditors who did not use the systems. However, auditors are still reluctant to use technology. Fisher (1996) examined the outcomes of using technology in audit work and found that the effectiveness of the systems depends on how much they conform to the current audit practices. One of the big international audit firms discontinued the use of DSS because it was used as an additional requirement, rather than a replacement to a traditional risk assessment process (Fisher, 1996). A study of continued and discontinued use of OptionFinder, which is one of the off-the-shelf software used in auditing, in another profession suggested that the users discontinued the software because it lacked task-

technology fit and because of the perception that OptionFinder is a large group tool (Pollard, 2003). These factors supported Fisher's (1996) findings.

The previous literature always assumes that IT implementation for auditors was beneficial but there was no study defining what the benefit is for auditors. The only possible explanation for how successful IT implementation and infusion in the firm was could be found by using Fisher's (1996) idea. If auditors do not realize the benefits of using IT, the fullest potential of IT usage will not be achieved.

## **2.6 CONCLUSION**

The review of literature suggests that a deeper understanding of IT infusion is required in order to help SMEs which are subject to limited resources, make the best out of a technology investment. Technology diffusion among professionals is another under-researched area. Even though professionals realize the benefits of technology, facilitating conditions are required in order to help professional firms use technology to its fullest potential.

Three major conclusions are drawn from the previous studies. Firstly, there is no unified idea of what IT infusion is. In addition, the different perspectives of the IT infusion definition may lead to incomparable research studies. This may give inconsistent findings. Secondly, all prior studies used survey questionnaires as a major research approach. They tested factors cited from previous literature of organizational innovation processes and rarely yield significant statistical results. They might have missed the real factors contributing to IT infusion. This fact indicates that the information system literature requires more in-depth studies that generate a set of IT infusion enablers. Finally, previous studies tended to classify IT infusion into three or four broad levels that took into account too many aspects of IT infusion. A more valid measure is needed in order to make statistical inference.

# **CHAPTER 3**

## **RESEARCH OBJECTIVES, RESEARCH QUESTIONS AND RESEACH DESIGN**

In this chapter, research objectives and research questions are developed based on the research gaps determined during prior studies reported in Chapter 2. The chapter begins by introducing the research gaps from prior studies before developing research objectives and research questions. The research design is then introduced, followed by the selection of appropriate context for this study. The Expectations are also used to develop the research protocol in order to ensure a rigorous approach for the positive case study research. The case study method is used primarily to construct a model from real business settings. The second phase of the study involves using a survey questionnaire to empirically test the model with a larger sample size. The development of the survey instrument is presented in Chapter 7. An outline of this chapter is given below.

- 3.1 Research gap
- 3.2 Research objectives and research questions
- 3.3 Research methodology
- 3.4 Research design
- 3.5 Research context and site selection process
- 3.6 Conclusion

### **3.1 RESEACH GAP**

The review of literature covered in Chapter 2 calls for additional knowledge of IT infusion and IT success. Prior IT infusion studies rarely yielded significant statistical results. This may have been because they did not include relevant factors to be tested in their study. As stated earlier, prior studies based their factor models

on diffusion and implementation, literature which may be less relevant to the infusion stage. In addition, the measures used by prior studies may be too broad to be applied to statistical tests. The summary of research critiques, research gaps, and suggestions are shown in Table 3.1A

Critiques	Research gaps and suggestions
1. IT infusion is treated as a final stage of an innovation implementation process. There are no absolute definitions or ideal characteristics of IT infusion stage. The phase “fullest potential use” is abstract and cannot be applied in practice.	IT infusion is a complex phenomenon that requires addition synthesis of constructs and dimensions. It should not be viewed as a single concluding stage in an innovation process. In-depth understanding of IT infusion level is also needed.
2. Prior studies tested IT infusion enablers that were found in IT diffusion and implementation literature and rarely yielded significantly statistical results.	IT infusion enablers may not be similar to those of IT diffusion and implementation but were tested as such in prior studies. Additional grounded studies are required in order to identify missing factors.
3. The insignificant statistical results may come from the fact that prior studies have used improper infusion measures or a broad level of classification. A narrow range of IT infusion values may not be suitable for quantitative studies.	There is a need for a valid IT infusion measure which can be used for a statistical test. The measure should incorporate all the most important dimensions of IT infusion.

Table 3.1A: Critique of prior studies and research gap

Critiques	Research gaps and suggestions
4. Most IT infusion studies at an organizational level of analysis pay attention to a large specific application, implemented within a large corporation environment. All other studies are conducted at an individual level of analysis.	There are no empirical studies conducted in a small business context. Therefore, additional studies are needed since a small business has some unique characteristics that large-organization-based research cannot be applied

Table 3.1A: Critique of prior studies and research gap (continued)

Review of auditing literature also shows that there is a big gap in auditing and technology research. Two relevant research streams about technology and auditors exist. The first stream aims to develop computer-assisted audit tools as decision aids to assist auditors in planning and evaluating associated inherent and control risks. The second research stream aims to convince audit firms to integrate technology into their work. Most studies in audit and technology area pay attention to the first stream and how technology and tools affect audit judgment and performance (e.g. Eining et al., 1997; Arnold et al., 2006). There are some studies on the practical uses of technology in auditing (e.g. Bedard et al., 2003; Dowling and Leech, 2007) and only a few studies on how IT is managed in audit firms (e.g. Manson et al., 2001). There are very few studies examining technology acceptance and implementation in audit firm (Davidson and Hart, 1995; Curtis and Payne, 2008); however, those that do exist focus on an individual level of analysis.

In conclusion, research gaps exist in both IT infusion and auditing literature. This study aims to fill in a knowledge gap in both fields.

### **3.2 RESEARCH OBJECTIVES AND RESEARCH QUESTIONS**

According to Jones (2004), an organization uses technology firstly to manage and control stakeholders, secondly to increase the success of its attempts to innovate and develop new products and/or services, and thirdly to reduce cost and increase efficiency within organizational activities. During the past decade, significant investments in technology have been made in order to achieve organizational objectives. Auditors have used computer-assisted audit techniques (CAATs) to increase the efficiency and effectiveness of audit engagements; however, the research in this area suggests that the techniques are under-utilized. IT was used in small parts of audit work and was sometimes omitted (Davidson and Hart, 1995; Eining et al., 1997; Manson et al., 2001).

#### **3.2.1 Research objectives**

The primary objective of this study is to model IT infusion in small and medium sized audit firms. Since prior studies suggested several other research gaps and issues that are related to the primary objective, this study also develops secondary objectives in order to achieve the primary objective. The issues raised in prior research include the lack of a unified definition of IT infusion and the valid measures at the organizational level of analysis. This study also aims at providing a better understanding of an organizational innovation process and IT infusion. Additionally, this study aims to construct a valid measure for IT infusion studies at the organizational level of analysis.

#### **3.2.2 Research questions**

In order to achieve the primary objective of modeling IT infusion, the research objectives are arranged into research questions as follows:

1. What is IT infusion?
2. What are IT infusion enablers? How do the enablers contribute to IT infusion at various stages or levels?



3. How can IT infusion be measured with validity and consistency?

### **3.3 RESEARCH METHODOLOGY**

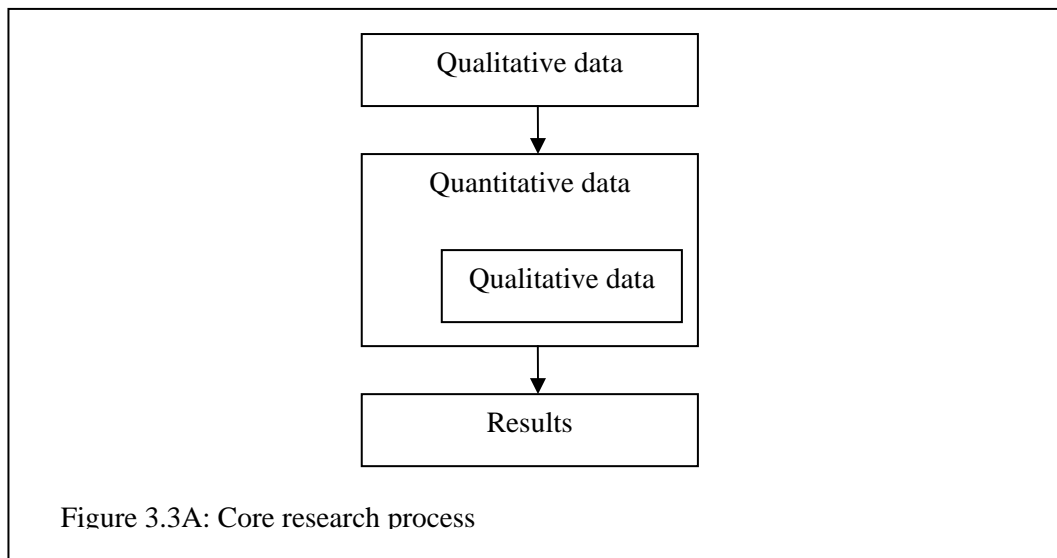
The research approach in this study is developed in order to obtain answers to the research questions. The mixed methods research approach (Creswell, 2003) is chosen in order to provide a better understanding of the under-researched area of infusion. The mixed inquiry and analysis techniques are used to collect and analyze the data.

#### **3.3.1 Research method**

The underlying concept of the mixed methods is the collection of both qualitative and quantitative data in order to triangulate the results and provide a better understanding of the phenomenon. Creswell explains about the mixed methods as follow.

*“The mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data in the research process. As a method, it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone.”* (pp. 5).

The overall research process is shown in Figure 3.3A. The research process begins with qualitative studies that help identify the missing contexts from previous research. The quantitative method is built on the results of the qualitative studies in order to validate the results. As suggested by Creswell, the mixed methods are used to connect the data during the core research process. The qualitative data is also embedded in the quantitative dataset during the final analysis of the study in order to report a full understanding of IT infusion process and enablers.



A series of case studies will be used as the primary technique during the first phase of this study. Case studies are used for identifying IT enablers in real business settings. Quantitative data is collected using the survey questionnaire approach. The selected research approaches are discussed as follows.

### *3.3.1a Case study methods*

This study uses the case study method as a primary approach. Case study research is appropriate for research objectives of an explanatory nature, which attempt to answer how and why questions (Yin, 2003). Little is known about technology infusion in small businesses, especially small and medium sized audit firms, so a series of exploratory case studies is needed. Yin also suggests that the case study is more appropriate than an experiment where there is no control over the environment, because the focus of the research is on determining technology infusion determinants in a natural setting. Case study research is also particularly suitable for problems where research is in the early stage (Benbasat et al., 1987). Many small and medium sized audit firms are in the stage of adopting and adapting new technologies for audit work.

In-depth structured interviews are used as the primary method of qualitative data collection. Additional data collection methods, such as observation and documents, are used for the purpose of triangulation of the results (Jick, 1979). Observations of

how auditors use technology in audit work are made in the field. Sample work papers are obtained (when permitted). This study follows Dube and Pare's (2005) suggestions to:

- identify clear research questions
- Specify clear rationale for case selections
- Use a pilot case study to refine the design and the data collection plans
- Provide detail information with respect to data collection methods and procedures (e.g. the use of interview protocol (as shown in Appendix A)).
- Use tables to summarize information about the data collection process.
- Use multiple-source data collection and data triangulation in order to increase internal validity of the findings.
- Use of multiple researchers.
- Provide clear descriptions of the analytic methods and procedures.
- Present sufficient quotes so that external observers can reach independent judgment.
- Compare findings with extant literature so as to increase confidence of the findings.

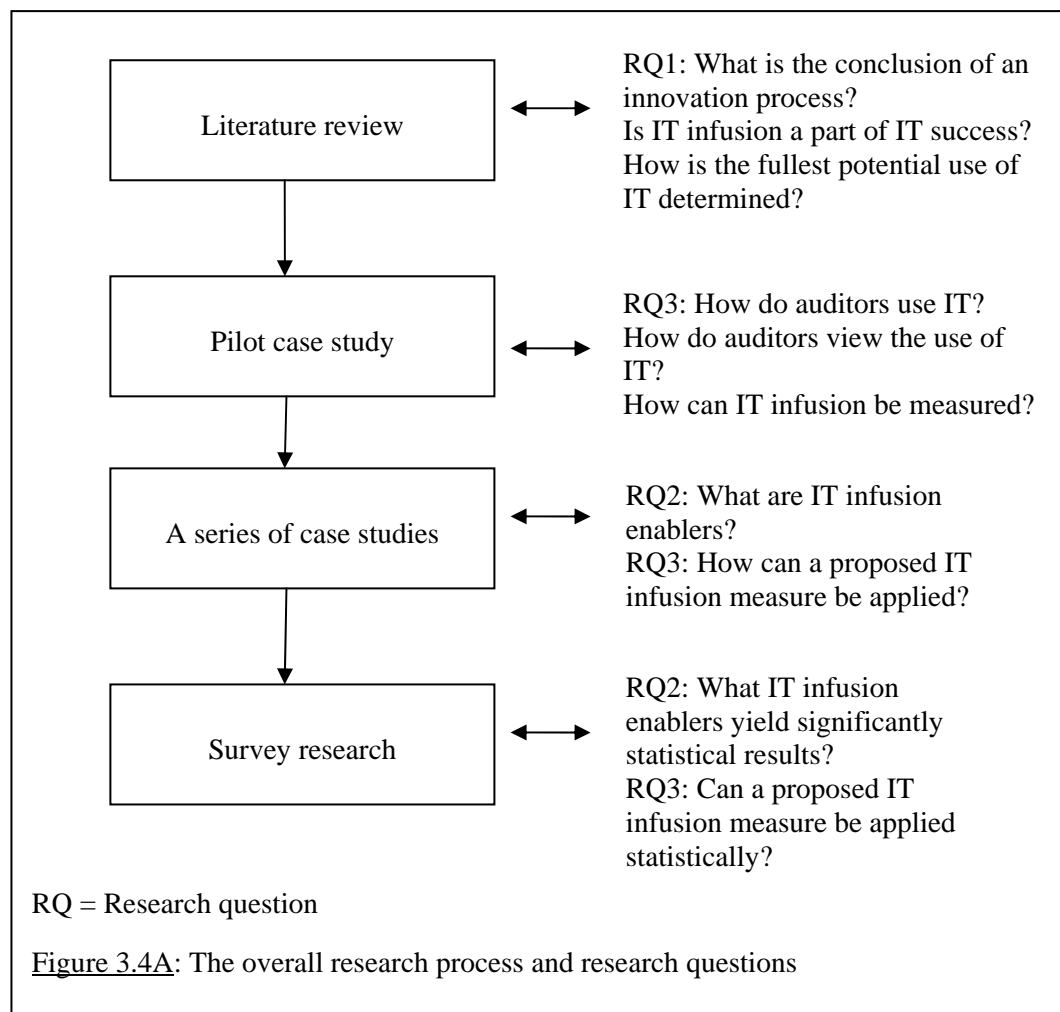
### *3.3.1b Survey research*

*"A survey design provides a quantitative or numeric description of attitudes, or opinions of a population by studying a sample of that population"* (Creswell, 2003). The questionnaire approach has been widely used for providing empirically quantitative studies in technology infusion (Zmud and Apple, 1992; Caster and Ferguson, 1998 and 2000; Eder and Igbaria, 2001; Chang and Lung, 2002; Jones et al, 2002).

*"Survey research is very useful, but it is greatly improved when used in conjunction with other research methods"* (Kraemer, 1993, pp. xvi) The purpose of using a survey research in this study is to confirm the proposed model of information technology infusion derived from the qualitative data, by providing quantitative data. The mixed methods (of case studies and survey research) in this study offer in-depth understanding of IT implementation.

### 3.4 RESEARCH DESIGN

The study is designed by applying a rigorous and appropriate research approach in order to answer the research questions set in the previous section. An overall process of study is shown in Figure 3.4A. The case studies method begins with the pilot case study. The pilot case is expected to be an explanatory study of how auditors use and view technology in their work. The data from the pilot case is analyzed in order to propose an infusion measure that is related to the study context. Seven further case studies are conducted and the data analyzed in order to construct an IT infusion model. The survey instrument is, then, developed in order to test the proposed model of IT infusion. The qualitative and quantitative data combined and analyzed for a full understanding of the study.



### **3.4.1 Designing case studies.**

The development of case study design in this study seeks to maximize construct validity, external validity, internal validity and reliability. Yin's (2003) and Dube and Pare's (2005) suggestions are used throughout the studies to ensure a rigorous approach in positive case study research. The multiple case studies which are used as a primary qualitative research method in this study are divided into two phases. The pilot case is conducted in order to fully understand how auditors use technology in their work and their views toward levels of use of technology. The results from the pilot case are used for the construction of an IT infusion measure and to develop a case study protocol for the additional case studies.

#### *3.4.1a The pilot case studies.*

Since the primary reason for conducting the pilot case study is to explore how auditors use and view technology in their work, the pilot case is selected because it is the biggest local audit firm in Thailand which exhibits an extensive and various use of technology. Even though convenience, access, and geographical proximity are not the main reason for the pilot case selection, the research still gain full access to the pilot case. The inquiry for the pilot case is much broader and less focused than the inquiry of other case studies. However, the prolonged interviews enabled the research to gain full detail on the topic.

The pilot case study is conducted as an open-end interview in a less formal format. The main research questions for the pilot cases are 1) what technologies do they use in audit work?, 2) how do they use them?, and 3) and how do they view the level of use of those technologies? Additional questions about firm profile are also used. The pilot interview protocol is included as appendices.

#### *3.4.1b The case studies*

An analysis of the pilot case study gives detail of how auditors use technology and how auditors view the use of technology in their work. The case studies protocol is, then, developed as a guideline for the case studies. The interview protocol is set up to target the research questions. In-depth interviews are used as a major data

collection method. Meanwhile, observations and sample documents are used for the purpose of triangulation. Two researchers are used (when possible) in order to clarify the answer and ensure validity of the analysis (Dube and Pare, 2005).

- Study questions: Case studies are used to answer the following research questions
  - Research question 2: **What** are IT infusion enablers?
  - Research question 3: **How** can IT infusion be measured?
- Propositions: Even though the case studies are done with an exploratory purpose, some propositions have been included as part of the questions. For example, earliness of adoption is found to be an IT enabler in prior studies (Zmud and Apple, 1992; Eder and Igarria, 2001); therefore, the interview protocol includes a question about how long since the firm has adopted the particular technology and some basic questions that link organizational characteristics to IT infusion.
- Unit of analysis: The study protocol is developed in order to analyze the data at an organizational level. The questions are asked in order to get the answers that best represent the firms' situation. The infusion enablers are for the individuals in the business most literate on spreadsheets, compared to an industry benchmark. However, the uses of spreadsheets by the individuals may not reflect uses across organization (diffusion), which has not been measured in this study.
- The logic linking of data to the propositions: Patterns matching and replication logic are used as a method of analysis in this study.
- The criteria of interpreting the finding: Most developed questions are straight-forward. Therefore, a complex technique is not needed to interpret the findings.

Replication logic is used throughout the process of case studies. The significant results from existing cases are reformed into expectations for future cases. Even though some researchers (e.g. Eisenhardt, 1989) suggested eight case studies as a rule of thumb, the replication logic suggests the study continue with cases until

most results have been replicated. Therefore, an additional case would not contribute new knowledge or results. Thus, number of cases cannot be determined at the case study design stage. In order to apply a replication logic approach, the case report and within-case-analysis of each case must be done before conducting further case studies.

### **3.4.2 Developing interview protocol**

An interview protocol is developed based on research questions proposed in section 3.3. Open-ended interviews are used in order to collect data that has not existed in the literature. The interview questions are set as main questions, follow ups, and probes (Rubin and Rubin, 2005) in order to ensure that the answers to research questions are obtained with a reasonable depth and width. The guidelines for a rigorous case study research approach (Yin, 2003; Dube and Pare, 2005) also suggest that prior expectations are formed based on available literature. The expectations help set up follow-ups and probes where the interviewees cannot give enough information based on the main interview questions. The interview protocol design contains an introduction and a conclusion as suggested by Rubin and Rubin (2005). The interview protocol is shown in Appendix A. The interview questions are divided into six parts, introduction, organization profile, defining IT infusion (RQ1), how auditors use technology in their work, and determining IT infusion enablers (RQ2).

- Introduction: This section includes the introduction by the interviewer (s) and the introduction of the study.
- Organization profile: The questions about the organization are asked. The interviewee is free to speak. However, the follow ups and probes are used based on expectations developed from the prior studies. For example, the interviewees are asked about firm structure and IT supports which are found to be IT infusion enablers in prior studies (Winston and Dologite, 1999; Eder and Igbaria, 2001).

- Defining IT infusion: The question asks the interviewees to describe organizational infusion process based on the tea bag analogy.
- How auditors use technology in their work: Referring to the audit process, the interviewees are asked to describe how they integrate technology into their tasks during the process. The information is used for the formation of the IT infusion measure.
- Determining IT infusion enablers: The interviewees are asked to state the IT infusion enablers or inhibitors that could or would have affected their firms use of the technology to its fullest potential.
- Conclusion: This part is used for obtaining additional comments from the interviewees. In addition, as recommended by Rubin and Rubin (2005), the interviewees may be able to think of additional comments on previous questions.

### **3.5 RESEARCH CONTEXT AND SITE SELECTION PROCESS**

This study aims at proposing an IT infusion measure and modeling IT infusion in a small business context. Professional accountancy firms are selected as subjects of the study.

In order to answer the research questions set in the previous section, the case firms were selected from a pool of small audit firms in Thailand. The case firms were chosen using a maximum-variation-cases approach based on information-oriented criteria (Flyvbjerg, 2006). This approach allows this research to study various factors at different IT infusion levels. The total number of case firms was determined by successively selecting and analyzing case studies until the addition of a new case did not yield new insights.

Three factors are relevant when choosing a field research site: richness of data, unfamiliarity, and suitability (Neuman, 2006). The exploratory purpose of this qualitative study adds a criterion as selecting negative cases of a phenomenon, or context in which the outcome of interest is possible but has never been found (Mahoney and Goertz, 2004). One exceptional advantage of this study is that the



research has full access to most audit firms in Thailand. Therefore, the selected cases are not limited by accessibility as most research studies are.

The selected firms share some common characteristics such as tasks performed and the business environment. These shared characteristics control some factors, such as organizational structure and culture whilst enabling the testing of the measurement constructs and other factors. Despite the common characteristics, the case firms were chosen to vary in size, IT infrastructure, IT support, and other factors claimed to affect an organizational innovation process (and IT infusion) from prior studies. The different cases were expected to yield a range of IT infusion levels.

### **3.6 CONCLUSION**

In this chapter, research gaps were identified in order to form research objectives and research questions. Then, appropriate research methodologies were chosen. Based on the research objectives, modeling IT infusion at early stage and qualitative approaches, case studies are needed. The interview protocol is developed as a part of a rigorous research process. Observations and documentation are also used as a data collection approach for the purpose of triangulation.

Quantitative studies are used as a later phase in order to test the proposed model and measure. In addition, the mixture of qualitative and quantitative data enables this study to explain in-depth findings which has never previously been done by IT infusion literature.

# CHAPTER 4

## THE PILOT CASE STUDY

### AND DEVELOPMENT OF IT INFUSION MEASURE

This chapter reports evidence found in early phases of this study, which are the results from the pilot case firm. The pilot case firm, a medium-sized audit firm in Thailand, used a wide range of computer applications in audit work. In-depth interviews were used as a major approach for data collection. The interviews were conducted with two senior partners, an audit manager, and two audit assistants. The data was also triangulated with observations of how auditors in the pilot firm used computer applications in real business settings. The triangulation ensured a rigorous qualitative approach for the case study research.

This chapter first presents evidence from the pilot case study, focusing on how auditors in the firm use technology to support their work. The next section focuses on the uses of spreadsheets. Then, the concept of audit task complexity is introduced and the pilot firm's uses of spreadsheets are mapped to the audit task complexity concept. The last section proposes the measures of IT infusion. The outline of this chapter is as follows:

- 4.1 The pilot firm
- 4.2 Technology used during the audit process in the pilot case firm
- 4.3 IT infusion enablers and inhibitors in the pilot firm
- 4.4 The lesson from the pilot case
- 4.5 The concept of audit task complexity
- 4.6 The proposed IT infusion measure
- 4.7 Conclusion

#### **4.1 THE PILOT FIRM**

The pilot case study is a medium-sized audit firm located in Bangkok, Thailand. Founded in the late 1980's, the firm initially had two staff who resigned from international audit firms to pursue their own professional careers. The firm currently has approximately 200 assistant auditors and 20 administrative staff spreading over two branches in downtown Bangkok. The firm also has an alliance with an international firm. The benefits of having an alliance are an opportunity to service multi-national corporations and the knowledge transfers among allies. However, the firm only uses the benefit of getting multi-national clients. There are no knowledge transfers or joint resource development between the firm and its international ally. The firm actively participates in accounting and auditing societies in Thailand and is considered to be one of the leaders in the small and medium sized audit firm sector.

The firm provides most assurance services such as statutory audit, special audit and due diligence. Unlike other audit firms, the firm does not provide accounting services. The firm has approximately 1,000 clients; 500 clients are considered to be medium to large sized companies. The firm's partners are also certified to provide service for companies listed in the stock exchange of Thailand (SEC). The firm's audit fees range from approximately THB 8,000 (NZD 400<sup>1</sup>) for dormant companies to THB 2,000,000 (NZD 100,000) per year for listed companies. Reviews of interim (quarterly) financial statements of the listed companies are charged separately, for an average of THB 100,000 (NZD 5,000). The firm's clients operate in various industries. Manufacturing, retailing, real estate, insurance, and finance companies are all major clients of the firm. However, since the economic crisis in Thailand in the late 1990's, the firm has audited less finance institutes<sup>2</sup>. The firm does not provide services for the banking industry. A partner claimed that it was beyond the firm's ability to perform services for a commercial

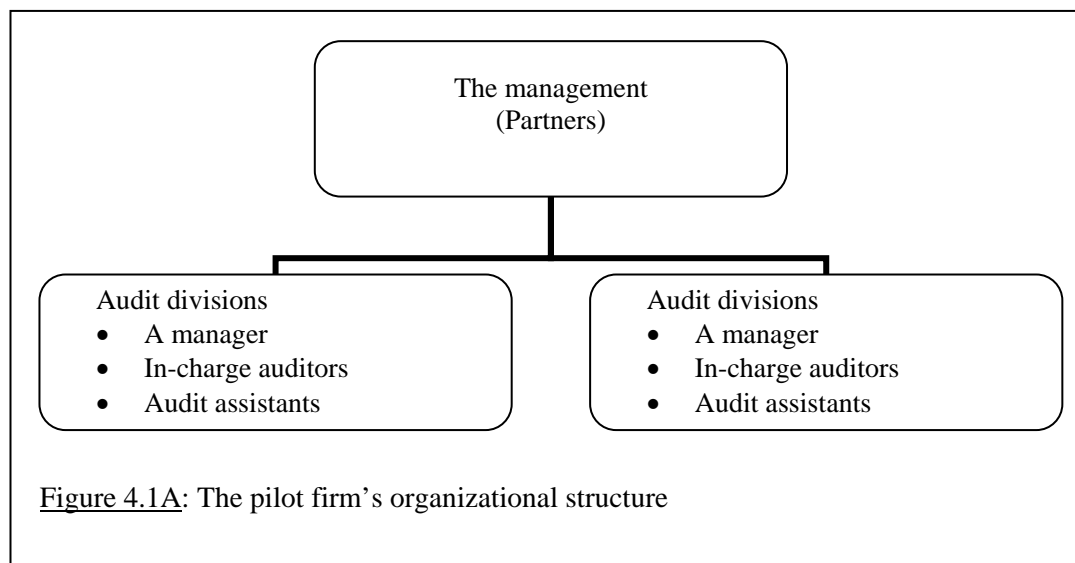
---

<sup>1</sup> The exchange rate is approximately NZD 1: THB 20

<sup>2</sup> During the economic crisis in Thailand in the late 1990's, more than 50 finance institutes were closed.

bank since a bank operates using sophisticated technology; it was not worth developing special skills for servicing only one bank.

The firm is managed by two full-time managing partners. Other partners are part-time auditors who share the profits of the firm but are not involved in the firm's decision making. The firm's structure is similar to other audit firms. Staff are grouped into 13 divisions. Each division has a manager, three to four in-charge auditors, and audit assistants. Figure 4.1A shows the structure of the pilot firm.



Managers of audit divisions are responsible for day-to-day operation and decision making. They report significant matters directly to managing partners. The partners claimed that even though the firm was big, all staff could talk to managers or managing partners directly if they had issues. The firm is operated in a family-like environment. Budgeting is done for the purpose of calculating clients' charges which are based on estimated time spent for the services, but not for the purposes of managing the organization. Decision making for small investment can be made by audit managers; however, any major investment decisions are made by managing partners.

Functionally, the firm consists of two main sections, auditing and administrative departments. All audit staff hold at least a bachelor degree in accounting; they are competent with personal computers and Microsoft Office applications. The firm has no internal information technology (IT) support. A freelance IT consultant is

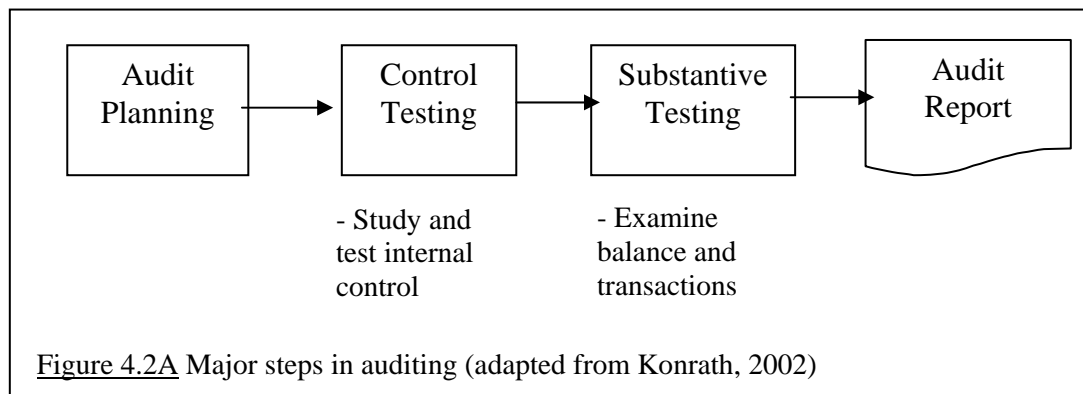
called and paid when services are needed. Relatives and ex-staff also help the firm when asked for help. The staff turnover is low compared to international audit firms.

The firm has made significant investments in IT since 2000. Laptop computers and Microsoft Office applications are commonly used by audit teams. The firm's staff can buy personal computers with firm's subsidies. A local area network (LAN) and an internet system have been implemented. The staff have developed their own approaches of using IT in their work. There are no guidelines or standard procedures proposed by the firm to apply IT in audit works. In 2002, the firm bought a single license of a commercially-available audit application named audit command language (ACL). However, staff use ACL on a very limited basis.

#### **4.2 TECHNOLOGY USED DURING THE AUDIT PROCESS IN THE PILOT FIRM**

In Chapter 2, Information technology used in auditing was classified into three broad categories; off-the-shelf software, artificial intelligence, and specialized software (Weber, 1999). Off-the-shelf software included generalized audit software (GAS), industry-specific audit software, high-level languages, and utility software. Two types of software that had their root in artificial intelligence were expert systems and neural networks. Specialized audit software referred to the software developed by auditors to meet their own need.

The initial interviews with the firm's partners and a manager showed that the firm used off-the-shelf and utility software. Two of the most important off-the-shelf software, MS-Excel (a spreadsheet application) and audit command language (ACL), were used in most audit work. Other software, including word-processing and other utility applications, was used in administrative systems. The firm was also engaging in developing a spreadsheet-based risk-assessment application with a few other audit firms. This study used Konrath's (2002) major steps in auditing (Figure 4.2 A) to describe how technologies were used in audit work. Table 4.2A summarizes technologies that were used in audit work in the pilot firm.



In all audit phases, auditors in the pilot firm claimed that the most common and basic use of spreadsheets and ACL was for number crunching. However, some of the low-IT-skilled auditors used spreadsheets for recording purposes. Data mining, such as statistical analysis, was claimed to be a more advanced level of use. The highest level was viewed to be the use of IT for making judgements and performing risk-assessments.

#### **4.2.1 Audit planning**

Audit planning involves preliminary acquisition of a client's information and assessment of inherent risk and materiality. Most audit planning and risk assessment procedures are done manually. Auditors take their first step by talking with the client's management and others in order to obtain related information, and writing it down in a work paper. Additional analytical procedures, observation, and inspection are also recommended by ISA 315 (2005).

In the pilot case, there were no guidelines of how to use technology during the planning phase. Spreadsheets were used for preliminary analytical reviews. The spreadsheets were used mainly for calculating figures for analytical procedures. Evidence showed that some audit assistants also recorded audit evidence in the spreadsheets. Several customised spreadsheet-based and end-user applications were also used. However, the managing partners believed that technology could offer suggested audit procedures but they did not make any comments on whether they

would use the technology. All audit assistants were free to use their own approaches and developed any application to suit their tasks. The interviews also showed that the firm was participating in a group of audit firms to develop a spreadsheet-based risk-assessment application. There was no evidence of the use of technology for audit management during the planning phase. Staff planning and assigning were done manually based on staff availability and locations of the clients' sites. Even though evidence showed that staff-planning charts were prepared using spreadsheets, the spreadsheets were used mainly for recording and printing the charts. The firm did not have special software to organize and assign staff to the jobs.

#### **4.2.2 Control testing**

Auditors usually obtain information about a client's accounting information systems from interviewing key personnel and from observing how the controls are conducted (ISA 315, 2005). Then, auditors record client's information using flowcharts or internal control checklists. Internal control testing is done to test whether the client's personnel follows the existing controls. Technology that is available for auditors to obtain clients' internal control systems and test the controls includes flow-charting applications and transaction-testing applications such as ACL.

In the pilot firm, internal control evaluating and testing were mostly done manually. The evidence from the control testing was recorded in paper-based work papers. However, some auditors in the firm used spreadsheets or word-processing to record such information. For clients with large transactions, ACL was used for testing the transactions. The audit manager claimed that there was no other way to perform this kind of test on significant transaction volumes. Meanwhile, the new techniques offered by ACL were integrated and applied to other clients' transactions by adapting some spreadsheet functions and commands. For example, an audit manager used a combination of a filter and a pivot table to perform data mining. However, these applications were not standardized since the firm had no guidelines for how to use IT for control testing.

#### **4.2.3 Substantive testing (Test of balance)**

Substantive testing is the most important in audit work. Auditors test detailed balances of each account and some transactions in order to ensure that the financial statements are free from material errors. Substantive testing involves massive number crunching work and rigid audit techniques.

In most fieldwork, audit teams used spreadsheet-based end-user applications for number crunching (footing and cross-casting accounting figures). With scanning technique and personal experience, auditors also used spreadsheets to help identify unusual balances or transactions (auditors have learnt this technique by using ACL). Spreadsheets were claimed to shorten time spent on audit work and enable auditors to deal with a large amount of data. On the other hand, spreadsheets could not be used for testing an extremely large amount of data. ACL was used to handle certain clients where there were significant amounts of data. For servicing clients who operated retail businesses which had a large numbers of small transactions, ACL was used for simple calculation such as footing, cross-cast calculating, and testing calculation. It was also used for preliminarily scanning for errors. Since ACL was designed specifically for audit work, it offered various functions and commands which, later on, served as examples of how spreadsheets could be used in auditing.

ACL was used by a single audit team and a part-time auditor. All team members had used ACL for a while. However, all team members did not know how to fully utilize the application. The firm used ACL for performing their work on two clients with point-of-sales (POS) computer systems and for clients in the hire-purchase industry. A part-time auditor who had experience using ACL and who was working as an internal auditor for an insurance company was hired specifically for auditing clients that operated hire-purchase businesses. ACL was used for searching for exceptions in hire-purchase contracts such as duplicated contracts, contracts guaranteed by the same person, and/or contracts made by the same customer or his or her relatives. These procedures were also called data mining techniques.



There was no evidence of using or tending to use a decision support system during substantive testing in the pilot case firm.

#### **4.2.4 Reporting audit opinions**

During this phase, auditors make judgments about what opinions should be given about the client's financial statements and they prepare the report. Auditors also prepare financial statements to compare with those prepared by their clients.

In the pilot case, there was no evidence of the use of any judgement tools or technologies. Audit opinions were given based on each partner's individual judgment. The firm used a simple word processing application to prepare and print the report. Spreadsheets were not used during this phase. The final financial statements were checked manually by auditors. The audit manager realized that spreadsheets could be used to prepare financial statements; however, the firm followed the old approach for preparing reports.

#### **4.2.5 IT used in other function**

The firm also used customised application for an accounting function. The application was used for preparing invoices for clients.

#### **4.2.6 Use of others off-the-shelf software**

There was no evidence of using other off-the-shelf software in audit work. Utility software such as Anti-virus software was used but not for an auditing purpose.

Type of IT Audit phase	Spreadsheet- based applications	ACL	Decision support systems	Other technologies
Planning	Preliminary analytical reviews	Preliminary analytical reviews	None	None
Control Testing	Testing transactions	None	None	None
Substantive Testing	Mathematical calculation	Mathematical calculation, Simple data mining	None	
Reporting	None	None	None	MS Word is used for preparing audit report

Table 4.2A: Summary of IT used in four audit phases

### **4.3 IT INFUSION ENABLERS AND INHIBITORS IN THE PILOT FIRM**

This section discusses both IT diffusion and infusion enablers in the pilot case firm at an organizational level of analysis. The analysis of IT diffusion enablers enabled a better understanding of the organizational infusion process.

#### **4.3.1 IT diffusion enablers in the pilot firm**

Findings from the pilot case study showed that the firm had adopted and used general technology and general audit tools. However, general audit tools had been

used selectively. Important organizational IT enablers were trialability (cost), adopters' characteristics, and relative advantages (perceived benefits) of information technology (IT). For audit tools, technology characteristics such as relative advantages were the most important. Academic institutes and training were identified as IT enablers that encouraged diffusion rate. Diffusion channels were professional institutes and other auditors. On the other hand, language barriers were found to be an IT inhibitor that made auditors reluctant to attend a training course. Other inhibitors were cost, limited resources, time constraints, lack of training, and complexity of technology.

#### **4.3.2 Within-case analysis and IT infusion enablers and inhibitors**

The evidence from the pilot case firm showed that training, the innovation characteristics, external network, management involvement, and individual attitudes influenced the firm's IT infusion. For a newly adopted technology, ACL, basic training and support were claimed to be key enablers for advancing the use of ACL to a higher level. However, the firm did not invest in any of these enablers. Meanwhile, major inhibitors included the software complexity and the lack of management support in the form of resources and time. On the other hand, the complexity of ACL, a substitute program, acted as an IT infusion enabler for spreadsheets.

The spreadsheets' relative advantage was a key enabler. Once auditors realized the advantages, they kept exploring how to use spreadsheets. The observability and complexity of ACL was also stated as an important spreadsheet enabler. ACL which was designed specifically for audit works gave auditors ideas of how audit tasks could be performed electronically. Therefore, the auditors learned to reconceptualize audit tasks via IT from ACL. However, the complexity of ACL pushed auditors to apply and develop spreadsheets in order to perform the same tasks.

#### *4.3.2a External support and professional network*

Even though the firm did not use external IT support, the firm used external experts to perform auditing within the clients' complex computer environment. The firm did not get benefits from knowledge-sharing and transfer between external experts and staff members. Therefore, an external support was not considered an infusion enabler since the firm did not complete the knowledge transfer process. This evidence is consistent with the existing literature (Cragg and King, 1993; Thong et al., 1996) which showed that the reliance on external support might not influence an innovation process if the firm had not established a knowledge transfer process.

Other external sources of knowledge include informal and formal professional networks (Johnston and Linton, 2000). In the pilot firm, the network was established at the management level. Since the management claimed that they were computer-illiterate, they could not act as IT knowledge intermediaries between the firm and the networks. The possible explanation is what Rogers (2003) called homophily. "Homophily is the degree to which a pair of individuals who communicate are similar" (Rogers, 2003, pp.305). Rogers explained that homophily could act as a barrier to a flow of innovations. Innovations are diffused through members of the network that share common beliefs, mutual understanding and attitudes. The high degree of homophily means a member will communicate to another member that is the most similar to him or her. In this case, the management could not communicate well with other auditors in the network about IT-related concerns.

#### *4.3.2b Training*

Training was claimed to be a key IT infusion enabler in the pilot firm. The staff stated that they did not have proper training. Even though the management tried to provide training, especially on computer techniques for auditing, the staff were reluctant to join any training session. They believed that IT training did not yield a good result since they could not communicate what they needed to IT trainers very well. In addition, for ACL, the training sessions were only offered in English so staff experienced a language barrier. This situation is also consistent with what

Rogers (2003) explained as heterophily. “Heterophily is the degree to which pairs of individuals who interact are different in certain attributes.” (Rogers, 2003, pp.306) Heterophily is also one of the inhibitors for both spreadsheets and ACL. Being reluctant to join a training class, auditors perceived that the trainers spoke different languages (both technical and national languages). Most software trainers had computer backgrounds and stepped into more advance detail than auditors expected. Auditors wanted to be trained in what they wanted to do, not something they could do. Evidence from the software dealers showed that they realized the problem and tried to provide trainers with an auditing background.

#### *4.3.2c Knowledge about task-IT integration and substitute software*

The lack of knowledge of how to integrate technology into audit work was also a major inhibitor. The evidence from the pilot case suggested that knowledge about task-IT integration could be obtained by the use of substitute software, ACL. Since ACL was designed specially for audit work, it integrated many audit techniques which were considered new to auditors in the pilot firm.

The evidence above was consistent with Saga’s (1994) findings that the ability of people to reconceptualize tasks via IT was positively related to IT infusion. As an antecedent of ability to reconceptualize tasks via IT, ACL offered knowledge on how audit tasks could be done with IT. The characteristics of ACL had mixed effects on IT infusion of spreadsheets. The infusion of spreadsheets increased because auditors gained an ability to reconceptualize tasks from the use of specific software. However, if the specific software posted a high degree of relative advantage, the auditor might discontinue the use of spreadsheets.

#### *4.3.2d The management*

As claimed earlier, the management viewed themselves as computer illiterates who they rarely got involved even though they wanted to give full support to IT use. In addition, they revealed their attitudes through the fact that they might not follow the results of the risk-assessment application that they were developing. Since

some high-level audit tasks were only done by the management, the spreadsheets would not be able to reach infusion without solving the management skills and attitude issues.

#### **4.4 THE LESSON FROM THE PILOT CASE**

The pilot case showed a wide range of computer applications being applied to audit tasks. ACL gave auditors ideas how spreadsheets could be used in audit tasks. The evidence of ACL and spreadsheet use in the firm was used to develop an interview script for the case studies. In addition, the use of spreadsheets in the pilot case gave examples of how spreadsheet use could be advanced from an early stage of implementation to later phases.

Evidence from the pilot case also suggested that spreadsheets had been widely used by auditors while the auditors had used ACL for a short period of time. In prior study, Eder and Igbaria (2001) found only a few IT infusion enablers and claimed that they studied intranet infusion when it was first introduced and that their study was conducted too early. Therefore, spreadsheets were selected as a context of this study in order to yield a wide range of infusion levels. This will make this study contribute a valid measure and a valid model of IT infusion.

The next few sections discuss and develop a new measure based on the use of spreadsheets in the pilot case firm by integrating the concept of audit task complexity.

#### **4.5 THE CONCEPT OF AUDIT TASK COMPLEXITY**

Bonner (1994) suggests that task complexity can be thought of as a function of the task itself or as an interaction between task and attribute (skills, knowledge, etc.) of the person who performs the task. In addition, two individuals may perform the same tasks differently in term of approaches, steps, and information required. Therefore, task complexity can result from the natural characteristics of tasks or from requirements imposed by humans (Bonner, 2008).

Bonner (1994) integrated the concept of task complexity into an audit context. According to Bonner, audit task complexity can be examined by an input-process-output perspective. A task is more complex when the amount of data required in input, process, and output is large or when the data required is unclear. Building on Bonner's work, Abdolmohammadi (1999) took into account factors that determine audit task complexity and classified audit tasks into three categories: structured, semi-structured, and unstructured tasks. A structured task is a task in which problems can be well-defined and solved with limited cues and procedures. An unstructured task has the opposite characteristics to those of a structured task. Semi-structured tasks have a combination of both. Abdolmohammadi (1999) found a relationship between task complexity and the rank of the auditor who performed the task. His findings are consistent with findings from an earlier phase of the current study. In the context of small audit firms in Thailand, higher ranked auditors performed more complex tasks than lower ranked auditors did. Since auditors follow standard audit procedures, this study focused on task characteristics.

When applied to measuring the extended use dimension of IT infusion, the concept of task complexity helped categorize audit tasks according to their complexity. It not only distinguishes the level of use but also takes into account a sequence level of technological and task configurations. The higher level of use implies that lower levels of use and technological configurations have been achieved. For example, it is impossible for auditors to use spreadsheets for analyzing data (a higher level), by using calculation features and functions, without first recording data (a lower level), by using simple keystrokes and basic open and save commands, as a prior step.

## **4.6 THE PROPOSED IT INFUSION MEASURE**

A measure of IT infusion was developed based on the three pathways of use: extended, integrative, and emergent use. The measure was operationalized as follows.

### ***4.6.1 Measuring extended use***

Data from the pilot case study showed that auditors generally use spreadsheets to record and calculate necessary figures for their work. In some cases, auditors use spreadsheets to do judgment-related work; for example, data mining and preparing data for making judgments on some issues. The higher levels of use, given by the pilot case's auditors, included predefined procedures, risk assessment, and applications that help the auditors make judgments. The pilot case study also suggested that audit tasks can be classified into four-levels of use based on the concept of task complexity. These four levels are tasks that require no skill, structured tasks, semi-structured tasks, and unstructured tasks. In each audit phase<sup>3</sup>, the highest infusion score was four, which shows that auditors use spreadsheets at all levels within an audit phase.

#### ***4.6.1a Recording information -- basic skill required (a low infusion level – score one)***

The lowest level of application of spreadsheets in audit work is to record information obtained from clients. This task requires only basic computer knowledge and typing skills. The spreadsheet has been used in the task with formatting the only features used.

---

<sup>3</sup> Auditing is a systematic process, consisting of a series of sequential steps/phases that include planning, testing of control, testing of balance, and reporting an audit opinion (Konrath, 2002)



*4.6.1b Preparing and calculating figures – Structured tasks (a moderately low infusion level – score two)*

This application of spreadsheets involves some calculation and mathematical functions. Basic audit and spreadsheet skills are needed to perform the task. Some spreadsheet features are used. For example, during audit planning, auditors use spreadsheets to calculate financial ratios in order to make decisions on the subsequent audit approach. During the test of controls, auditors may sort and prepare data or calculate some figures for further sampling or the test of controls procedure. During the test of balance, auditors calculate necessary figures for analysis. In the reporting phase, auditors use spreadsheet features to calculate figures and prepare financial statements.

*4.6.1c Advanced application – semi-structured tasks (a moderately high infusion level – score three)*

The application of spreadsheets at this level requires moderate auditing and spreadsheet skills. It may require models and information similar to those that constitute decision support systems (DSS). The following provide examples of use at this level. During the planning and control testing, auditors use models to do risk analysis. During tests of balance, auditors apply spreadsheet features in order to test accounts. Advanced reporting such as cash flows and consolidated financial statements preparation is considered a semi-structured task in the final audit phase. These applications include some complex references and features in order to prepare the report.

*4.6.1d End-user application (EUA) – Unstructured tasks (a high infusion level – score four)*

The developed application needs sophisticated auditing and spreadsheet skills. The auditor needs to take into account possible cues and structures of the tasks and features that they can use to develop the application. Some unstructured tasks are judgment- related. Auditors try to incorporate their knowledge into the application. The application of spreadsheets at this level can be shown by the additions, such as

the incorporation of Macros and Visual Basic programming, into making decisions during audit planning, control testing, balance testing, and reporting phase. The development of standardized audit processes and lead schedules is considered to be an EUA. Table 4.6A shows how the proposed model is applied to measure extended use.

The proposed IT Infusion measurement includes all possible audit tasks as categories and takes into account successive levels of technological and task configurations. Data from the pilot case study showed that users may apply different features in order to complete the same tasks. This issue comes from the interaction between human attributes and task complexity as discussed earlier. Based on a dimension of a higher level of features used (Castner and Ferguson, 2000), this study proposes that when two cases (subjects) are compared, features that assist users to complete the tasks with higher efficiency indicate a higher level of infusion.

#### ***4.6.2 Measuring integrative use***

Integrative use reflects the degree of interconnectedness within organizational work flows. The basic idea is that the data is entered once and flows from one task to others. A closed-loop system is where the data flows from the audit planning phase to the reporting phase. This study focused on measuring the interconnected work flows among the 16 audit-task categories identified in Table 4.6A. The scores were counted separately within audit phases and between audit phases. The within-phase interconnectedness is shown by carrying data over from one level to the next level. For example, during tests of balance, auditors record data into audit lead schedules (task category one - recording) and the data is carried over with cell references to be manipulated for further analysis within the same phase (task category two – manipulating data). Between-phase measurement is evaluated separately. Observations of the pilot case study showed that spreadsheets did not need to be used to the highest level of the phase in order for the output to be carried over as input to the next phase. The evidence of interconnectedness between phases is already given when the data is transferred from one phase to others. For example,

Table 4.6A: The score of extended use

	Planning	Test of control	Test of balance	Reporting
Applications of spreadsheets to audit tasks sequenced by task complexity	<ul style="list-style-type: none"> <li>- Recording (1)</li> <li>- Manipulating data (2)</li> <li>- Risk assessment (3)</li> <li>- Making judgment and developing audit program (4)</li> </ul>	<ul style="list-style-type: none"> <li>- Recording (1)</li> <li>- Manipulating data (2)</li> <li>- Risk assessment (3)</li> <li>- Making judgment and developing audit program (4)</li> </ul>	<ul style="list-style-type: none"> <li>- Recording (1)</li> <li>- Manipulating data (2)</li> <li>- Test of balances (3)</li> <li>- Predefined procedures (4)</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing reports (1)</li> <li>- Basic reporting (2)</li> <li>- Advance reporting (3)</li> <li>- Judgment reporting based on audit opinions (4)</li> </ul>

Extended use score

- (1) Spreadsheet is used for recording audit evidence or clients' information without any manipulation. Spreadsheet features are rarely used to assist audit task. Only basic IT skills are needed.
- (2) Spreadsheet is used for simple calculations. Spreadsheet features are used to assist audit work. Audit tasks are mostly structured.
- (3) Spreadsheet is used for testing balance and transactions. DSS may be developed to assist audit tasks. Combination features have been used. Audit works are mostly semi-structured.
- (4) Spreadsheet is used as EUA. Spreadsheet is developed to store knowledge and make inferences, similar to a human expert. Audit work is mostly unstructured.

auditors pull out analytical data manipulated during the test of control phase and carry the data over to compare with analytical figures calculated during the test of balance phase. This indicates a between-phase link and was given a score of one. The highest possible integrative use score is 15, of which 12 may be counted from the within-phase interconnectedness (three from each phase) and three from interconnectedness between the four phases.

#### ***4.6.3 Measuring emergent use***

Emergent use reflects new uses that are not possible without spreadsheets. In order to realize real benefits of IT and create a competitive advantage, the firm has to reconceptualize or reinvent tasks, which may not be possible without IT, concurrently with technology (Saga, 1994; Fischer 1996). According to Sullivan (1985) and Cooper and Zmud (1990), the infusion stage occurs when IT has strategically penetrated the firm and the IT is used for running the business.

Consistent with this view, the current study adopts the view that the infusion stage is where the firm uses IT strategically to run the business in order to create competitive advantage. Data from the pilot case study showed that auditors applied technology in order to assist the completion of many audit tasks. However, some tasks, such as data mining, could not be performed manually. Saga (1994) operationalized the measurement of emergent use by counting IT uses that created a competitive advantage for the business. Respondents were asked a series of questions to indicate whether they used IT for specific tasks identified by the researcher. These tasks were believed to create competitive advantage. This is problematic because the study may have omitted applications.

This current study proposed that the measurement of emergent use be based on the firm's attitudes toward IT use. The use of IT strategically to create competitive advantage is the highest level of emergent use. In order to distinguish different levels of emergent use, this study borrowed from the work of Fischer (1996). Fischer suggested that, in order to realize the real benefits of IT, auditors need to change the audit approach concurrently with the technology. A lower level of

emergent use is where auditors adopt a new approach/idea offered by the technology in order to realize a higher benefit of IT. This is followed by the use of technology to improve the efficiency of existing works (audit approaches are not changed). The pilot case study shows that some auditors who cannot reconceptualize their work still enjoy the benefit of spreadsheets for increased effectiveness and efficiency. The emergent use score was based on the following:

Level 0 – technology is used to assist existing works (no emergent use)

Level 1 – technology is used to improve efficiency of existing works

Level 2 – technology offers a new approach/ new idea to the work

Level 3 – technology is used strategically to create competitive advantage for the firm

#### **4.7 CONCLUSION**

The pilot case study was used in order to test the research objective and develop a research instrument as suggested by Dube and Pare (2003). The pilot case study was a medium-size audit firm in Thailand. It used a wide range of computer applications enabling this study to draw significant expectation for the case studies.

External support and network, training, knowledge of task-IT integration and the management were identified as key IT (spreadsheets) infusion enablers. The information about how the organization obtained knowledge from external sources required an extensive investigation.

## CHAPTER 5

### WITHIN-CASE ANALYSIS

Chapter 5 presents detail from the seven cases along with the analysis of spreadsheet infusion enablers and inhibitors from each case. Seven case firms were selected from a pool of small audit firms in Thailand. The interviews were arranged with a few staff members who were most literate on spreadsheets of the case firms. Additional observations were made and sample work papers were collected as possible. The staff members who participated in the interviews are as follows:

Firm	Interviewees
Firm A	A partner who is responsible for IT used and represents the highest use of spreadsheets within the firm.
Firm B	A director who is responsible for IT used and represents the highest use of spreadsheets within the firm  An audit team which was composed of a manager and two audit assistants.
Firm C	The managing partner who represents the highest use of spreadsheets within the firm
Firm D	A manager who is responsible for IT used the highest use of spreadsheets within the firm

Table 5A: The staff member who participated in the interviews

Firm	Interviewees
Firm E	<p>The managing partner who is responsible for IT used and represents the highest use of spreadsheets within the firm.</p> <p>An audit team which was composed of a manager and two audit assistants</p> <p>An external IT consultant</p> <p>A technician</p>
Firm F	<p>A manager who is responsible for IT used and represents the highest use of spreadsheets within the firm</p> <p>A managing partner</p>
Firm G	A manager who represents the highest use of spreadsheets within the firm

Table 5A: The staff members who participated in the interviews (continued)

The result shows that the case firms share a few common characteristics. However, they are different in terms of organizational factors and the management. These firms have different infusion levels and claim a variety of enablers and inhibitors. An outline of this chapter is presented as follows.

- 5.1 Firm A
- 5.2 Firm B
- 5.3 Firm C
- 5.4 Firm D
- 5.5 Firm E
- 5.6 Firm F
- 5.7 Firm G

## **5.1 FIRM A**

Firm A is a small audit firm located in Bangkok Thailand. The firm was founded about ten years ago by three auditors who worked for a big international audit firm. The interviewee joined the firm about four years ago.

The firm employs approximately 30 staff. The turnover of the firm is approximately Baht 20 million (NZD 1 million). Less than half of the total income comes from assurance services. The firm services to more than 100 clients with the fee ranging from Baht 10,000 (NZD 500) to Baht 300,000 (NZD 15,000). The firm's clients operate mainly in manufacturing and trading industry. The firm does not provide for clients services which are subject to special regulations such as banks, financial institutes, and companies listed in the Stock Exchange of Thailand (SET). Most audit services are performed during March – May of each year due to most clients' fiscal year end on 31 December.

The firm has an organizational structure that is common among audit firms. There are three divisions; accounting, auditing and administration. Accounting and auditing divisions have approximately 14-15 staff. Audit staff are ranked as partners, managers, supervisors, senior auditors, and assistants. They are responsible for different parts of auditing. Since the firm is small, there is no clear cut audit team or group.

The firm is managed by four partners. The firm's operation is planned and executed by the partners. Staff are supported with necessary computer facilities (e.g. laptops) to perform their work. MS-Windows and MS-Office are standard packages on their machines. The firm uses an external technician to provide computer-related support. The technician visits the firm as requested and only provides support for computer hardware.

### **5.1.1 Use of spreadsheets**

There is no evidence when spreadsheets were first adopted by the firm. However, it is believed that MS-Excel or spreadsheet-like applications have been used since the



firm's beginning or approximately 10 years ago. Spreadsheets are used mostly by assistant auditors who perform fieldwork.

During four-broad audit processes which are audit planning, test of control, test of balance, and audit report, spreadsheets have been used mainly for testing balance. The firm uses spreadsheets to record audit evidence and to calculate necessary figures. The areas where spreadsheets are used the most are preparing lead schedule, testing inventory balance, and testing fixed assets balance. Lead schedules are predefined templates set by the firm. Normally, assistant auditors obtain a client's trail balance and input figures into an input section; then, templates automatically classify figures into auditing and financial statement formats. A predefined model in the template also determines the materiality level for auditing. For testing the inventory balance, the interviewee gives an example of reconciliation of beginning and ending inventory balance and cost calculations. The beginning and ending balance are entered and reconciled with purchases or manufactured inventories. The calculations of manufacturing costs are also on the spreadsheets. Sales prices after balance date are collected and recorded in spreadsheets in order to compare the costs and net realizable values or inventories. A reconciliation of beginning and ending balance is also a primary use for audit of fixed asset accounts. In addition, spreadsheets are used for calculating fixed asset depreciation.

Spreadsheets are not used during the first two phases which are the audit planning and the test of control. During the planning phase, the possible application of spreadsheets is as analytical and risk analysis tools. However, the firm does not do those two audit tasks during this phase. The interviewee states the reason:

*“Most clients are recurrent. We do not do much for audit planning or test of control. Clients usually notify us of usual transactions. For a new client, we usually get to know the client by talking to the clients and short note the information. We obtain financial information and identify risk but we do not calculate ratios or do a full analytical review.”*

During test of control the firm may use spreadsheets as recording devices. *“Instead of using paper-based work papers, we use spreadsheets to record the test.”* The

result is read and interpreted by experienced auditors in order to set up audit strategies for the test of balance phase. The firm monitors the clients closely. Therefore, the firm generally knows what clients have done during the year. There is no need to use complicated procedures to evaluate risk. The work papers are also printed and put in box files. The firm also gives reason for not using spreadsheets during the test of control phase as follows:

*“We do not do the first two procedures. Clients use small accounting software. We do not need full test of control. We do more of test of transaction during the final audit course.”*

Spreadsheets are not used to make judgments on client's financial statements. The interviewee explains that after finishing audit fieldwork, auditors discuss possible errors and adjustments required for the client's financial statements. The client usually agrees with most adjustments proposed by auditors; therefore, the firm views that a judgment-related application is not necessary.

The uses of spreadsheets in audit process are mostly discreet. Auditors use spreadsheets in each phase separately. The interviewee states a possible reason that auditors still get used to the process before implementing technology for example:

*“Auditors prepare the financial statements by printing out the previous-year financial statements, crossing the previous year figures by hand, and replacing them with the current year figures. Therefore, when Excel is used to prepare financial statements, it is used separately from the working papers module.”*

Other applications include a valuation template and a budget control worksheet for each client. A valuation template involves the collection of cash flows information that is necessary for valuing asset values. In terms of the firm administrative work, spreadsheets are used to record and control budgets for each clients.

### **5.1.2 Spreadsheet enablers and inhibitors**

The interviewee states that the firm is satisfied with the current level of use of spreadsheets. Most of the firm's clients are small and their transactions are simple. The firm, therefore, does not formally perform audit planning and test of control.

However, spreadsheets can be used to support the first two phases, the planning and the test of control. The firm will be forced to use spreadsheets more if the firm has clients that are listed in the Stock Exchange of Thailand (SET). According to SET regulations, auditors must conduct a risk assessment as part of audit procedures. The interviewee claims:

*“We may need to do so if we have a new client which is subject to more regulations. We will be checked whether we follow Security Exchange Commission’s (SEC) regulations as an auditor. We may need to use Excel more in the planning and the test of control phase”*

In order to use spreadsheets in audit tasks, especially in the first two phases, the firm requires training from experienced users. The firm wants to know how other firms, especially the big international firms, use spreadsheets to support audit work. The interviewee also claims that a higher application of spreadsheets can be done through a self-study. Auditors usually search through internet and read spreadsheet manual in order to solve existing technical problems. The interviewee cites how auditors learn how to use functions Vlookup and Hlookup from a web site as an example.

The interviewee also gives an example of how internet and world-wide web can help perform audit services by referring to a valuation template. The firm was originally asked to perform special asset valuation services. The template was obtained from publicly-shared information in an academic institute. An inhibitor is not given since the interviewee claims that the firm is satisfied with the current use of spreadsheets in audit work. However, the interviewee mentions the firm’s staff turnover which causes learning processes stop at some point.

### **5.1.3 The fullest potential use of spreadsheets**

Neither the fullest potential use of spreadsheets nor a next step of using spreadsheets can be identified by the interviewee. The interviewee is satisfied with the current level of use.

*“We know that Excel is very powerful but in our work we do not need all capabilities that it offers”*

The application of spreadsheets is problem-driven. The auditors do not learn or explore how to use spreadsheets in their free time. Most of new uses come from the fact that auditors need to solve existing problems during their work.

#### Measuring infusion of spreadsheets

The evaluation of Firm A yields an infusion score of six (five for extended use score and one for integrative use score). These score are given based on how many task categories spreadsheets are integrated into, the links between work flows, and the attitudes toward using the spreadsheets.

In addition to the score above, the infusion of spreadsheets in the firm can be measured in two approaches. The first approach asks a respondent to rank the level of use relative to the fullest potential use within a firm. The second approach asks how the respondent's firm uses spreadsheets; the answer is then mapped to the possible uses of spreadsheets given by literature. The answer to the first-approach questions which rate the application of spreadsheets relative to the firm's potential use in terms of the interviewee's opinion give a high infusion level. However, the firm will show a low level of infusion if it is rated with the second approach.

Based on an extended use perspective of IT infusion, the firm only uses spreadsheets to support test of balance. Spreadsheets are used for recording and calculating figures which are considered a low level of infusion. Even though the firm uses spreadsheets in a very limited area, it cannot conclude that the firm has a low level of infusion. The results are mixed since the firm does not perform some audit tasks that may involve a higher level of use of spreadsheets; especially during the audit planning and the test of control phases.

In term of an integrative use, spreadsheets do not promote the interconnectedness among audit procedures. Audit tasks are performed separately; an output of one task does not electronically become an input of another task. For example, auditors do not link the auditing figures from work papers to the financial statements. Consequently, there was evidence showing that the figures from work papers are different from those on the financial statements since the financial statements are manually drafted from the work papers.

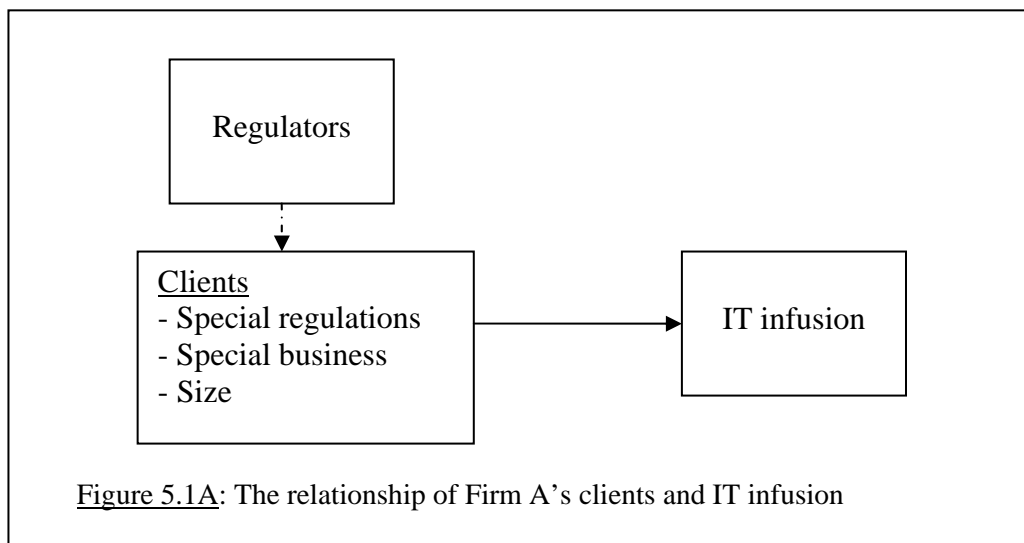
An emergent use cannot be identified by the interviewee. Auditors view spreadsheets as a tool that facilitates audit work. Spreadsheets are used as a tool and mapped into existing tasks. The use of spreadsheets is task-driven. Therefore, auditors apply only features that facilitate traditional auditing approaches.

An external environment factor which is a special type of client of the firm tends to create a gap between a self-report measurement and a use-related measurement. The differences between the self-rating infusion and the use-related infusion can be explained by how auditors view technology. In a traditional infusion definition given by Sullivan (1985) which was used and applied by Cooper and Zmud (1990), Hahn and Weber (1995), and Castner and Ferguson (2000), infusion was also based on the importance, impact, and significance of technology to an organization. In terms of the firm's technological strategies, auditors view technology as a tool that saves audit time and costs. This also affects the measurement of an extended use and an emergent use. Since there are no tasks that require the use of technology, auditors will not explore a higher level of spreadsheet use. In addition, there is no new approach of auditing resulting from the use of new technology.

#### Spreadsheets enablers and inhibitors

Clients, observability, and training are stated as spreadsheet infusion enablers. The existence of particular types of clients contributes to IT infusion in two ways. A client that is subject to special regulations, for example, a financial institute or a listed company, require more complex audit procedures. Meanwhile, a bigger client who has a lot of transactions or a client whom operates in a special industry may

have some uncommon transactions. Those clients need application of spreadsheets in more sophisticated way (Figure 5.1A).



Even though training is claimed to help auditors integrate spreadsheets in audit procedures, technological training alone cannot help auditors use spreadsheets more. The application of spreadsheets to support audit work is a main concern. An ability to observe how other auditors use technology to support their work help the firm to increase the use of spreadsheets. This is consistent with a factor that contributes to IT diffusion (Rogers, 2003).

In case of the valuation template which is an application of spreadsheets as an expert system (according to Weber's (1999) classification), it can be implied that being exposed to more assurance services give auditors ideas how to apply spreadsheets into more audit work.

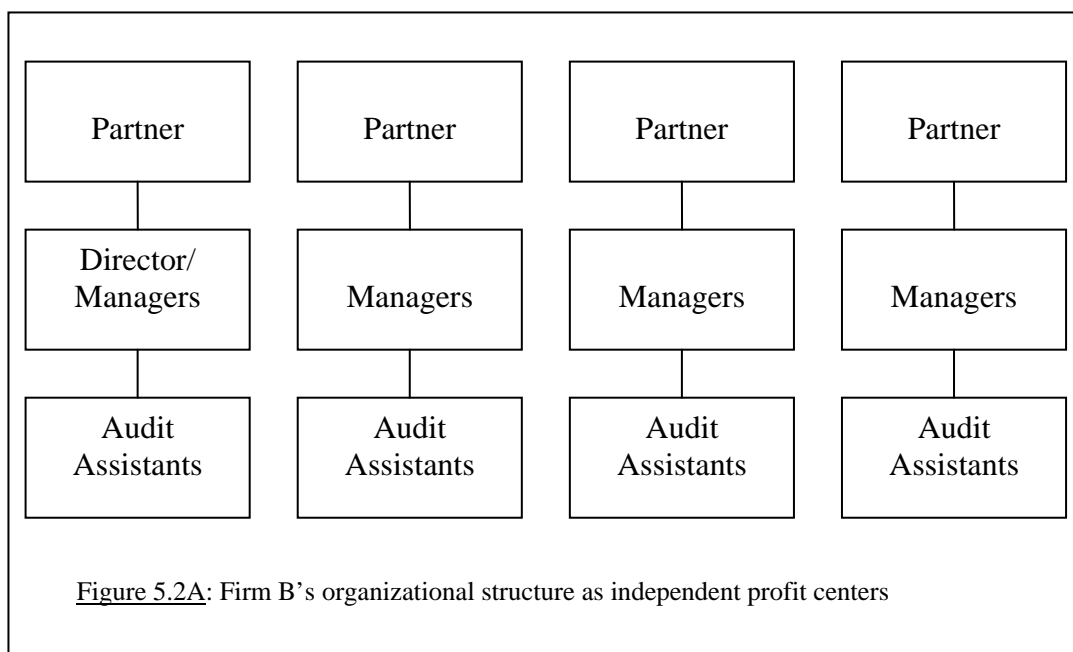
## 5.2 FIRM B

Firm B is a medium-sized audit firm located in Bangkok Thailand. The firm was founded about seven years ago by three partners from a resolution of a big international firm. The fourth partner joined the firm a few years ago after working for a chain of another international firm for a year. The firm has expanded its operation rapidly during the last 2 years. The interviewee is an associate director

who joined the firm a few years ago. The interviewee is responsible for providing services to clients that operate under computerized environment. In addition, the interviewee also provides support and training in related computer auditing for the firm's staff. The training provided by the associate director also includes how to use Spreadsheets to support audit work.

The firm employs approximately 50 staff. The turnover of the firm is approximately 50 million. The firm focuses on assurance services. The firm's turnover is approximately Baht 50 million (NZD 2.5 million). More than 90 percent come from assurance services. The firm provides services to a variety of clients both listed companies and non-listed companies. However, the firm does not provide services to banks or financial institutes. Audit fees range from Baht 30,000 (NZD 1,500) to Baht 2 million (NZD 100,000).

The firm operates as four profit centers (Figure 5.2A). Even though all profit centers share similar service policies and standards, each profit center (division) has its own investment plan and budget. Each division, therefore, has a different technology take-up rate depending on the partner of the division. Audit staff are ranked from partners, managers, supervisors, senior auditors, and assistants.



Staff are given personal laptops and necessary computer facilities. MS-Windows, MS-Office, and MS-Visio are three main applications that are used in audit courses. All firm-owned computers are installed with authorized copies of application; however, the firm claims that it is not responsible for staff's laptops. The firm does not have a specific IT support staff.

### **5.2.1 Use of spreadsheets**

The firm has used spreadsheets to support audit work since it was founded. However, the use of spreadsheets can be related to the use in the big international firm from which most staff came. Most staff have used spreadsheets or a spreadsheet application for about 10 years. The interviewee claimed that he started using spreadsheets when they were first launched to the market. The current version is MS-Office 2003. The interviewee has used MS-Office 2007 for a few months. However, the use is limited to the interviewee.

#### Uses of spreadsheets during the audit planning phase

The first application of spreadsheets is as a client's risk-analysis checklist. The checklist is a spreadsheet-based model developed by the firm in order to decide whether the firm should provide services to a particular client. The software was originally used by an international firm and was used by this firm during an earlier period. The original version was developed by an international firm. The software, called SMART, gathers data from auditors, processes data according to pre-defined models, and exports output to spreadsheets work paper. In the current version, the firm modifies the program to be spreadsheets-based. Auditors input data into an input section which looks like a check-list as; yes, no, and not applicable. The first firm-developed version was equipped with Macro. The firm believes that it was too complicated and less flexible with Macro and protected templates. Therefore, Macro features were removed in order that auditors can customize the checklist



questions. Most of additional questions involve judgments and decision making. The results from the column can be obviously seen. Spreadsheets are also used for calculations. Currently, the program is not completed. Spreadsheets can give ratings. But auditors will evaluate an overall picture of a client using their judgment. Then, spreadsheets are used for recording judgments made by auditors. The final decision is usually made by a partner.

During the audit planning phase, audit work involves documenting information from clients. MS-word is used the most due to its superior formatting features (to spreadsheets). Spreadsheets are used for keeping client's trail balance, conducting analytical procedures, and preparing work papers during the planning phase.

#### Uses of spreadsheets during the test of control phase

During the test of control phase, the firm uses Visio and MS-word to document client's accounting systems since audit work involves drawings and writing narrative descriptions on clients' accounting systems. Spreadsheets are used for documenting (recording results from the test) when the firm begins testing clients' transactions. Spreadsheets are also used for analytical procedure conducted in interim auditing which includes test of control and the preparation for test of balance. Even though spreadsheets are used during this phase, auditors do not use statistical or sampling features. Those tasks are based on judgments and systematic approaches; e.g. every 500<sup>th</sup> transaction is tested. As a final step of this phase, auditors use judgments to develop MS-word-based audit programs based on the results of the test of controls.

#### The use of spreadsheets during the test of balance phase

Auditors begin the most important phase by importing clients' trial balance into a template in order to prepare lead schedules. The lead schedules are copied from the old work. Even though, formats of work papers throughout the firm are similar to each other, the firm uses neither standard-predefined templates nor includes them as firm policies. Auditors prepare the lead schedule based on their experience. The interviewee claimed: *"We do not lock input cells. The templates are flexible*

*because different clients have different nature. Therefore, templates should be able to be modified.*” In addition, standard templates cannot be used fully when auditors import clients’ trail balance directly from client’s soft files or use software called Able-to-Extract to import the data directly from a hard copy.

All auditors are asked to prepare the lead schedules and work papers using cell references. The complete work papers link figures from client’s trail balance, audit lead schedule, adjusting work papers, and financial statements. Auditors use across-sheet cell references, but they do not use across-file cell references. The figures are also used for preparing statement of cash flows. After preparing the lead schedules, auditors prepare preliminary analytical reviews. Some auditors use graphical features to present the results for a better understanding.

After the lead schedules have been prepared, spreadsheets are used for testing balance in accounts that involve lots of calculation; for example, fixed assets and inventory. The most common application of spreadsheets to audit work is audit of depreciation calculation. The firm usually obtains client’s assets registers as soft-format data files. The files are then rearranged to be tested for calculation accuracy. The test of calculations seems more like 100% percent test. The interviewee does not deny that in some areas 100% is used instead of audit testing as required by audit standards because of the availability of spreadsheets. However, the interviewee claims: *“For a big client, even though we test some record, but we want detail about fully-depreciated and other information, full information is what we need.”* Spreadsheets are used for recording and summarizing the results from the tests. The formats are common among auditors in the firm even though the work papers are not predefined. The firm also uses spreadsheet templates to determine values of assets during the impairment testing procedure.

#### Uses of spreadsheets during the audit reporting phase

During the final phase, spreadsheets are used to prepare financial statements; however, the figures in the final version of financial statements may be different from those shown in the audit work papers since they are on separated files/systems. Auditors prepare financial statements using spreadsheets while notes

to the financial statements are prepared using word-processing software. Auditors use copy and paste value functions for financial statement and manually check for the accuracy when they prepare financial statements.

The interviewee claims: *“We need to send a soft-copy of Excel-format financial statements to SET; therefore, we could not link our work papers to the file or there will be errors. SET requires listed companies to submit financial statements in an Excel format and notes to the financial statements in a MS-word format.”* Spreadsheets are not used for making decision on audit report or judgment related tasks at this stage. Auditors use simple calculations and make judgments based on total tolerable errors

#### Other uses of Spreadsheets

A complicated application of spreadsheets is for consolidating financial statements since the worksheets contain complicated cell references and links. Spreadsheets are not complicated but the concept is quite hard. Auditors need to combine technical skills and the concept of financial statements consolidation in order to perform the task. Other uses of spreadsheets include preparing calculation templates such as hire-purchase schedules and loan schedules.

Auditors use spreadsheets mostly for calculations. A complicated application can be rejected by other auditors. The interviewee claims *“Last time I developed a template in order to test depreciation calculation (called predictive by the interviewee), auditors did not understand how formulas were developed. I spent lots of time explaining how to use. But they complained that the template is too complicated and they did not want to use it.”*

Spreadsheet features used in the firm include cell references, functions, formulas, and pivot tables; however, the firm does not currently use Macro. The firm uses financial functions, and/or conditions (if function) to find specific transactions (filter/sort) and perform some data mining. For example, an “if” function is used to pick up the appropriate adjustment referring to account code in consolidation.

Spreadsheets are also used for maintaining clients' database; especially for those that have a huge numbers of transactions.

The interviewee currently uses three versions of MS-Excel, 2007, 2003, and 2000. The most commonly used version is MS-Excel 2003. MS-Excel 2007 has an advantage of its capability of maintaining unlimited data while MS-Excel 2003 can store approximately 65,000 records. MS-Excel 2007 has a lot of automatic features; for example, auto-save which creates a restore point more often than the previous version does. The interviewee claims that formats and functions in MS-Excel 2007 are easier to use. However, the menu is new and different from the previous. The interviewee states: *"People may not get used to it. People asked where old menus have gone. Can we change to use the old one?"* Drawbacks of the new version are that it creates new file extensions every time the file is saved and the files cannot be used with older versions of Excel.

MS-Excel changed significantly in 2007. In the firm, significant changes occurred when the firm was set up. When auditors worked for an old international firm, most of their work papers were prepared in MS-word. The interviewee claims *"We changed when we set up our own firm. When we set up a new firm, we can select our own path. We talked and set as a policy of the firm"* (no written policies).

#### Audit work which is cannot be done without spreadsheets

There is no particular audit work that cannot be done without spreadsheets. The interviewee claims: *"Even though we can do our work without Spreadsheets, we do not get used to doing our work without Spreadsheets."* In the case, spreadsheets do not offer new work or new approaches, but improve the efficiency of the existing works. This is shown the following statements. *"We cannot do our audit work without spreadsheets. Practically, we cannot work without spreadsheets but actually we could do our work without spreadsheets in the past. We use twelve-column worksheets. We would spend lots more time on auditing if we did not use computer. We have used spreadsheets for very long time. I cannot imagine how we did our work without spreadsheets long time ago. If we did not have spreadsheets, it would take a lot of time for us."*

### Uses of spreadsheets to a higher level

The interviewee claims that standardized templates and the analysis of complex data are other audit works that spreadsheets should be applied to. Even though auditors use templates, they are flexible and may exhibit different formats such as templates for the hire-purchase and finance lease schedules. Auditors also independently use trial-and-error approach in finding an appropriate interest rate even though a special function (goal-seek) should be used. The analysis of complex data is the setting up of business database and the ability of suggestion of a possible relationship.

The interviewee also mentions about the application of spreadsheets for audit sampling: *“We have not used sampling but I believe that with reliable calculation, we can use spreadsheets for sampling.”*

### Areas which spreadsheets should not be used or cannot be used

The interviewee has tried to apply spreadsheets in much audit work since it promotes integration among works. However, there are some areas that spreadsheets cannot be used. Spreadsheets cannot be used for preparing notes to the financial statements because spreadsheets do not have an appropriate text formatting feature. However, the interviewee wants to see the integration between spreadsheets and MS-word so that auditors can reduce the risk of calculation and information between financial statements and their related notes. In addition, spreadsheets are not suitable for a test of control; Visio and other flowchart applications are more appropriate.

### The fullest potential use of spreadsheets

*“We use spreadsheets for more than 80% relative to the spreadsheets features. But it is fully support our work. We can use more complex functions,”* claimed the interviewee.

### 5.2.2 Spreadsheet infusion enablers/inhibitors

The interviewee claims that training, staff's personal factors, availability of materials for self-study, and information from external sources and friends are four key factors contributing to spreadsheet infusion within the firm. The interviewee also implies that self-efficacy of the interviewee, himself, is also a factor. He states a reason for using spreadsheets 2007: *"I want to know more than other people so that I can understand the problem before someone else so that I can tell them. I feel that it is challenging me. I have done self-study. I bought my own computer long time ago even though it was expensive and the old firm did not use computer."*

Staff are claimed to be the most important factor. *"No matter how much training we provide, staff may not want to know so that does not want to do work with a more complicated application."* Another statement is given: *"Staff can use spreadsheets more efficiently if they are eager to learn."*

Other factors include the support from professional institutes for standardized software of methods. Academic institutes should also help by delivering some training to their graduates. The interviewee complains: *"I find that some new graduates from some school do not know how to use Spreadsheets."*

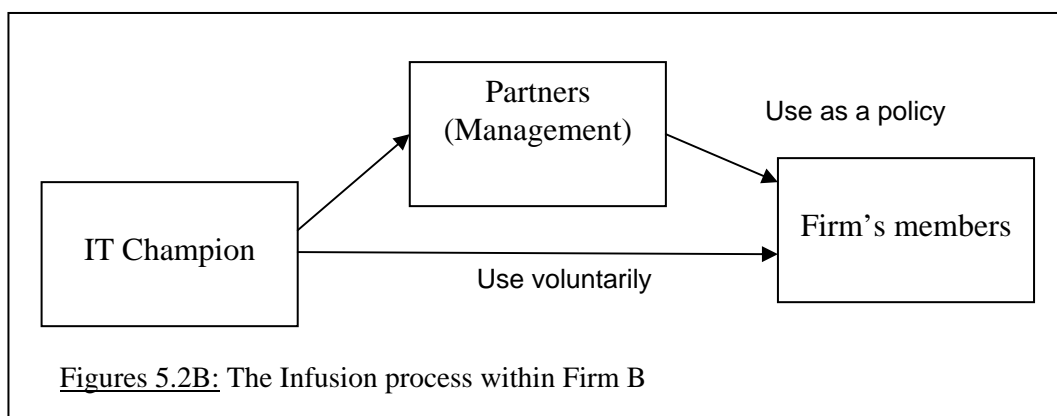
Infusion inhibitors are claimed to be from both internal and external sources. In the firm, support from management is required. The lack of support is, therefore, an inhibitor. The interviewee claims: *"When I develop something too complicated, partners sometimes ask me to slow down."* The claim also implies that complexity is another inhibitor. The interviewee believes that the management makes decision whether to support the new application based on their views on the technology: *"Sometimes, partners do not want the firm to use because they think about cost-effectiveness. It may be not worth to use more complicated application if staff spends too much time to learn how to use."* It can be concluded that once the interviewee convinces the management about the benefits of the new application, the infusion rate can be improved.

On the other hand, a SET's requirement which is an external factor is claimed to be an inhibitor for IT infusion. The interviewee claims: "*A complex application is not accepted by SET.*" Sometimes, the use of spreadsheets is discouraged by audit clients by refusing to give out soft-copy data because they believe that it reduces the risk of data transfers. The firm overcomes the problem by using special software to import data to spreadsheets.

### Infusion process

The case shows that the infusion process within the firm can be divided into two phases. The first phase refers to the highest infusion within the firm regardless of how the whole firm uses the spreadsheets. An IT infusion of generic software usually occurs at an individual level. An individual challenges himself/herself by adopting and using technology; then, diffuse the new idea to other members in the firm. This individual is called an IT champion (Rogers, 2003). The interviewee is considered an IT champion.

In the firm, an infusion of Spreadsheets channels through IT champion. Then, the infusion of Spreadsheets diffuses to members in the firm. However, in order to be set as a policy, the use must be supported by the management. The process can be shown in Figure 5.2B.



This infusion process implies that routinization may not be a pre-requisite of IT infusion as observed by other studies (Cooper and Zmud, 1990; Zmud and Apple, 1992), but it may contribute to IT assimilation. Once an invented use becomes a policy, the use is common among all firm's members; then, the whole firm realizes the benefit of the use. On the other hand, voluntarily uses by some members benefit the firm. In this case, there may be different infusion levels among members of the firm.

#### Spreadsheet infusion enablers and inhibitors

The most important spreadsheet infusion enabler in this case is the availability of an IT champion. Cooper and Zmud (1990) state that an IT champion helps infuse the technology in an organization. However, there is a burden of IT infusion from the operational work to managerial work. An operational manager may enjoy the infusion of technology but fail to convince a higher level management to infuse technology. Meanwhile the higher management may not see the clear benefit of technology which is used or initiated by a lower level; therefore, neither an operational manager nor a higher level manager act as IT champion in order to infuse the technology into managerial work.

In audit firms, the environment is different. A partner or a manager of the firm has gone through all levels of tasks and sometimes has had to perform those tasks. Because most management of small audit firms involve most operational and managerial works, they realize the benefits of technology at operational level and can act as IT champion in order to infuse the technology into managerial works.

The infusion processes can be viewed as two steps. IT infusion enablers can be categorized into two levels of analysis. IT infusion enablers during the first level of analysis relate more to individual-level than to organizational-level enablers. Meanwhile, the overall infusion level of the firm relates more to organizational level of analysis.

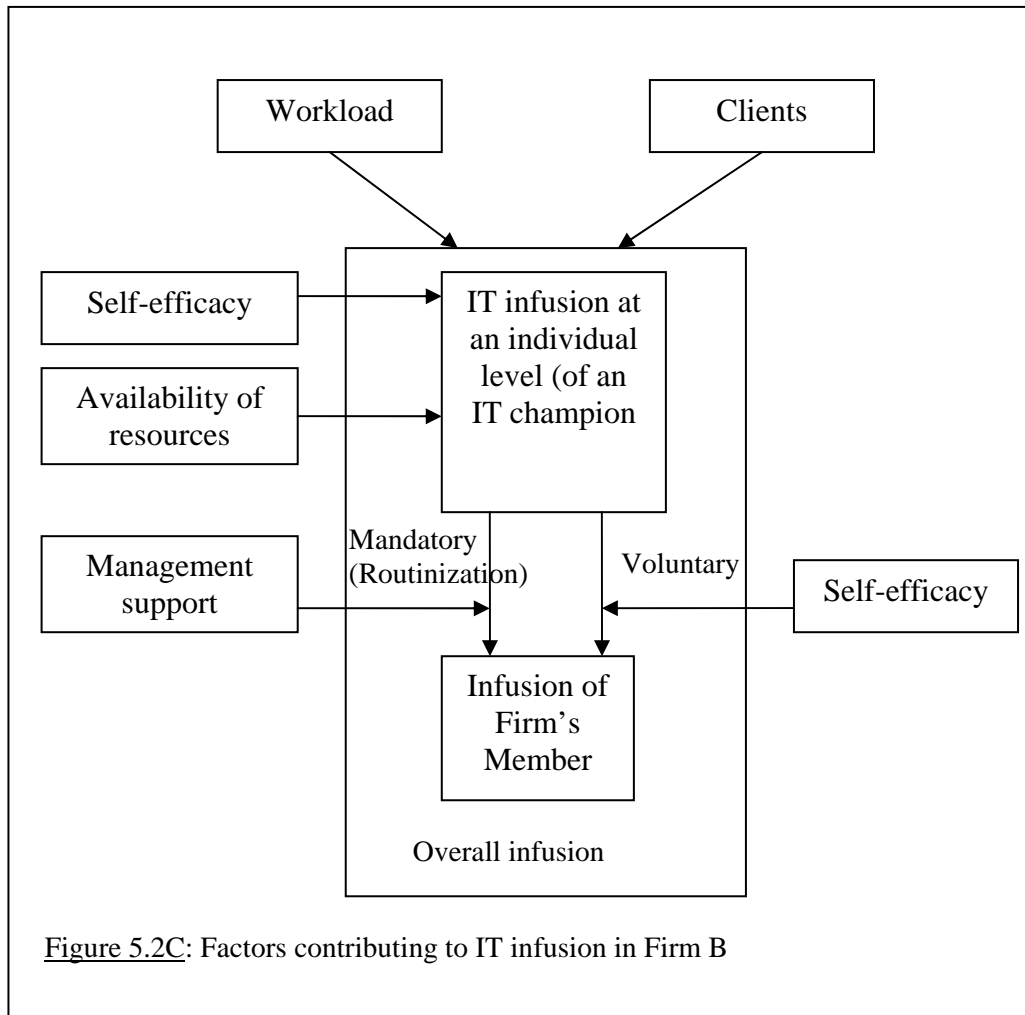


Self-efficacy of an IT champion and the availability of the resources encourage the IT infusion at the very first point. Spreadsheets are viewed as a generic application where a higher level of use cannot be obtained by training. The users may know how to use spreadsheets, but they may not know the application of spreadsheets to audit works. Observability is another factor. An individual can observe from external sources; for example, from training materials provided by professional institutes.

In the second stage, staff are the most important factor. Even though the basic application of spreadsheets to audit works becomes an unwritten policy of the firm, higher or further application is voluntarily. Staff should be appropriately convinced about the higher use of spreadsheets through relative advantages of the application in order to diffuse the use. In addition, staff should be educated basic use of spreadsheets.

Pressures from clients and competitive market may also force the management to give full support on implementing the technology. The management views the use of spreadsheets as a way to increase work efficiency by reducing audit time and increasing productivity. For big clients, spreadsheets are unavoidable. Therefore, the use of spreadsheets becomes an unwritten policy of the firm. The complexity of clients' computer systems also forces the firm to use spreadsheets

It can be concluded that how well an IT champion can help infuse technology in a firm depends on how much authority and experience an IT champion has. If an IT champion does not have enough authority within the firm, full support from the management is necessary (Figure 5.2C)



On the other hand, attitudes toward technology may inhibit IT infusion. In this case, auditors and audit partners usually view spreadsheets as tools that support audit works and the use of spreadsheets to a higher level is based on cost-benefit considerations. Therefore, a higher level of use that yields more costs than benefits may not be accepted. Another inhibitor is the requirement from the regulator which limits the use of spreadsheets to a certain level.

### Measuring infusion

The evaluation of Firm B yields an infusion score of fifteen (twelve for extended use score, two for integrative use score, and one for emergent use score). These score are given based on how many task categories spreadsheets are integrated into, the links between work flows, and the attitudes toward using the spreadsheets.

In the firm, spreadsheets are claimed to be the most important software used by all auditors in the firm. It can be concluded that spreadsheets become embedded deeply in the firm in term of importance, penetration and significance. This indicates the highest infusion level according to the Sullivan's (1985) definition. Even though the interviewee emphasizes a few times the importance of spreadsheets, evidence given is more related to using computers in general because other software is used more in some phases. Since spreadsheets are used mostly during the test of balance phase which is the most important phase in audit work, it can be implied that auditors cannot do most of their work without spreadsheets.

In Firm B, the fullest potential use of spreadsheets refers to application of the software to audit work. The interviewee claims that the firm reaches the fullest potential use of spreadsheets. The interviewee indicates a few times during the conversation that spreadsheets are integrated into as many audit tasks as possible in the firm. The fullest application of spreadsheets are evaluated relatively to all works into which interviewee believe spreadsheets can be applied. Therefore, it is possible that self-ranking instrument for IT infusion measure may not indicate an actual infusion level within the firm.

#### *Extended use*

The firm integrates spreadsheets into as many audit tasks as possible. However, a remark should be given on some tasks; for example, the sampling task does not involve spreadsheets because auditors choose to use a sampling method that does not require the use of spreadsheets. Spreadsheets are adapted to suit audit tasks conducted by the firm. During the planning phase, spreadsheets are adapted for a recording purpose instead of suggesting results for decision making. Spreadsheets are also adapted to prepare only parts of financial statements. In terms of task complexity, even though spreadsheets are applied to some judgment-related tasks, they are not fully used.

### *Integrative use*

The uses of spreadsheets increase the interconnectedness among audit work. However, the interconnectedness occurs only between tasks in the same phase; for example, the interconnectedness of work flows exists between the preparing lead schedules, conducting analytical procedures, preparing work papers, and preparing financial statements. However, there is a comment from the firm that the financial statements cannot be fully linked because the requirement from the regulator.

### *Emergent use*

This is consistent with the firm's attitude of using spreadsheets to support audit work. Therefore, there are no emergent uses according to the interviewee.

## **5.3 FIRM C**

Firm C was founded in 1974. The firm provides only assurance services. The firm has 2 partners. The interviewee is a managing partner who takes care of both audit work and general administrative work. The senior partner, who is a parent of the interviewee, represents the firm to external parties. There are approximately twenty auditors and six administrative staff. One of an administrative staff is responsible for IT support. The firm has four audit teams. Each team consists of audit managers, supervisors, senior and junior auditors. Unlike other audit firms, the firm also relies on trainees and part-time staff. The managing partner conducts some fieldwork.

The annual income of the firm is Baht 10-15 million (NZD 500,000-750,000). The firm provides service to both SET listed companies and non-listed companies. There are approximately 300 clients. Audit fees range from Bath 10,000 (NZD 500) to Bath 700,000 (NZD 35,000). However, there are a significant number of small clients. Other services include deal diligence. The firm admits that auditors are not familiar with big computer systems such as SAP.

The firm provides training based on staff's needs. However, there is no computer-related training. Even though the firm does not provide laptops for all staff, most of them have their own laptops. The firm provides limited computer resources for the staff.

### **5.3.2 Use of spreadsheets**

The firm has used spreadsheets for approximately 7-8 years. Spreadsheets were first used for preparing financial statements. The interviewee claims: *"Unlike other firms, our firm use Excel to prepare all parts of the financial statements. Other firms use a work processing to prepare notes but we also use Excel."* (21.07)

#### Uses of spreadsheets during the audit planning phase

During the planning phase, the firm use spreadsheets to gather and manage information from the clients. Spreadsheets are also used for preliminary analysis and staff planning.

The firm has a pre-define template in order to gather information from the clients before providing services. The template includes some information about suggested fee from the information collected. However, the model is not completed. The partner uses the combination of judgment and pre-defined formula in the work sheet in order to calculate audit fee and plan staff.

#### Uses of spreadsheets during the test of control phase

Spreadsheets are used for recording information in order to do risk assessment. Most of the work papers were prepared using spreadsheets. The assessment is done by audit judgment. *"Our staff who studies advanced degrees brought in some formula for risk assessment model, but it is too complicated."*

The auditors calculate a sample size manually using a calculator. Spreadsheets support the sampling process by sorting the transaction. *"Auditors key in or obtain the transactions in soft files. When we decide to pick 10 transactions, auditors will gather preliminary information such as how many transactions in a month and what transactions should be selected. For example, we want to select every 28<sup>th</sup> transaction, we pick the transactions with the reference to 28<sup>th</sup> line in Excel."*

Worksheets preparation is done on Spreadsheets; however, auditors may prepare manual work papers. The firm does not support laptops for all staff.

#### Uses of spreadsheets during the test of balance phase

Auditors use spreadsheets to prepare lead schedules. Predefined templates cannot be used because the figures are linked from the clients' trail balances; therefore, it is not practical to set up a standard template. However, auditors usually adapt the existing work papers to prepare a new lead schedule. Spreadsheets are also used for recorded audit evidence such as accounts receivable confirmation. Auditors sort the accounts receivable list in order to pick samples for being tested. Spreadsheets are also used for preparing an aging schedule. Spreadsheets are used the most in auditing fixed asset accounts. The reconciliations and calculations of depreciation are the main uses of spreadsheets.

Predefined templates set by the interviewee are used for preparing lease and loan amortization schedules. The templates are adapted and modified by auditors to suit particular clients.

#### Uses of spreadsheets during the reporting phase

The firm uses spreadsheets to prepare financial statements and the related notes. The firm also uses spreadsheets to prepare the summation figures for consolidated financial statements but the use does not involve any links or complicated calculations.

Auditors in the firm are familiar with spreadsheets. They use spreadsheets for everything even though MS-word may be more suitable for some tasks. For example, auditors use spreadsheets to prepare narrative and reports during the planning phase and to prepare note and financial statements. Spreadsheets are preferred because they in a column-and-row format. *“When we train other auditors, we ask them to report in column-and-row so that it is easily to be understood”*

Although the firm does not set the use of spreadsheets as a policy, the use becomes a norm since it has been delivered through the existing practices from senior auditors to new auditors. The senior do not need to explain what should be done.

The new auditors can study from what they are given through the supplied spreadsheet work papers.

#### Other uses of spreadsheets

The use of spreadsheets is discreet. Even though the firm needs some interconnectedness between audit work flows, the firm does not fully promote the interconnectedness of spreadsheets because auditors believe that it is risky to do so. It is also because of a confidentiality reason. From an observation, most of audit documents are paper-based more than spreadsheets-based.

#### Audit work which is cannot be done without spreadsheets

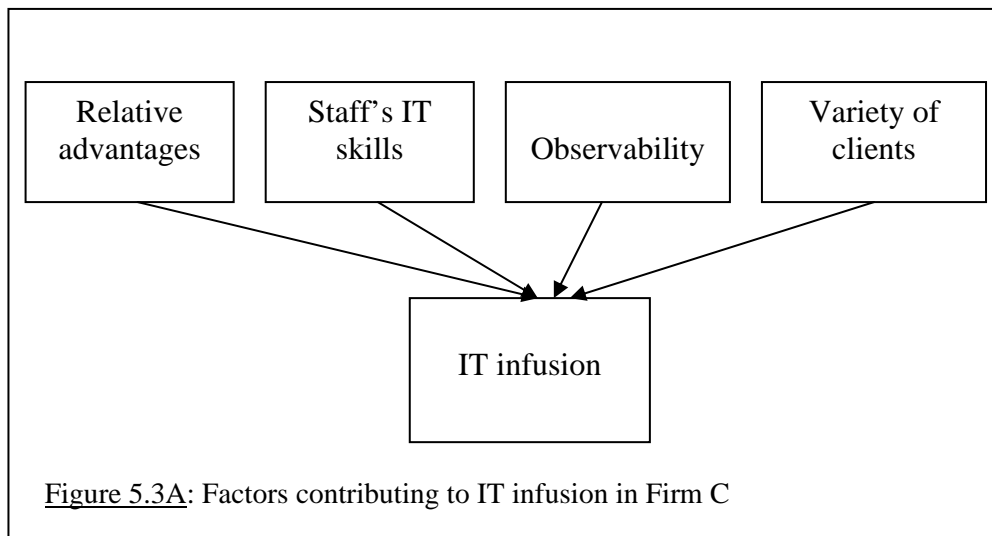
The interviewee claims: “*We were born (implying the auditors begin working in the field) with Excel. We cannot imagine how we worked without Excel.*” The possible work that is hard to do without spreadsheets are financial functions such as internal rate of return (IRR) and the loan schedule for float-rated interests. “*They can be done manually but take very long time.*”

#### Use of spreadsheets to a higher level

The interviewee claims that the firm advances the use of spreadsheets because of the variety of clients. The firm learns from the clients. The next levels of use include the use of condition such as “if” and standard templates. They also include the use of spreadsheets in judgment-related tasks. “*We are afraid that we may in trouble if we use Excel in judgment-related work, and we cannot have the results we need. The work may be harder.*”

### **5.3.2 Spreadsheet enablers and inhibitors**

The firm’s spreadsheet infusion enablers include relative advantages of the use of spreadsheets, observability of how other firms use spreadsheets, staff-related factors such as staff’s IT skills and staff turnover, and clients’ related factors such as variety of clients and clients’ computer system stability. (Figure 5.3A).



The key IT infusion enablers in an earlier phase are staff's IT skills and relative advantages of spreadsheets. Staff need to gain more knowledge from outside in order to advance the use of spreadsheets. The interviewee claims: *"I believe that everyone wants our work to turn out good. But it is limited to our skills; we cannot see how it can be used or adapted to our work."* The interviewee rarely communicates with auditors from other firm. The communication channel is only through the senior partner who does not have computer skills. The interviewee wants to establish a network among small and medium sized firms in order to improve the firm's IT knowledge and skills. The use of spreadsheets is voluntarily. At the same time, the firm cannot provide all resources needed. In addition, the variety of clients gives not only new ideas of auditing and also new ideas of application of Spreadsheets.

Inhibitors include staff turnover and client's willingness to give data to auditors. The firm cannot compete with others in term of compensation. Therefore, the firm cannot recruit highly-skilled staff or retain staff with high skills in the firm. Even though it is required that clients must give necessary information for auditors, they usually discourage auditors by giving away hard-copy reports instead of soft-files. Auditors have less opportunity to try out new idea since it may involve re-inputting the data.



### **5.3.3 Analysis of IT infusion enablers and inhibitors**

The firm infusion process is slow. The firm used spreadsheets for preparing financial statements during the earlier period. Since then, the uses have been advanced to some part of audit work in the test of balance phase. Even though the firm claims that spreadsheets have been used in most of audit work, the uses are simple and fragmented. The uses of spreadsheets are only for recording and preparing report.

#### Spreadsheet infusion enablers and inhibitors

Findings from the case are consistent to prior studies about IT implementation process success factors. Staff's IT skills are critical success factors in IT implementation in several studies. The case also extends the body of knowledge from the perspective of an IT champion or an IT manager in the business. The status of the IT champion indicates the level of communication across firms in the same industry. The firm's IT champion needs to have enough authority to communicate or gain access to external networks in order to observe the uses of technology and adapt them to fit into the firm's context.

The variety of clients can also be compared to job rotation factors. Chances of providing services to clients in different operational environment and industry challenge the firm's staff members to invent a new of application of technology.

The organizational structure also affects the overall infusion process. The high dependency on part-time staff and trainees and high turnover of the full time staff clearly disrupt the infusion process. This fact also explains why earliness of adoption which was examined by Zmud and Apple (1992) and Eder and Igbaria (2001) may not relate to IT infusion. Although the firm has adopted the technology for a period of time, the infusion process has not occurred smoothly. The presence of continued staff is required in order to infuse the technology.

#### Measuring IT infusion

The evaluation of Firm C yields an infusion score of nine (seven for extended use score, one for integrative use score, and one for emergent use score). These score

are given based on how many task categories spreadsheets are integrated into, the links between work flows, and the attitudes toward using the spreadsheets.

The case indicates that an overall measurement of IT infusion may be affected by observability of the respondent to other firm's uses of technology. Normally, the respondent rates the firm infusion level in relative to the fullest potential uses given in the firm's environment. Therefore, where observability is claimed as one of the most important factors, the overall measurement may indicate a higher level than one rated by a respondent that has an idea about how other firms use technology. The firm may positively rank its own infusion level higher than the objective measurement on uses of technology resulting the higher gap between two measurements.

#### *Extended use*

Given the work integration perspective, the firm integrates technology into most work; however, the use of technology is not applied to a higher level. The infusion level is low in degree but high in numbers of work.

#### *Integrated use*

Resulting from the purpose of using technology in a low level without interconnectedness among work process, the infusion rated by integrated use perspective is very low.

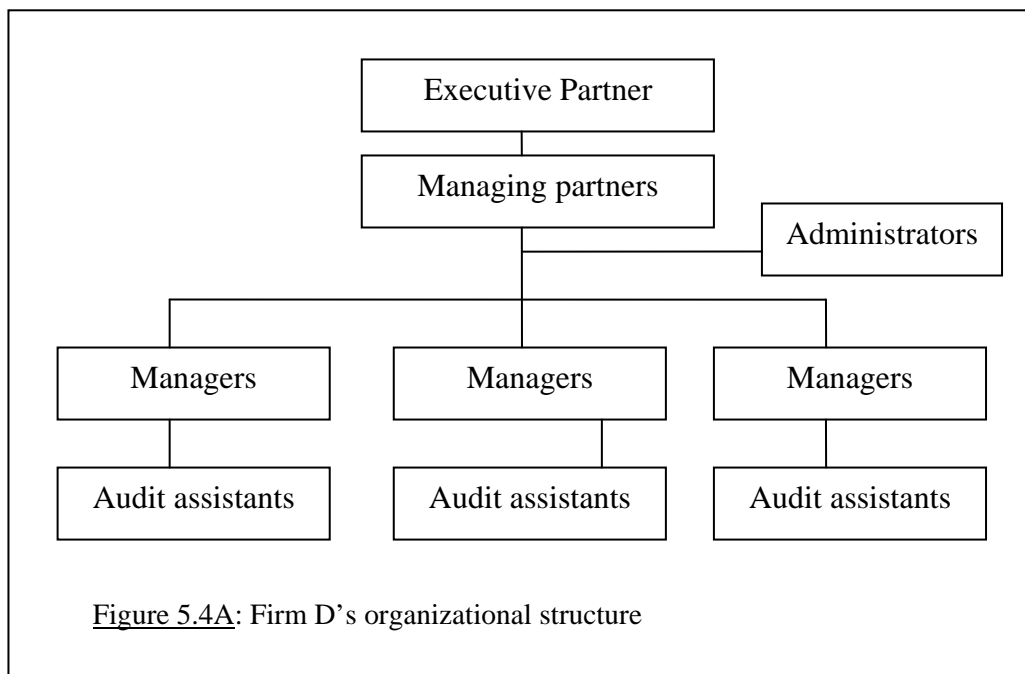
#### *Emergent use*

The infusion is rated very low from this perspective. The interesting point is when the firm adopted the technology earlier or members of the firm begin their work with the technology. The emergent use cannot be identified or ranked.

## 5.4 FIRM D

Firm D was founded 15 years ago by a group of accountants and lawyers. At an earlier period, the firm provided both accounting and legal services. Presently, even though the firm still provides some legal services, most income come from auditing services. The firm is claimed to be very conservative.

The firm employs approximately 100 staff in three divisions. There is an executive partner and a managing partner who run the firm. Each division has two managers and 2 sub-divisions (Figure 5.4A). However, the sub-divisions are hardly pooled in practice because the old culture is hard to change. There are three SET approval certified public accountants (CPAs) in the firm who can provide services for listed-companies. Half of staff in the firm are CPAs who can provide services to general clients. The firm absolute authority is at the partner level. All decisions are made by the executive and managing partners. A few administrators are hired for clerical work.



The firm's audit fees range from Baht 20,000 (NZD 1,000) to Baht 5,000,000 (NZD 250,000) for a group company. The total annual income of the firm is approximately Baht 30-40 million (NZD 1.2-2 million). Clients operate in various businesses. However, the firm does not provide services to banks and finance institutes. The firm also claimed that the firm recently withdrew the service from a lease company from the reason that the firm does not have sufficient ability to provide services for this type of client. In additions, the firm mostly provides services to local businesses since it is claimed that the staff are not good at English.

There is no specific IT staff in the firm. The interviewee helps the firm on computer issues. The interviewee is an auditor and does not have a computer degree. The interviewee claims: *"Audit work does not require a computer support"* The firm participates in a group of small and medium sized audit firm known as 75CPE limited in order to develop Spreadsheets-based risk assessment software.

#### **5.4.1 The use of spreadsheets**

There is no evidence how long the firm has adopted spreadsheets. However, the interviewee specifies that the firm has adopted a spreadsheet, Lotus 1-2-3, earlier than 1995 which is the year that the interviewee joined the firm.

The interviewee claims that the uses of spreadsheets in the firm are limited to recording and calculating some figures. The use spreadsheets is claimed to be 30% out of its potential use in audit work and the interviewee claims further: *"If Excel can be used to the fullest potential, we may not need other audit software."* Table 5.4A summarized the use of spreadsheets in audit work.

##### The use of spreadsheets during planning phase

The firm does not follow a standard procedure when a new client is accepted. The partners have an absolute authority in making decisions and they make their own judgments when they talk to the clients. *"Sometimes, they know not to accept clients from a particular group or name."* This is the reason why spreadsheets have not been used much during this phase. However, the firm uses spreadsheets to record data and to calculate necessary information for a preliminary analytical

review. The interviewee claims: *“For recording, we use Excel. Excel is a lot easier than MS-word; especially formatting features. People who do not know how to use computer well can use Excel, but MS-word.”*

#### The use of spreadsheets during test of control phase

The firm participates in a group of small and medium sized audit firms in developing a spreadsheets-based application for risk assessment. The interviewee represents the firm in the group. The interviewee shows attitude toward using technology in risk assessment: *“It is hard to use Excel for risk assessment. We still have to evaluate in order to set knowledge bases to the programmer. We will use it as a guideline. It is hard to evaluate; for example, you say moderate risk but I say high risk. It depends on judgment and experience.”*

Presently, spreadsheets are used for recording test of control as a work paper. Spreadsheets are not used for other purpose during this phase. The interviewee mentions a sampling method. *“We mostly use block sampling for a test of control. We do not need Spreadsheets.”* In the firm, there is no expert staff who can use Spreadsheets in sampling. However, the interviewee do not oppose a creative sampling approach if it is used by auditors

#### The use of spreadsheets during test of balance phase

Spreadsheets are used for preparing audit lead schedules, conducting analytical review, and preparing detail accounts. Auditors obtain clients' trail balance and key in the figures. The firm allows auditors to develop their own work papers based on the firm's standard format. *“The firm has a standard format, but template. Auditors may adopt others' templates if they think they are good and easier to work with. For example, the template for preparing cash flows.”* Auditors link most parts of work papers and adjustments. Some parts are prepared manually, especially people who do not have computer skills.

The interviewee shows his attitude of how auditors use spreadsheets: *“There is a problem when auditors use Excel differently; for example, rounding figures may create a problem. We need to limit the use of Excel to prevent this problem. I am personally against the use of Excel because people print out all works and may*

*reprint and waste lots of work papers. We want to develop a full system that partners have passwords to review audit work papers in the future.”*

The simple calculation is used in auditing costing and depreciation. However, the firm tests the depreciation calculation from clients’ fix assets register. The firm does not use sorting or filtering features. The interviewee states that those functions are not necessary because clients are not sizable. The interviewee also claims that the most complex application of spreadsheets is for preparing leasing schedule. Another area is the use of if functions in order to prepare statement of cash flows. *“It is convenient. Sometimes, an auditor who prepares the statement of cash flows does not know how to do it, but just can just plug in the figures.”*

#### The use of spreadsheets during reporting phase

Spreadsheets are used for preparing financial statements. The opinion is given based on audit judgments.

	Planning	Test of control	Test of balance	Reporting
Tasks	<ul style="list-style-type: none"> <li>- Recording information</li> <li>- Basic calculations for analytical procedures</li> </ul>	<ul style="list-style-type: none"> <li>- Recording information</li> </ul>	<ul style="list-style-type: none"> <li>- Recording information</li> <li>- Basic calculations for analytical procedures</li> <li>- Prepare detail accounts</li> <li>- Lease schedules</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing financial statements and statement of cash flows</li> </ul>

Table 5.4A: The uses of Spreadsheets in Firm D

#### Audit work which cannot be done without spreadsheets

The firm views spreadsheets as a tool that is used to support audit work. There is no audit work that cannot be done without spreadsheets.

#### Use of spreadsheets to a higher level

The uses of spreadsheets to a higher level include sampling and scrutinizing exceptions. The interviewee cites an example of scrutinizing inventory items that have negative value. The interviewee also mentions that using spreadsheets to a higher level means auditors turn to be an end-user developer: *“If you do not provide the user with a template, they cannot think or use it. We can make them a user, but a developer.”*

#### Interconnectedness and the use of spreadsheets

The interviewee believes that spreadsheets links audit evidence together for auditors to see the overall picture when making decisions. The spreadsheets increase interconnectedness in audit work flows.

### **5.4.2 Spreadsheet infusion enablers and inhibitors**

Resources (infrastructure), staff competence, and education background are claimed to be factors that accelerate IT infusion.

The firm changed significantly when a big investment was made on computer hardware. However, some staff do not use spreadsheets in their work. This may be related to their knowledge and skills. Staff competency such as knowledge and how they were educated in college are stated by the interviewee. In this case, the interviewee believes that training and proper courses offered by an expert or by academic institutes can help the staff. However, staff's attitudes can be implied from the claim that *“auditors only want to solve the existing problems rather than learning how to solve them.”*

An integrative use is thought as all people involved in an audit project using spreadsheets. The missing part that spreadsheets are not used is by the partner. The

interviewee mentions a partner who has a problem with using technology. Partners do not know how to use.

Therefore, inhibitors in this case may include the management and the fear of changes that may not be accepted by regulators. The interviewee states the reason why the firm does not use an appropriate sampling procedure: *“We are not a big firm. We will be in trouble if we get charged by SET from using an inappropriate audit approach. We cannot answer the regulators about a new approach if used”* [refer to correct sampling approach]. *“We do not have those problems because we do not use those approaches. In this firm, a review is done the same way as an audit. We sampling calculation in client’s fix assets register. It is hard to extract client’s data because we are not as powerful as a big firm.”*

On the side, the fact that the firm does not provide service to big clients is claimed as a reason for no need of complex application of spreadsheets into audit work.

#### **5.4.3 Analysis of IT infusion enablers and inhibitors**

The case shows the earliest of adoption by auditors. Unlike other firms, auditors were the first group who adopted the technology into their work. Even though the case shows an earliness of adoption, its contribution to an infusion of spreadsheets is not consistent with findings in earlier studies (Zmud and apple, 1992; Eder and Igbaria, 2001). It is possible that an earliness of adoption in prior studies is related to IT infusion by chance.

##### Spreadsheet infusion enablers and inhibitors

The spreadsheet infusion in the case is supported by an availability of resources e.g. hardware and staff-related factors. IT resources that provide a foundation for present and future application of technology are prerequisites to IT infusion. These resources are mentioned as IT infrastructure in prior studies where more flexible IT infrastructures seem to be positively associated with IT infusion (Eder and Igbaria, 2001).



Staff competency is identified as another key enabler. Academic institutes and colleges are blamed for not educating graduates with practical auditing approaches. Staff competency seems to be related to infusion at a lower level. It is indicated that assistant auditors consult a higher level for help on basic spreadsheets skills and refuse to learn what they do not need to solve an existing problem. This also reflects staff's negative attitude toward technology where technology is only recognized as a mean to solve an existing problem (Winston and Dologite, 1999).

The firm shows a strong bureaucratic structure where the management makes decision on everything. Since some audit work such as clients' acceptance is done solely by the management who has not got used to computer, the technology has not been integrated into the clients' acceptance procedure. This centralized decision-making process may also contribute to a technology gatekeeper hypothesis proposed by Davidson and Hart (1995) where the management prevents the integration of technology into some tasks. As stated earlier, an inhibitor is more a fear of change to a new approach. Therefore, spreadsheets are not applied to a higher level. This finding is inconsistent to Eder and Igbaria's (2001) study where they found no relationship between centralized-decentralized structure to intranet diffusion and infusion.

The management attitude also affects the use of technology through other factors. The fact that the management choose not to provide services to clients in specialized businesses or sizable clients gives the firm less opportunity to develop new audit approaches and new applications for technology.

#### Measuring IT infusion

The evaluation of Firm D yields an infusion score of eight (seven for extended use score and one for integrative use score). These score are given based on into how many task categories spreadsheets are integrated, the links between work flows, and the attitudes toward using the spreadsheets.

The case gives contrast evidence on a self-report measurement. A hidden assumption on self-report measurement used by prior study is that the respondent rates infusion relatively to his/her idea of fullest potential uses in his/her own work. However, the respondent, in this case, rates infusion relatively on an ideal state of

use. This fact raises a big issue on self-report measurement where the infusion level is lower if the respondent rates the use relative to idea stage of use. The measurement, therefore, is more valid with the three perspectives of use.

#### *Extended use*

The firm exhibits a low level of infusion through extended use perspective. In each phase during audit procedure, spreadsheets have been integrated into a few areas and at very low level of use (Table 5.4A). Spreadsheets simply replace work papers and a simple calculator.

#### *Integrated use*

The infusion measured on this perspective is also at the lowest level. Audit work is done on spreadsheets as pieces. There is no link from one task to another. It can be implied by the fact that auditors print out all work papers in order to continue to the other phases. The interconnected work flows, therefore, are not established through the use of spreadsheets.

#### *Emergent use*

The emergent use of spreadsheets is highly related to users' attitude toward the application. Where the application is viewed as a tool to support existing work, an emergent use does not exist.

## **5.5 FIRM E**

Firm E is a medium sized audit firm and was founded approximately 30 years ago. Originally, the firm was set up to provide accounting and legal services. Presently, the firm has approximately 80 staff with the annual income of Baht 30 million (NZD 1.5 million). The firm provides accounting, consultant, payroll, and legal services. However, approximately 90 percent of the income comes from assurance services. A few years ago, the firm changed its structure and diversifies to other services such as fostering new international companies to do business in Thailand. The firm claims that auditing services are risky and subject to many codes of ethics and regulations. The firm is also a member of an international audit firm.

Advantages of being the member are the availability of audit resources and bringing in new international clients.

The firm provides services to clients both SET listed and non-listed companies. The firm has more big and medium sized clients than it did in the past and it has less and less small sized client. *“We just change our way of doing audit so the cost has been increased. When we propose audit fee, smaller clients cannot afford to pay us.”* The firm does not provide services to financial institutes because the firm may need hi-technology to support the work. The respondents also claim that complicated businesses are service industry and provident fund. Retail businesses which use point-of-sale systems make audit work harder. Clients may hide some transactions behind technology. A provident fund calculates returns on the fund every day and needs a complex computer system on its operation.

Three partners take charge of the firm management. Originally, the firm had 3 partners, an executive partner, an audit partner and a managing partner. A year ago the managing partner quit because of personal reasons. A new partner has been appointed to take care of new business sector and the audit partner takes charge for all matters in the firm. All partners are in the same family. The firm claims that it also treats staff as family. The firm's audit department has a similar structure to most audit firms. The departments are led by managers who manage audit teams that consist of senior and assistant auditors.

A partner used to devote his time on developing the application of technology to audit work. He helped develop and implement new systems that used for both operational and managerial work within the firm. However, he quit a while ago for personal reasons. The firm also has external IT consultant and a full-time technician who maintains the firm's computer system.

Training has been provided to staff for accounting, auditing, and technology. The firm has training for the new computer systems which require auditors to log on the systems and work on shared files. The use of audit work papers has also been standardized through the training.

### **5.5.1 The use of spreadsheets**

The firm uses spreadsheets in both operational and managerial work (Figure 5.5A). Spreadsheet software has been used for a long time. The respondent cannot specify how long the firm has used spreadsheet application. The firm originally used spreadsheet for preparing audit lead schedule. Presently, audit lead schedules are standardized and easier to prepare. The firm uses spreadsheets to link clients' trial balance to lead schedule and financial statements. Spreadsheets came with the availability of computer. At that time work sheets were prepared in pieces. The respondent believes that spreadsheets help integrate audit procedures together. For managerial work, spreadsheets are also used to do budgeting and cost control. The use of spreadsheets is formally required as a part of audit work. All spreadsheet-based work papers must be kept in the firm's computer server for future uses.

#### Uses of spreadsheet during the audit planning phase

Spreadsheets have not been used much during the planning phase. The respondent explains that the work includes getting to know the clients where internet is a valuable source for researching a new client's information. Mostly, the partners do this work themselves. Spreadsheets are only used for conducting a cost control sheet for the client. Auditors use spreadsheets more when the client is accepted. The client's information is then inputted on a standardized spreadsheet template in order to do ratio analysis. The firm is developing a new spreadsheet-based risk assessment application. However, the development is happening slowly because of the termination of the partner who initiated the project.

#### Uses of spreadsheets during the test of control phase

Spreadsheets are used for preparing work papers and recording results during the test of control phase. Auditors use spreadsheets for testing calculation; for example, calculation of depreciation on fixed assets register. Mostly, clients provide auditors with soft files to be tested. Even though spreadsheets have been used by all auditors in the firm, no one uses spreadsheets for sampling. The use of spreadsheets in the firm is originated by an ex-partner who did not use the sampling feature when he quit.

	Planning	Test of control	Test of balance	Reporting
Current uses	<ul style="list-style-type: none"> <li>- Recording information</li> <li>- Basic calculation for analytical procedures</li> </ul>	<ul style="list-style-type: none"> <li>- Recording information</li> <li>- Testing calculation</li> </ul>	<ul style="list-style-type: none"> <li>- Recording information</li> <li>- Basic calculation for analytical procedures</li> <li>- Prepare detail accounts</li> <li>- Testing accounts: Fixed assets, accounts receivable, inventories</li> <li>- Tax calculation</li> <li>- Payroll testing</li> <li>- Data manipulation for further uses.</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing financial statements and statement of cash flows</li> <li>- Preparing consolidated financial statements</li> </ul>
Future uses	Risk assessment & Sample size calculation  (Integrated over 2 phases)			
Managerial work	Recording client's information, budgeting, staffing and evaluating auditors performance			

Table 5.5A: The uses of spreadsheets in Firm E

### Uses of spreadsheets during the test of balance phase

Lead schedules and analytical reviews are the main uses for spreadsheets. Standardized templates are set up and used for all clients. An auditor inputs figures from client's trial balance onto the work papers. The work papers group those figures to proper lead schedule and financial statements. The respondent claims that auditors use spreadsheets primarily for auditing fixed assets, accounts receivable and cost of inventories, mainly allocation of overhead costs. From the sample work papers, confirmation letters sent to accounts receivable are also prepared on spreadsheets. The firm also uses spreadsheets for tax calculation. The calculation sheet is set as a standardized work paper. The respondent claims advantages of using a predefined tax worksheet: *"We can update a new regulation onto the worksheet. It enables novice auditors to do it. The work sheet includes the instruction that auditors can follow. This way everyone can do it the same way. We can use it as a quality control in audit work."* Another example is cited: *"For payroll testing, we also have standard form. However, clients do not provide us with soft files for payroll because the information is strictly confidential."*

Spreadsheets are not used for sampling during test of balance phase. However, spreadsheets are used for assisting sampling procedure by sorting and filtering necessary information. For example, spreadsheets are used for sorting accounts receivable into high and low balance. Then auditors use stratified-sampling procedure to pick accounts receivable record to be tested.

### Uses of spreadsheets during the reporting phase

Spreadsheets are used for preparing financial statements and notes to the financial statements in order to ensure accuracy of calculation. *"It is very good for checking. MS-word cannot check calculation accuracy. However, the links between financial statements have not been established. We use typists to prepare financial statements."* Auditors usually draft the financial statements using spreadsheets and send the files to typists for formatting. The financial statements are, then, filed to the central server for future references. The respondent claims an advantage of using spreadsheets: *"I usually correct wordings and check some figures. But if*

*auditors prepare financial statement using Excel, I do not need to recheck the figures on a calculator.”*

The firm does not spreadsheets for making decision on what type of report or adjustment should be given. The respondents state that audit judgment can be used by skimming on financial statements.

#### Other uses of spreadsheets

From the review of electronic work papers prepared by auditors of the firm, the uses of spreadsheets to assist audit work are complicated. Features such as filter, sorts, and complex functions and calculations are used throughout audit work papers. The combination of complex cell references and conditions (if function) are set and formatted on work papers are predefined and standardized for use throughout the firm.

#### Audit work which cannot be done without spreadsheets

The first answer that comes to the respondent’s mind is about the efficiency improvement gained from spreadsheets. *“Nothing changes. Excel provides more efficiency and accuracy. We can still prepare work papers manually. If the work is rush, Excel gives more opportunity for us.”*

There are two areas that are claimed not able to be done without spreadsheets, the ability to work on the same information (files) simultaneously, the ability to pool and analyze clients’ data. The respondent gives example of how electronic worksheet can facilitate the work: *“We can divide our work to many staff on spreadsheets. For example, some report, some work, or some deal, we can split them to many assistants at the same time. We can do our work separately and pool them later. We can have several copies of data in order to perform different work for example two auditors may perform two different works on the same fixed assets register. Having many auditors working on the same tasks at the same time is the major advantage of spreadsheets.”*

The firm also plans to establish clients’ database as knowledge bases for each industry. Currently, the information is on spreadsheets, but the firm wants to use other application.

#### The area where spreadsheets cannot be used

The respondent gives an example of where spreadsheets cannot be used in audit work: *“I feel more comfortable with paper-based. Some of them, I want to see the original copy of work papers to ensure the validity of the work for example bank confirmation. A client used to give us a fake bank confirmation.”*

#### Use of spreadsheets to a higher level

The firm is jointly developing a spreadsheet-based risk assessment application with other 3 audit firms. The respondent claims that the shell has been done, but the content. The content needs to be a combination of audit approaches from all participating firms. Besides, the process has been ceased because of a partner's personal reason. The partner acted as a leader of the developing team. Therefore, the project has no progress. The original time frame to implement a new system is 2007. However, it is postponed to 2008.

In addition to a risk-assessment application, the firm plan to use full managerial system in order to manage the clients and staff. Presently the evaluation is done on an overall basis based on each division. A well-designed system will give more necessary information for managerial needs.

### **5.5.2 Spreadsheet infusion enablers and inhibitors**

Partner involvement and staff turnover are the main reasons for the firm to develop the use of technology, especially spreadsheets, to the fullest potential. The firm exhibits a high reliance on the partner in infusing technology (Figure 5.5A)

In 2004, the managing partner with an external support from his friend developed a predefined work papers by gathering existing work papers done by the firm's auditors. The main purpose of the action is to harmonize and standardize the work papers. The team including managers from all divisions talked through the detail, developed and implemented standardized work papers into audit work. The team is set up as a pilot project. The managing partner implemented the application in a division. Once other team realized the benefits of the new application, they adopted and spread it over to other members. The use of the work papers are then required



by all managers. Along with the new work papers system, another external support was hired to set up IT structure within the firm. Formal trainings and two-way communication were provided to users. The managing partner made an electronic channel for his staff to communicate to him electronically on LAN ICQ if there are technical and other problems. The implementation was so successful that electronic work papers became a standard audit procedure within the firm. The respondent who is a partner makes a comment on the managing partner: *"The person also needs to be interested in technology. He likes IT. It is not just about being an auditor. Some auditors only interest in their work, but IT."*

In late 2005, the partner quit the firm for a personal reason. Even though the implemented application has been used, further development has ceased. A manager who is responsible for accounting technical support joined the project. However, the project still has no progress. In order to infuse spreadsheets in the firm, the respondent claims: *"I need someone who knows technology and also know our firm's work procedure. Maybe someone from external or a team from external could help us."*

Staff turnover is claimed as another reason that the firm need to use spreadsheets to the fullest potential. The respondent gives two explanations for why the firm chooses spreadsheets and why the standardized procedure using spreadsheets should be used. Most auditors are assumed to have basic spreadsheets skills. Besides, spreadsheets are also cheap. The respondent adds: *"If there is other user-friendly application, we may want to use it; however, auditors get used to spreadsheets."* She is also concerned about the application license which can be replaced with an open-source spreadsheet application developed locally. The application is very similar to spreadsheets. The format and standardize procedure will control the quality of work and working procedure. Therefore, new staff do not need extensive trainings. The respondent also states: *"A small firm like us will have trouble if we use complex technology because the turnover of the staff is high. We may have to train staff often because staff comes and goes. The higher technology we use, the higher training costs we have to spend. However, the use of predefined worksheet is easier because auditors get used to spreadsheets."*

A major inhibitor is the availability of other application. The respondent mentions how an international alliance, Moore-Stephen showed the firm the new application available to members. The new application is web-based and easy to use risk assessment software. The respondent claims: *“Actually, we just found out that Moore-Stephen already has used it. They just visited us earlier this month for a peer review. They showed us how to do risk assessment through their software. They set the formula that could calculate the sample size. I think we will use what Moore-Stephen provide us instead of waiting on our own program. If they come earlier, we might not develop the software ourselves.”*

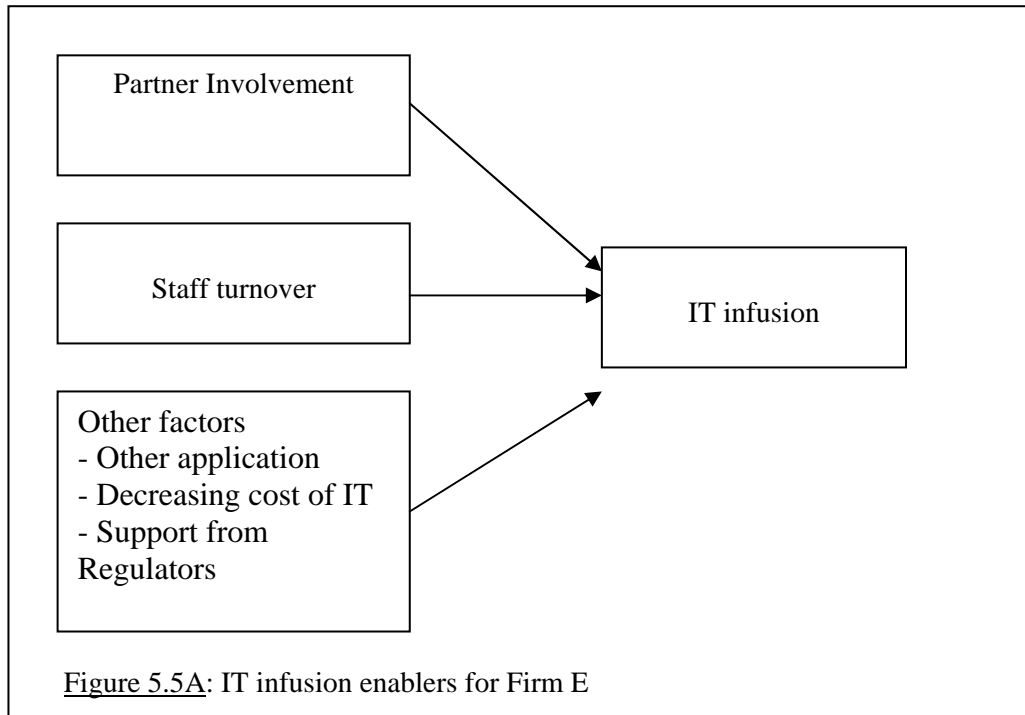
Other implied factors/inhibitors include the availability of hardware due to the decreasing price of laptops, the growing of accounting and auditing standard, the support from the regulators. The decreasing cost of technology makes it possible for the firm and auditors to afford laptops and to require auditors to work on spreadsheets.

Meanwhile, the improvement of accounting and audit standards require auditors to improve their work, through the use of technology. The respondent notes: *“At that same time if our Thai standards run toward international standards faster, we may need new audit approach or technology sooner. We need to support staff with hardware and training. However, spreadsheets are more for on the job.”*

The involvement of regulators in raising the quality of audit work for local firm is also mentioned by the respondent. The respondent adds: *“In China, there are standard audit programs which firms can access and use. But in Thailand, we need to help ourselves local firms.”* This also indicates that if there was publicly available content such as audit program, the new application might be used already.

During the course of interview, the respondent who is a partner of the firm shows her attitude toward technology in many statements. Originally, the technology is used for solving existing problems: *“We believe big clients lead to technology. We need to solve the problem and how to handle big clients.”* Then the firm uses technology to a higher level by creating a new approach of audit: *“In the past, we relied on clients for their business information. Now, we can do our homework by searching on the internet. When we talk to them, we can triangulate the*

*information you have gotten. Sometimes, CFOs of our clients does not know some detail in their own company; for example, the CFOs may not know what business transaction or in what company the management also does or the major shareholders also invest. We can check the shareholders' list online. Technology helps us a lot."*



### 5.5.3 Analysis of IT infusion enablers and inhibitors

#### Executives' supports (Partner's involvement)

The case exhibits high degree of infusion through an executive involvement and an executive participation as a technology champion. In the case, three partners play different important roles contributing to IT infusion. Two partners give support in term of budget and encouragement and another partner participate in pushing technology through an innovation process. Jarvenpaa and Ives (1991) distinguish the difference between executive involvement and participation where involvement reflects attitude toward technology and participation reflects activities the executive has done concerning technology.

The finding about executive involvement is consistent to those of Barki and Hartwick (1989) and of Saga (1994) that it contributed to progressive use of technology and IT infusion. However, the contrast comes from the executive participation part. The study of Barki and Hartwick believes that executive participation seems to be short and temporal. The participation contributes less to the progressive use of technology. This can be explained that the prior study did not include an IT role of the executives on implementing new technologies.

According to Scheepers (2003), participators in an organizational innovation process play different roles in order to achieve the IT success. One of the most important role is an IT champion. IT champions are managers who actively and vigorously promote their personal vision for using information technology and get it investigated and implemented (Buswick, 1990; Beath, 1991). There are two supporting factors that make the IT champion in this case very successful. The champion gets necessary supports and his or her personal characteristics. The champion himself or herself plays two roles which are IT champion and organizational sponsor at the same time. He or she not only supports himself or herself and his or her beliefs with necessary resources but also negotiates further resources with other partners. It is crucial that the sponsor does not leave the process before a new idea survives Scheepers (2003). Where new ideas come from a deeper application of spreadsheets, the ongoing support from the sponsor is very important.

Scheepers (2003) states that the role of IT champion is significant during the initiation and disappears into the background as technology progresses. However, in the case of using spreadsheets, an innovation process is on-going. The champion has continuously delivered new ideas of using spreadsheets to the organization as the partner claims that the company's progress of using technology is more a slow built-upon process. This can be seen from the fact that as the champion quit from personal reason, the whole infusion process stopped.

### Staff turnover

Staff turnover is an important factor contributing to a progressive use of technology in the organization. The firm advances the use of technology in order to establish a standard approach of audit based on technology. Several predefined work papers such as tax calculation and lease amortization tables are implemented to help new auditors and replace a traditional way of audit tasks. The firm shifts its reliance on audit expertise in some tasks to a more standard system which can be used by less-experienced auditors. The firm also used technology as a mean of control over audit quality from tasks done by these less-experience auditors (Manson et al., 2001). Spreadsheets are chosen based on the fact that it is the most commonly used software for all accounting and auditing graduates. Minor problems still exist since some accountants who were studied in some institution are not skilled on spreadsheets and some of the older people psychologically refuse to adopt spreadsheets. Those minor problems can be solved by offering training and persuading. The new predefined work papers incorporate technology into audit tasks. This indicates a higher level of extended use. The establishment of workflow systems through the use of spreadsheets, therefore, exhibits a higher level of integrative use of spreadsheets.

### A pilot team and its championship role

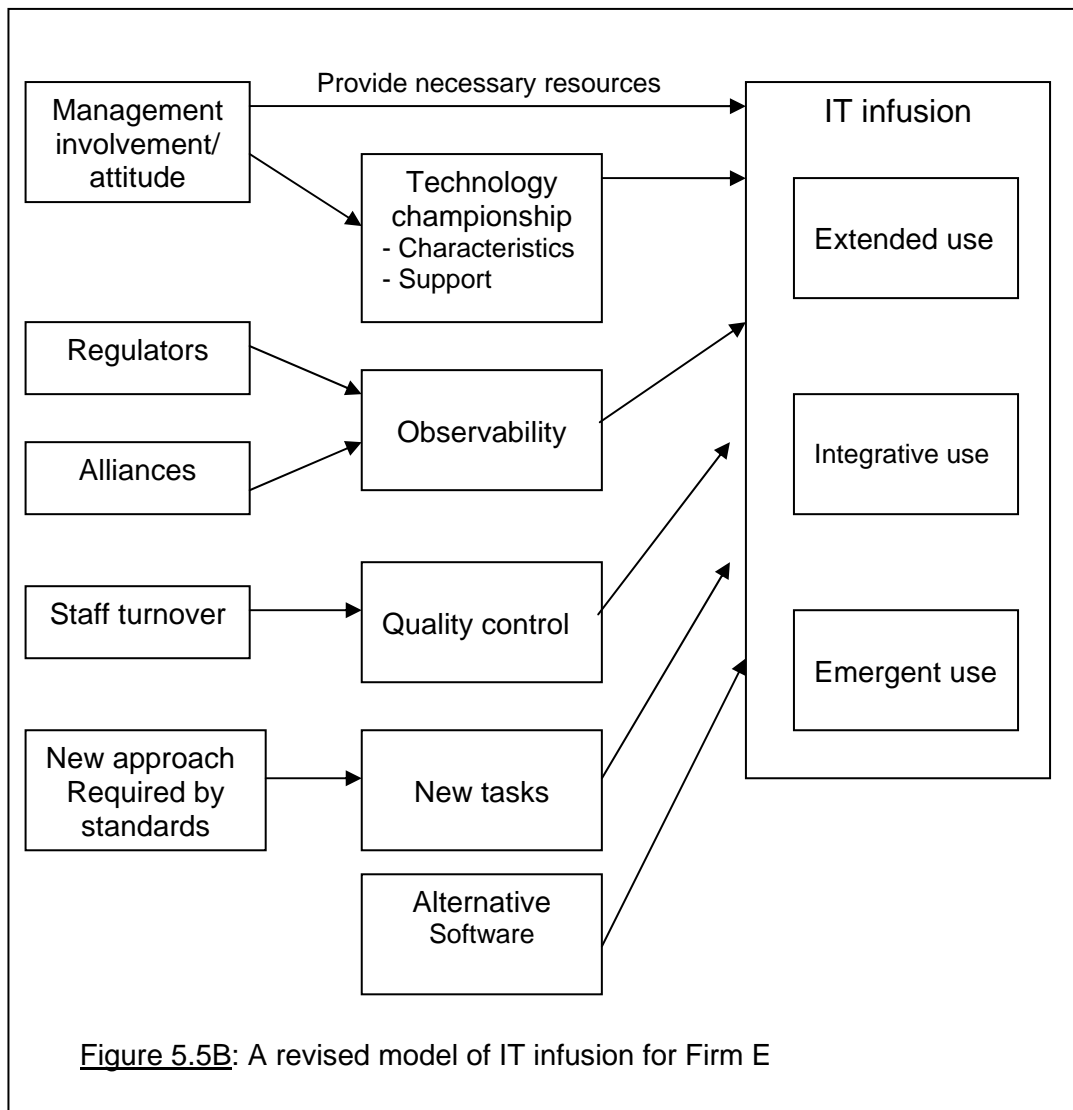
A pilot team also plays an IT champion role. A pilot team has been set along with the work of a partner since 2004. A pilot team has been given supports necessary such as resources, time, etc. (Beath, 1991). The team targets at initiating new ideas and diffusing them to other members of the firm. However, the pilot team neither gives a new idea to the firm nor progresses any use of spreadsheets. This reflects the fact that the combination of supports (Beath, 1991) and an executive involvement (Barki and Hartwick, 1989) do not give enough force for a firm to be successful in using technology. Executive participation and the characteristics of the champion are more important. The possible explanation is that in a professional firm, an executive is a person who is recognized as an expert in the field; he knows what he is doing. This makes the most appropriate person to play an IT champion

role. In contrast, in most firms, an executive may not know what the tasks for all members are. He or she cannot support other members.

#### Other factors/inhibitors

The decreasing cost of technology contributes to IT infusion through the availability of IT resources to staff. The availability of the hardware should be considered more as a prerequisite than as a factor. However, the prior studies may miss this factor because they assume the availability of technology hardware through the studies of bigger organization. In a smaller business context, this factor may be reflected by management's support, sponsorship and involvement.

Regulators and the improvement of standard of works also contribute to IT infusion. Regulators help increase observability of how tasks should be performed which the firm currently obtained partly through strategic alliances (Winston and Dologite, 1999) and the network of IT champion (Buswich, 1990). The improvement of standard of works, on the same direction, pushes the firm to apply spreadsheets to new tasks through relative advantage of the application (extended use and emergent use).



Lastly, the availability of alternative software is claimed to inhibit the infusion of spreadsheets. This claim ignores any transaction costs that may happen from the switching of technology used (Castner and Ferguson, 2000). It can be implied that where the use of spreadsheets is deeply embedded with tasks as extended uses, there will be some switching costs because users need to learn how to use the new application. Assuming that there is no additional cost for a new application, when a brand new task is established, the switching costs may be slim to none with the use of new application compared to reinventing the old application. It is highly probable that the availability of other software may affect infusion of spreadsheets through the measurement of an emergent use.

In conclusion, the case suggests that the factors contribute to IT infusion differently. Some factors contribute to IT infusion through other factors and some of them may contribute or inhibit IT infusion in some aspect. (See Figure 5.5B). However, the case does not suggest the interaction among three pathways of infusion measurement.

#### Measuring of IT infusion

The evaluation of Firm E yields an infusion score of eighteen (eleven for extended use score, four integrative use score, and three for emergent use score). These score are given based on how many task categories spreadsheets are integrated into, the links between work flows, and the attitudes toward using the spreadsheets.

This case establishes the whole set of infusion measurement through the fact that Tasks and technology features are totally separated constructs and they can be measured differently through 3 pathways of use. On an overall basis, the use of spreadsheets has been integrated in both operational and managerial work. Most audit works have been recorded and assisted by spreadsheets. The use of spreadsheets has become a policy for the whole firm for an operational function which involves audit tasks. However, spreadsheets have been applied very little to managerial work and the firm plans to use other application to assist the work.

In the study of Saga (1994), features and tasks are assumed to be a one-to-one function. Saga defined a measurement of an extended use as assessing “*the number of IT features applied within a comprehensive set of work tasks*” (pp.141). Meanwhile, her questions on the survey measure the number of tasks accomplish by using the systems. Therefore, the more features used, the more task IT has been integrated and vice versa. The score was calculated based on how many items the respondents answered “yes”. However, the case shows that users can use different features to do the same tasks. For example, an auditor may use command sort or filter to assist stratifying of accounts receivable. Presumably, the feature that is more efficient reflects a higher degree of infusion on an extended use evaluation. On the other hand, features that are less efficient but may establish a higher degree of interconnectedness may contribute to integrative use.



### *Extended use*

The case exhibits a high score on extended use. The total of 11 from the total infusion score of 16. The total comes from planning-2, test of control-2, test of balance-4, and reporting-3. The highest score is from the test of balance phase on which auditors focus most of their attention. Even though the first two phases are ranked 2, the case is on the process of developing the next level of use.

### *Integrative use*

Where evidence that exhibit interdependently on others of the respondent were counted and reported as an integrative use score in Saga's (1994), the case report the integrative use score on a 10-Likert scale ranked by the respondents. Two questions are asked.

On a scale of 1-8, how much do spreadsheets establish interconnectedness among audit works?

On a scale of 1-8, how much do spreadsheets establish interdependency of your work on other auditors' works?

Evidently, the firm establishes a work procedure for the staff in order to control the work quality. The staff becomes dependent on the work flows instead of other members of the system. This fact questions whether an integrative use should be measured based on the interdependency of members. The complete workflows, therefore, should reduce the dependency on people as expected by the firm.

### *Emergent use*

One of the emergent uses claimed in this case is ability for users to work on the same data at the same time. This is also claimed to be an integrative use (Saga, 1994). This raised the fact that three pathways can be overlapped and correlation among them. Integrative may not cause an emergent use as suggested by Saga. Or an emergent use cannot be separated from other use.

## **5.6 FIRM F**

Firm F was founded 14 years ago by partners who worked for an international firm. Services provided include accounting services, systems analysis and designs and other assurance services. The firm employs approximately 40 staff. The audit department has approximately 25 staff while other staff provide accounting services and a few staff work in administration. From an annual income of Baht 15 million, approximately one-half comes from statutory audit services and approximately 20 per cent comes from other assurance services. The firm provides services to more than 300 audit clients. Audit fee ranges from approximately Baht 10,000 (NZD 500) to Baht 300,000 (NZD 15,000). There are no clients which are listed with SET. Clients operate in various businesses. Manufacturing firms are viewed as a more complicated industry because the audit procedures used are more complicated. Most of the manufacturing systems are computerized. Some clients operate on AS400 and JDEdward.

There are no clear divisions or teams in the audit department. The ranks include partner, senior auditor, semi-senior, and junior auditors. The interviewee is the senior auditor who is responsible for conducting fieldwork, planning, and reviewing some of the other auditors' work. There are five senior auditors in the firm. The firm use monthly-contracted IT support for hardware. Staff help each other in term of software.

### **5.6.1 The use of spreadsheets**

Spreadsheets have been used for four to five years. Spreadsheets were introduced to the firm operation as part of an investment in computers. The original objective of the investment was for the firm to provide other assurance services. Auditors began using computers about four years ago, after computer became available from other assurance services.

The first use of spreadsheets in audit work was for preparing audit lead schedules. Preparing lead schedules is claimed to be a time-consuming task especially when clients have many accounts. At an earlier level, auditors still worked manually but

switched to computers when they were free from other work. When auditors began to use computers more, the partners decided to invest in more computers. Most of the other assurance services clients required computers, as their systems are large. The auditors needed more facilities in order to provide both statutory audit and other assurance services.

The development or application of technology into work is a continuous process. Nowadays, senior and semi-senior staff have their own laptops. Other auditors share a pool of approximately ten laptops. Most audit work is done using spreadsheets; however, some small and easy work papers are prepared manually. The interviewee claims that he wants them to all be computerized. There is no policy on using spreadsheets. Partners require print-outs for their work. However, they do not get involved in other audit processes. Auditors are free to use any approach to finish their work.

#### Uses of spreadsheets during the audit planning phase

The firm uses predefined templates to record general information about clients. The templates were developed by the interviewee with the content from the partners. Spreadsheets are viewed as easier to use and organize than other work processing software. The templates include some ratio calculation for which Spreadsheets are suitable. In addition, auditors are more accustomed to spreadsheets than to word processors.

Auditors conduct analytical procedures, but the partners make decisions based on overall results and perform additional risk analysis. Even though auditors use spreadsheets to prepare figures for analytical reviews, there is no evidence that partners use spreadsheets to help make decisions, because all work papers must be printed for the partners' review. The templates are not used for all clients. They are used for big clients. Mostly the templates are diffused to other auditors when senior auditors supervise their subordinates. Auditors adopt the templates voluntarily; however, the interviewee has an informal influence, as a direct boss of his subordinates.

The interviewee claims that the firm has a Spreadsheets-based risk analysis program but the firm does not use it since clients' size and transactions are not

complicated. The audit program is developed on word-processing software using a standard audit program of the firm, with a reference to judgment-based analytical results. Spreadsheets are not used for managerial work such as staffing and audit budgeting.

#### Uses of spreadsheets during the test of control phase

Spreadsheets and Visio are used as primary software during test of control phase. Visio is used for drawings of system flowcharts, while spreadsheets are used for recording narration and questionnaires. Spreadsheets are also used for recording results from control testing. Even though the questionnaires were standardized, the uses of Spreadsheets are not restricted by the firm. The interviewee repeats: *“Excel is easily formatted and everyone knows how to use Spreadsheets more than any other software.”* The control evaluation is still based on audit judgment. There are no statistical models to evaluate results.

Spreadsheets are used for statistical sampling during test of control. Auditors use Spreadsheets for calculating sample sizes needed and for picking samples from clients' records. The sampling procedures were obtained from general sources on the internet. Some auditors who perform services for big clients also use these sampling procedures. The results from control testing are evaluated by audit judgment. The interviewee states: *“This is not a full system. We use Excel to help us. Finally, it is still us who make the decisions. All these processes can be used immediately without consulting the partners because there are small effects on the financial statements. Partners may not accept Excel for some applications that may effect the financial statements.”* The partners also confirm that they focus on the results, not on how their assistants pick samples. The interviewee explains further: *“It may be because auditors do not focus on control testing even though auditors believe that control testing is necessary for limiting the scope of audit work during the test of balance phase.”*

The interviewee used to use MS-Access to help with audit work during this phase but he gave up because other auditors in the firm do not know how to use MS-Access.

#### Uses of Spreadsheets during the test of balance phase

The application of Spreadsheets to test of balance begins with preparing audit lead schedules. The templates have been set up for four years. The original version is used to group clients' accounts in order to prepare financial statements and for audit purposes. The current version templates include more detail such as ratios and common size analysis. Audit materiality is calculated on predefined templates. The templates are equipped with materiality calculation criteria based on five factors with instructions on how to use those criteria. The previous year's data is also given by the templates. Auditors do not use the blank template, but the template used in the prior year. The templates are used throughout the firm. Users can modify the templates as they wish. Even though the firm does not set the use of templates as a policy, they are implemented by managers who require their subordinate to prepare work papers on spreadsheets. On the other hand, partners require paper-based work papers from all auditors and do not require the use of Spreadsheets.

Most tests are performed and recorded using spreadsheets. The areas where spreadsheets are applied are audit of fixed assets, cost of inventories and accounts receivable. Audit of fixed assets composes of three standard work papers. These are test of additions, test of disposal, and test of depreciation calculation. Generally, auditors receive a soft-copy of records from clients. Spreadsheets can test the data from the file directly. Another area to which spreadsheets are applied is the cost calculation. The template is customized in order to suit particular clients because they have cost calculation methods and data formats.

Spreadsheets are not used for sampling during test of balances. The interviewee stated that sampling at this stage is more complicated. Sometimes, the auditors consider other factors such as the nature of the transactions or items. Auditors usually obtain a list of accounts receivable with aging analysis from the clients. They then use filter and sorting features in spreadsheets in order to stratify accounts receivable based on their balances. Accounts receivable with higher balance tend to be selected for testing more than the ones with lower balances.

The firm has most forms in spreadsheet format; for example, accounts receivable confirmation letter and bank confirmation letter. The confirmation letter is prepared by entering accounts receivable code and VLookup function. The function will automatically fill in accounts receivable details in confirmation letters to the corresponding accounts receivable code input. Auditors input accounts receivable codes individually and print each confirmation individually.

#### Uses of spreadsheets during the reporting phase

Spreadsheets are used for preparing financial statements and MS-word is used for preparing notes to the financial statement. The auditors prepare all draft financial statements. Audit judgment is used for making decision about what kind of audit report should be given.

Adjustments are linked to financial statements in the audit work papers; however, the final financial statements are separated from the work papers. The firm uses the administrative department as a central information center. At the end of the audit cycle, all work papers are printed and filed permanently.

#### Other features in spreadsheets

The firm also use some functions such as internal rate of return (IRR) and net present value (NPV). Those functions are part of a predefined template to prepare hire-purchase schedules, loan amortization schedules, and leasing schedules.

#### Audit work which cannot be done without spreadsheets

All spreadsheet applications are claimed to support audit work. Therefore, auditors can perform their work without spreadsheets. However, a new technique was added. The interviewee claims: *“All audit works can be performed manually, but it is too slow to do so. We did all audit work manually in the past. For example, we can calculate sample size for testing manually; then, pick samples to be tested. We may pick samples with bias in that case. Excel standardizes our procedures at some level. Audit procedures are the same as before, but some new techniques. Real random cannot be used without Excel.”*

#### Use of spreadsheets to a higher level

When defining infusion, the interviewee refers to the audit process. *“The firm reaches infusion when Spreadsheets are used in all work and for all clients.”* Infusion is also thought of as the integration into audit work, and as the width of application. In addition, the interviewee views infusion as the use of all features of spreadsheets even though auditors may not need to use all those features.

The interviewee used MS-Access to compliment Spreadsheets for supporting audit work. However, MS-Access was discontinued because other auditors were not used to MS-Access.

### **5.6.2 Factors/inhibitors to IT infusion**

Staff and relative advantage are claimed to be two most important factors enabling infusion of Spreadsheets. The interviewee claimed that the application of Spreadsheets to audit work has come from his self-study and from information over the internet. The interviewee states: *“When I tell other people to use it, I tell them that it can be used to save time.”* Other factors include the availability of the resources, which are hardware and a knowledge base. A big change from manual auditing to computer-support auditing happened when computers were brought into the firm.

Other supporting resources such as knowledge are needed in order to use spreadsheets to a higher level. The interviewee states: *“I cannot think of other applications of Excel to audit work. Excel can be used for calculating results, but other information is needed to be gathered. We do not have such information. We think of gathering the information. At this stage, we cannot do it because our information is limited. In order to reach a higher level, we need a model; maybe from the internet.”*

Staff can also be an inhibitor of the firm. In general, staff competency and efficacy seem to discourage development. When a new use is suggested to auditors, auditors usually say: *“It is enough. We do not need to know more.”* Even though the management supports the use of spreadsheets by investing in hardware and software, the action toward technology is different. Partners require print-outs or paper-based work papers. Sometimes, auditors choose to prepare work papers

manually in order to provide results to the partners immediately. The interviewee says: *“Sometimes, we have to prepare work papers manually because partners require some paper-based work papers to be reviewed especially when there is no printer we do it twice. I want to change our partners. I want the firm to be paperless. We have problems when partners ask us to print during the fieldwork.”*

The interviewee also implies a few more factors such as observability by stating: *“I cannot think of more application of Excel to audit work. I cannot think of anything else. But I think the firm reaches nine out of ten. One is for something I do not know.”*

The interviewee also makes further comments on how spreadsheets promote the interconnectedness of audit work and procedures: *“Link of Excel from one process to an other process? This is considered a high risk area because they may have errors. Links can be made among sheet, but among files. We prefer to prepare each piece of work separately. We are aware that when we change something it will not affect other things without noticing.”*

### **5.6.3 Analysis of IT infusion enablers and inhibitors**

The infusion process in the case is common. The infusion starts with an IT champion in the firm and diffuses to other staff. However, IT infusion process is not a one-way process. An IT champion usually introduces an application of software into audit work. An IT champion may fail to convince other staff members to use the technology retaining the use to himself / herself and waiting for other members adopt the technology

The discontinuation of MS-Access in audit work also implies that in order for an IT infusion to happen, an innovation needs to be adopted by other members of the organization. The IT champion alone cannot complete the implementation and infuse the innovation if it is refused by other members. This finding is consistent with prior studies, that IT diffusion is related to IT infusion (Cooper and Zmud, 1990; Eder and Igbaria, 2001). However, the effect is considered to be at an earlier stage. Once the members adopt the innovation, the infusion can be increased by the

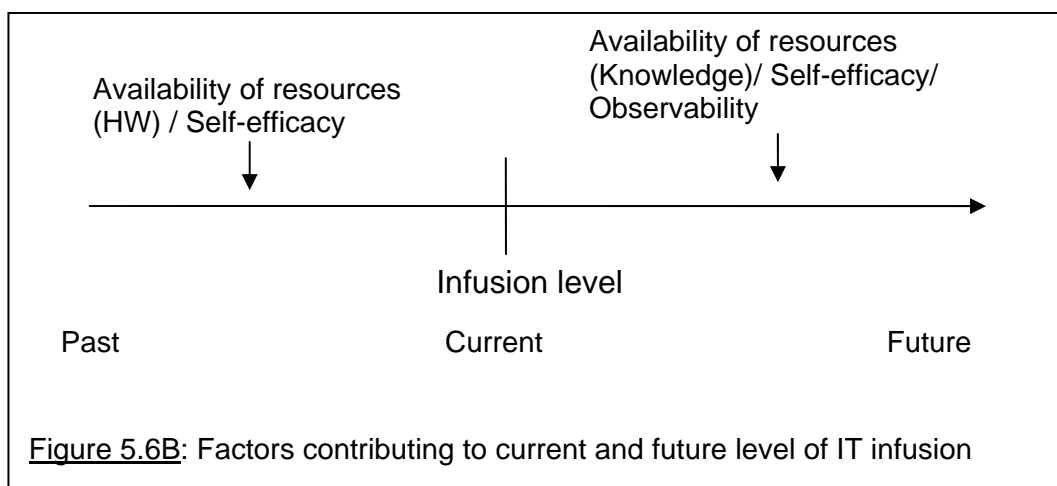
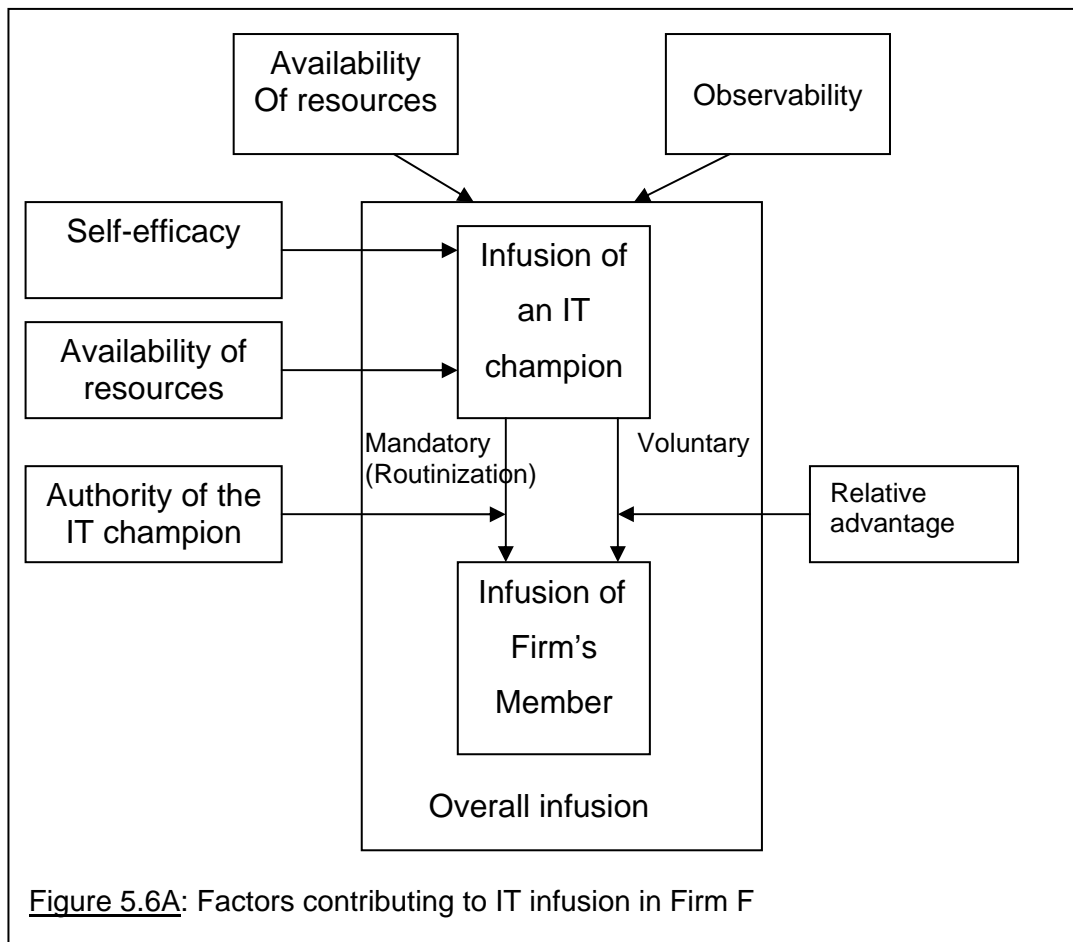


champion. This raises a question of whether IT infusion can survive and continue with a big gap of infusion assimilation.

#### IT infusion enablers and inhibitors

The most important factor in this case is the availability of an IT champion and other resources (See Figure 5.6A). These factors are consistent with those found to influence an organizational innovation process (Rogers, 2003; Eder and Igbaria, 2001). Where there is an IT champion in the firm, the highest infusion level will occur; therefore, it is possible that individual level factors play an important role. On the other hand, the case suggests that an innovation must be accepted by other firm members or it will be discontinued. Availability of hardware is the primary driver for the use of spreadsheets in audit work in the first place. Spreadsheets become common in audit work when auditors realize the superior ability (relative advantage) of spreadsheets to the traditional manual audit approach. This case also separates factors relating to the current level of infusion versus the higher level of infusion. Observability is claimed to be a factor that may help the firm to infuse technology to a higher level in the future (See Figure 5.6B).

Where there is lack of management involvement, the combination of relative advantage and self-efficacy play the most important role for technology infusion in an organization. Self-efficacy is defined as personal judgments of one's capabilities to organize and execute courses of action to attain designated goals (Bandura, 1997). Self-efficacy allows the IT champion to apply Spreadsheets to conduct a sampling approach on auditing and to diffuse the approach to other firm members. Relative advantage by the application of Spreadsheets also helps the champion and firm member to reach audit results more efficiently.



The lack of management involvement can positively influence IT infusion. Once the technology negatively affects the management's expectation, the management can become involved and discourage the use of the technology. This can be seen by

the fact that partners will not accept computer-based work papers. They work with their own approach, expecting auditors to produce what they want. This fact also helps explain why the infusion may not reach the highest level, as the technology is not applied to managerial work by the management.

### Measuring IT infusion

The evaluation of Firm F yields an infusion score of eleven (nine for extended use score, one for integrative use score, and one for emergent use score). These score are given based on into how many task categories spreadsheets are integrated, the links between work flows, and the attitudes toward using the spreadsheets.

IT infusion in the firm can be viewed as an overall measure or by three other perspectives of used, discussed before. How an IT infusion is measured is also related to factors contributing to IT infusion. For example, the overall measurement from the self-reporting relates to observability.

#### *Extended use*

The degree of integration of Spreadsheets into audit work in this case is high. In terms of numbers of tasks, the firm relies heavily on spreadsheets for testing of balance phase, partly for testing of control, and for recording purposes on any other phase. Even though the use of Spreadsheets is applied to most clients (in term of width of use on client's portfolio), there are some clients for which spreadsheets are not used. Partly, it is because spreadsheets do not offer relative efficiency to the manual approach and the use of Spreadsheets are not a policy of the firm. In term of task complexity (Bonner, 1994), Spreadsheets are applied to low- and medium-complexity tasks, which are recording and calculating figures and ratios. A predefined template is not standardized. Therefore, it cannot be used as a control of audit quality (Manson et al, 2000). Neither complicated data mining procedures, judgment related tasks or unstructured tasks, are conducted using spreadsheets.

#### *Integrative use*

The results from the firm show that to a certain level spreadsheets can promote interconnectedness within audit procedures since audit procedures are traditionally divided into pieces. The interconnectedness can be within the same phase; for

example, during test of balance, spreadsheets link from the initial tasks to the end. Interconnectedness can also be viewed as how many people are linked into the procedures. The evidence shows that even though audit tasks are linked from the beginning to the end of each phase, it may not link all people involved in the procedures together. The case implies that the measurement can be separated more according to detail in the tasks themselves, than by the people involved in the tasks. The factors related to infusion of two measurement of interconnectedness may also be different. It can be assumed that relative advantage promotes infusion among tasks while the staff factor may enable or inhibit infusion among people involved in the tasks.

#### *Emergent use*

This factor is not obvious but it can be assumed that the measurement of infusion through this perspective is moderate. Some tasks, such as sampling, cannot be done efficiently without spreadsheets.

### **5.7 FIRM G**

Firm G was founded about 50 years ago and is one of the oldest audit firms in Thailand. The firm has five partners who share the management roles of the firm. The partners have their own teams, comprising of a manager and assistant auditors. The audit teams are clear cut and separated from one another. The firm shares strategic planning and investment; however, each partner makes decisions for their own teams. The firm employs approximately 70 auditors and 10 administrative staff.

The firm focuses on auditing service with an annual income of Baht 50 million (NZD 250,000). Other assurance services such as due diligence are rarely provided. There are approximately 300 clients, with audit fees ranging from Baht 20,000 (NZD 400) to Baht 1 million (NZD 50,000). Clients operate mostly within the manufacturing industry. Some other clients provide services. The firm does not provide services to financial institutes or any other clients in special businesses. There is no external IT support. The firm uses the staff to maintain the system.

### 5.7.1 The use of Spreadsheets

Spreadsheets have been used since 1992 when the firm adopted the use of the Windows operating system. In an earlier period, the firm used Spreadsheets to prepare financial statements. Auditors did not use Spreadsheets in the work. The increased availability of hardware gave auditors the option of using spreadsheets about 10 years ago. When spreadsheets were first adopted, auditors needed to learn how to use them. Nowadays, most auditors have studied Spreadsheets in school. They learn how to apply spreadsheets in their work in the firm.

In all phases, auditors use spreadsheets for recording and printing data so that there is no need to redo work. Spreadsheets are used like a word processing-application. *“Most auditors use Excel to record and print, because they begin working with Excel, use Excel, and end with Excel. Even though Excel cannot format document properly, they still use it”*

#### Uses of Spreadsheets during the audit planning phase

The firm does not use spreadsheets during this phase. Mostly the firm gathers information from the clients based on a checklist form. The preliminary analytical procedure is done on the client's report. The partners who accept each client pass the clients' documents to their managers who analyze figures and write on the same papers. Most memorandums are prepared using paper-based work papers. *“We do not use a laptop at this stage. Auditors in our generation write on a paper. I, myself, cannot type; therefore, I do not use a computer to record information. It is more convenient for me to write on a paper and it does not make any sense to retype.”*

#### Uses of spreadsheets during the test of control phase

The firm uses questionnaires as a primary tool for evaluating clients' internal control. The understanding of internal control and work flows are done at the same time as testing the transactions.

*“Excel is used for recording what we have tested. The advantage of using Excel is that we do not have to rewrite the data. We pull out last year information and input new information.”*

*“We do not use Excel for sampling because we do not have skills. We cannot think of how Excel can give us the samples. I tried generating a random number table, but I have no idea how to use the table. The set of numbers change when I tried the new table and I do not know how I can refer to statistical theory.”* At present the firm samples clients’ transactions to test using systematic method; for example, sampling every 100<sup>th</sup> transaction to test. The firm’s primary objective when sampling is to cover all types of transactions. The revised audit program is done based on the auditors’ judgment. Conclusions are not drawn from statistical analysis or from a particular model.

#### Uses of spreadsheets during the test of balance phase

The firm uses spreadsheets to prepare audit lead schedules. Auditors input figures from clients’ trial balance into spreadsheets and classify them into the format they want. There is no predefined template. *“We cannot set up the template because the information varies from a client’s to others.”* The interviewee claims that all auditors use Spreadsheets because they do not want to redo their work. Auditors simply use work papers from the previous year and input current year information. The firm also uses Spreadsheets to calculate financial ratios and for trend analysis. (29.48)

Spreadsheets are used primarily for recording information. Auditors test calculations from clients’ reports instead of obtaining soft files. For example in order to test depreciation calculations, the interviewee states: *“We use report from the client and test fixed assets register individually. We do not test addition of total figures because we cannot do that. We cannot input all detail into Spreadsheets in order to test calculation.”* When the interviewee was asked how auditors test calculation from leasing or loan amortization schedule, the interviewee claims that auditors just test based on the clients’ paper-based report. However, the interviewee states: *“We allow auditors to do their work freely. I do not know whether other auditors may use Spreadsheets to help testing calculation.”*

#### Uses of spreadsheets during the reporting phase

Spreadsheets are used for preparing financial statements. The use is primarily for printing. The interviewee cannot think of how Spreadsheets can be used for other

audit work. *“I cannot imagine of how we can use Excel to do judgment related work. Most decisions about reporting, for example, are obvious; therefore, auditors do not need computerized tools.”* If spreadsheets could be applied, it should be applied to setting up audit programs.

#### Audit work which is cannot be done without spreadsheets

The trial-and-error of calculating new ratios, which may take significant lengths of time, would not be done without spreadsheets. Without spreadsheets, auditors would only stick with the old ratios and an old analysis approach.

#### Use of spreadsheets to a higher level

The next level of use by the firm is the use of predefined templates. The current usage is subject to each individual's skills. Spreadsheets should also be used during planning phase in order to set up the audit scope. In addition, the interviewee believes that spreadsheets can help determine the sample size for transactions/balances to be tested, but they cannot help pick up samples.

### **5.7.2 Spreadsheet infusion enablers/inhibitors**

An important enabler that contributes to the current level of use is skills of staff members. The ability to redo and to calculate figures are reasons that auditors adopt Spreadsheets into their work. A drawback of depending on staff members' skills is that the firm loses the skills and the infusion process stops if the firm loses the staff members.

In order for the firm to use spreadsheets to a higher level, an external support or a special division that helps the firm on audit approach and technology is needed. An external support must be an auditor who knows what other auditors need. An external support must be able to convince the management in order to gain support and reinforcement in convincing auditors any the new use of Spreadsheets is superior to the old approaches used. The interviewee claims: *“When we ask for more computers in the firm, the management asks what computers can do and why do you want more computers? Do you just use them for recording data? We answer that computers can help us perform the work faster.”* The interviewee

further claims: *“Auditors may disagree and do not use the new approach. Auditing is a professional career. Auditors can freely use their own approach if they can finish the work given.”* Any new use of spreadsheets must be enforced as a policy and the management must follow up whether it is used regularly. The interviewee views an integrative use as a use of database. One set of data should be used and linked to all works. In order to establish interconnectedness of audit work flows, an external support must also be brought in.

The interviewee makes further comments on an external support:

*“We want a separate person or a division that helps develop the use of Excel. The person must understand audit work and know Excel. This person should be from outside the firm. Existing auditors may not be appropriate since they may not be sure that other auditors will accept what they develop. Besides, auditors in the firm are so different. All divisions in the firm have slightly different audit approaches.*

*How an auditor from a division can convince other auditors in other divisions about the new approaches?”* The existing staff may think that the work as a developer is not fun.

- *Auditors have no time to do it*
- *If an auditor do it, how he or she convince other auditors to use (need a support from management)*
- *The follow-up. Supervisors need to check whether the new approaches have been used by their subordinates.”*

Inhibitors may come from the fact that auditors think the old approach is good enough. Auditors can complete their work using the old approach. On the other hand, auditors are afraid that if they make a mistake they cannot solve it. The interviewee comments: *“I do not know how it works. For example, when I try developing a complex worksheet or systems and we cannot find out if something wrong has happened. Therefore, auditors prefer the simple use with fewer links so that they can correct it if there are errors.”*

The lack of knowledge or skill is also another inhibitor. Auditors cannot apply auditing theories in their work. For example, auditors do not know how to apply

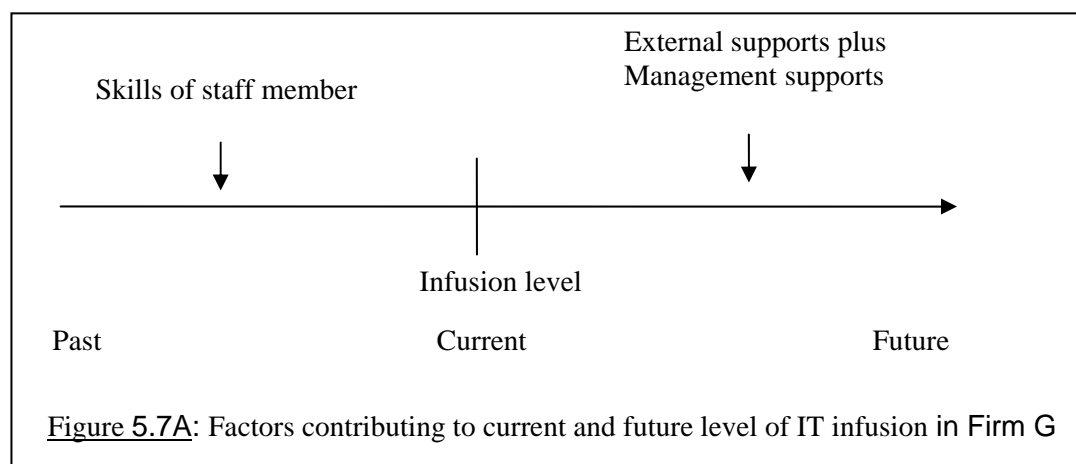


the theory of sampling for testing clients' transactions. *"Sometimes, we do not know how Excel can help audit work how Excel provides audit evidence. The benefit should be that Excel can be referred to audit theories and can go into clients' data."*

## 5.7.2 Analysis of IT infusion enablers and inhibitors

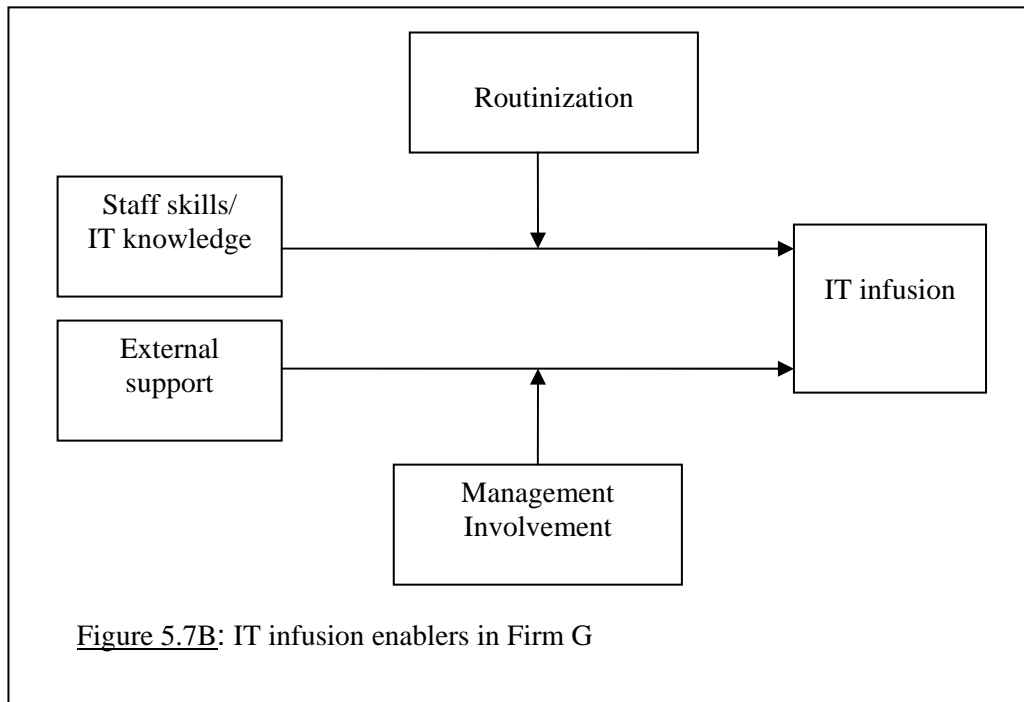
### Spreadsheet infusion enablers/inhibitors

The most important factors contributing to IT infusion in the firm are IT skills of the staff and an external support (Figure 5.7A). The factors affect IT infusion in different stage. Staff's IT skills and knowledge help infuse the use of technology to a certain level. In addition, the infusion of technology may need users to have other skills. An external support is needed to increase infusion level to a higher level since the staff's skills and knowledge are limited. An external support must also be enforced by the management. Major inhibitors include auditors' attitudes toward technology and the management as an IT gatekeeper as proposed by Davidson and Hart (1995).



The characteristics of an external supporter are also important to the infusion of technology within the firm. The external supporter must know both the firm's practice and their technological skills, and must be able to get support and trust from the management and the firm's staff members.

Other factors include routinization of technology in the firm. From the data collected, staff's IT skills and knowledge can infuse technology to a higher level with the support of routinization (Figure 5.7B)



### Measuring IT infusion

The evaluation of Firm G yields an infusion score of four which come from extended use. The score are given based on into how many task categories spreadsheets are integrated.

#### *Extended use*

The degree of integration of Spreadsheets into audit work in the case is very low. The technology is used for recording and some simple calculations. The firm still relies moderately on a manual approach. The technology has been integrated into a few tasks instead of being applied to all possible tasks.

#### *Integrative use*

Even though the technology is claimed to increase the interconnectedness of audit processes, the evidence shows that the audit processes are hardly linked. This fact

indicates the possible differences between a self-report measurement and the objective measurement which shows that Spreadsheets do not improve the interconnectedness among audit process. It is partly because users feel insecure about the system.

#### *Emergent use*

An emergent use can vary because of the auditing approaches used by the firm. The factor is inversely related to staff's skills and knowledge on the firm's practice before adopting the technology. Where staff are highly skilled, the staff use several innovative approaches in order to finish their work. The lower-skilled staff will be offered more approaches when adopting the technology. Therefore, the firm's overall skills and knowledge on the subject will affect the level of emergent use gained from the use of technology.

## **5.8 CONCLUSION**

The within-case analysis for all case firms showed that the firms were on different levels of infusion and had various IT infusion enablers and inhibitors which were analyzed in Chapter 6

# CHAPTER 6

## CROSS-CASE ANALYSIS: MEASURING IT INFUSION

Chapter 6 and chapter 7 present cross-case analysis of the data from seven case studies. Chapter 6 reports how the proposed measure has been used to measure IT infusion in seven case studies. Chapter 7 reports determinants and inhibitors of IT infusion from the cases. Findings from the case studies are reported in appendices along with within-case analysis.

This chapter begins with a brief description of the seven case studies. Then, the cases' uses of spreadsheets are mapped in order to measure infusion through three pathways of use and the concept of task complexity as proposed in the previous chapter. Discussion and analysis is provided along with conclusions. This chapter is outlined as follows:

- 6.1 The case firms
- 6.2 Measuring IT infusion
- 6.3 Conclusion

### **6.1 THE CASE FIRMS**

The case firms were selected from a pool of small audit firms in Thailand. The firms share some common characteristics, such as tasks performed and their business environment. These shared characteristics control for some factors while enabling the testing of the measurement constructs and other factors. Despite the common characteristics, the case firms were chosen to vary in size, IT infrastructure, IT support, and other factors claimed to affect an organizational innovation process (and IT infusion) from prior studies. The different cases were expected to yield a range of IT infusion levels. Table 6.1A provides some descriptive data for the case firms. In this study, firm size ranged from about 30 staff to 100.

	<b>Firm size (No of staff, Annual income)</b>	<b>Service provided Clients' characteristics</b>	<b>Firm structure</b>	<b>IT infrastructure/ IT support</b>	<b>External communication and Alliances</b>
Firm A	Staff: 30  Income: Baht 20 millions	Auditing, Accounting, and other related services  No SET listed clients	Flat, No clear-cut division	Necessary infrastructure provided  External support hired	Informal contact with other firms' partners
Firm B	Staff: 50  Income: Baht 50 millions	Auditing  Both SET listed and non-listed clients	Clear-cut profit-centered divisions	All infrastructure provided  Internal support provided  External support provided	Informal contact with other firms' partners
Firm C	Staff: 26  Income: Baht 16 millions	Auditing and other assurance services  Both SET listed and non-listed clients	Flat, No clear-cut division  Part-time staff	Some infrastructure provided  Internal support provided	Informal contact with other firms' partners
Firm D	Staff: 100  Income: Baht 40 millions	Auditing and other assurance services  Both SET listed and non-listed clients	Formal structure with 3 clear-cut divisions	Some infrastructure provided  No technical support	Formal - 75CPE  Informal contact with other firms' partners

Table 6.1A – The case firms' profiles

	<b>Firm size (No of staff, Annual income)</b>	<b>Service provided Clients’ characteristics</b>	<b>Firm structure</b>	<b>IT infrastructure/ IT support</b>	<b>External communication and Alliances</b>
Firm E	Staff: 80  Income: Baht 30 millions	Auditing, accounting, payroll, consultant, and legal services  Both SET listed and non-listed clients	Formal structure with 3 clear-cut divisions	Necessary infrastructure provided  Internal support provided  External support provided	Formal - 75CPE  A member of an international firm  Informal contact with other firms’ partners
Firm F	Staff: 40  Income: Baht 15 millions	Auditing, accounting, and other assurance services  No SET listed clients	Flat, No clear-cut division	Necessary infrastructure provided  External support provided	Informal contact with other firms’ partners
Firm G	Staff: 80  Income: Baht 50 millions	Auditing and other assurance services  Both SET listed and non-listed clients	Formal structure with 4 clear-cut division	Necessary infrastructure provided  No technical support	Formal: A member of an international firm  Informal contact with other firms’ partners

Table 6.1A – The case firms’ profiles (continued)

## 6.2 MEASURING IT INFUSION

Most small audit firms still used audit approaches that relied heavily on tests of balances (i.e. a substantive approach). Some firms paid little attention to audit planning and tests of controls. Most firms initially used spreadsheets to prepare financial statements during the reporting phase. The firms which provided services

to bigger clients such as Firm B and E also used spreadsheets to assist audit work during the test of control phase, while other firms used spreadsheets mostly as recording tools. The most common uses of spreadsheet in all cases were preparing financial reports and audit lead schedules.

### **6.2.1 Measuring extended use: the integration of Excel into audit work**

Table 6.2A summarizes how the case firms used spreadsheets to assist audit work. The extended use scores are presented in parenthesis. The table groups firms with similar infusion levels based on their extended use scores. The scores are based on counting the number of audit-task categories into which spreadsheets have been integrated. For example, Firm G got an extended use score of four. The firm integrated spreadsheets into three audit-task categories during the test of balance phase and one audit-task category during the reporting phase.

#### **Firm A and Firm G**

Firm A and Firm G used spreadsheets primarily for recording audit evidence and manipulating data for further audit procedures. In both firm, the spreadsheets were used for preparing lead schedule, testing inventory balance, and testing fixed assets balance. Lead schedules were predefined templates set by the firm. An auditor obtained a client's trail balance and input figures into an input section; then, templates automatically classified into auditing and financial statement formats. The spreadsheets were also used for preparing financial statements during the reporting phase. However, calculation or cell references were not integrated into the process at the reporting phase.

Even though both firms did not use spreadsheets during the audit planning and the test of control, the reasons seemed to be different. Firm A rarely conducted audit planning and control testing procedures by claiming that most of clients were small and the work was not complicated. The firm therefore focused on testing clients' balance. In contrast, Firm G generally conducted audit planning and control testing. The firm used checklists and questionnaires as primary tools in those two phases.

In addition to general use, Firm A shows a unique use of spreadsheets by adapting an asset valuation template downloaded from a public sharing website. The fact that the firm equally provides auditing and other services leads to the use of other end-user application (EUA) in audit work.

#### Firm C and Firm D

Firm C and Firm D used spreadsheets primarily for recording information and manipulating data for further audit procedures. Compared to Firm A and G, Firm C and D used spreadsheets in all audit phases even though they still concentrated on the tests of balance. During test of balance, both firms used spreadsheets to prepare lease schedule, tested some accounts, and prepared a loan amortization table.

Although both Firm C and Firm D integrated spreadsheets into most audit tasks during the tests of balance, Firm C seemed to use spreadsheets more extensively. Firm D used a manual audit approach, which did not require advance statistical calculation, to sample test clients' reports such as fixed assets register. Firm D claimed that its clients were not sizable to use spreadsheet. On the other hand, Firm C used spreadsheets as much as possible to reduce audit time. Firm C also partly applied statistical method into audit sampling procedures during the test of control phase by sorting records in order for them to be picked systematically. In the reporting phase, Firm D set up a template that helped auditors prepare statement of cash flows while Firm C prepared basic financial statements.

Firm C's staff used to bring in a risk assessment model which was later abandoned because it was too complicated.



Firm (Extended use score)	Audit planning (Phase I)	Test of control (Phase II)	Test of balance (Phase III)	Audit reporting (Phase IV)
Firm G (4)  Firm A (5)	None	None	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> <li>- Test of balances (accounts)</li> <li>- Predefined procedures -- Assets valuation template and predefined lead schedule (Firm A only)</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing reports – without calculation</li> </ul>
Firm C (7)  Firm D (7)	- Recording	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data (Firm C only)</li> </ul>	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> <li>- Test of balances (accounts)</li> </ul> <p>[Firm C integrates spreadsheets into most tasks while Firm D only integrates them into some tasks]</p>	<ul style="list-style-type: none"> <li>- Preparing reports – without calculation</li> <li>- Basic reporting – with some calculation (Firm D only)</li> </ul>

Table 6.2A – The case firms’ spreadsheet use in audit work

Firm (Extended use score)	Audit planning (Phase I)	Test of control (Phase II)	Test of balance (Phase III)	Audit reporting (Phase IV)
Firm F (9)	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> </ul>	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> </ul>	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> <li>- Test of balance (accounts):</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing reports – without calculation</li> <li>- Basic reporting – with some calculation</li> </ul>
Firm E (11) Firm B (12)	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> <li>- Risk assessment (DSS kind) (Firm B only)</li> </ul>	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> </ul>	<ul style="list-style-type: none"> <li>- Recording</li> <li>- Manipulating data</li> <li>- Test of balance (accounts)</li> <li>- Predefined procedures (Development of standardized lead schedules, lease and loan amortization table, Tax calculation sheet)</li> </ul>	<ul style="list-style-type: none"> <li>- Preparing reports – without calculation</li> <li>- Basic reporting – with some calculation</li> <li>- Advance reporting – statement of cash flows and consolidated financial statements</li> </ul>

Table 6.2A – The case firms’ spreadsheet use in audit work (continued)

### Firm F

Unlike other firms, Firm F first adopted spreadsheets in order to assist other services. The excess capacity of computers enabled auditors to use spreadsheet to prepare audit lead schedules. In most phases, spreadsheets were used for recording information and manipulating data for further audit procedures. For example, auditors recorded information and prepared figures for analytical reviews during the audit planning phase. During the tests of control and the test of balances, auditors recorded and prepared data for further statistical sampling procedures. Spreadsheets were also used for testing account balances. However, audit services for some small clients were performed manually. In Firm F, each auditors prepared financial statements and basic calculation features were used in order to prevent mathematical errors. The financial statements were then sent to an administrative department for finalizing the format and for printing. The financial statements were not interconnected to audit work papers.

### Firm B and E

Firm B and Firm E exhibited the highest extended use score among the selected firms. Two areas that spreadsheets were more highly integrated into Firm B and Firm E audit tasks were the standardized audit lead schedule and predefined models such as a tax calculation sheet and lease amortization tables, during the tests of balance phase. In addition, both firms used spreadsheets for preparing complex financial reports such as consolidated financial statements. These came from the fact that both firm B and Firm E had innovators who introduced new ideas into the firms. The use of spreadsheets became routinized in the firms. Both firms required all work papers to be prepared electronically.

While Firm E established a standard process through harmonizing existing applications of spreadsheets and redeveloped into standard work papers, Firm B simply attained the standard formats from an international firm. Therefore, Firm B shortens the development and start-up time by adopting some application such as a risk assessment program and all staff from an old firm.

In 2006, Firm E allied with other firms to develop a spreadsheet-based risk assessment application. The firm claimed that the risk assessment being developed would be the next phase of integrating spreadsheets into audit works.

#### Analysis of extended use

In this study, the measurement of extended use incorporates concepts of task complexity (Wood, 1986; Bonner, 1994; Abdolmohammed, 2001), the integration of technology into tasks (Saga and Zmud, 1994; Saga, 1994), and the incremental built-on higher level of use (Zmud and Apple, 1992).

#### *Spreadsheets and task integration*

The measurement was found to be feasible and reliable because it took into account the possible audit tasks that might not be specified by the literature. This is done by grouping the tasks into categories according to their task complexities. This contrasts to Saga's (1994) study which listed the possible tasks for auditors and asked them whether they integrated technology into those tasks. The measurement also took into account the audit tasks that might be separated and not performed because the cost-benefit of small businesses nature by dividing into audit phases..

#### *Spreadsheets and a sequence level of technological and task configurations*

A sequence level of task configurations was verified by asking auditors about the next level of spreadsheet integration and steps of those integrations were observed.

The evidence suggested that all case firms' steps of spreadsheet integration passed through sequential levels of technological and task configurations. For example, during the audit planning phase, Firm B used spreadsheet for (1) recording information, (2) manipulating data, and (3) assessing associated risks. This indicated that the firm followed the sequential levels of use/integration (from the first level to the second to the third level) in audit planning phase. All seven firms did not skip any levels of use across the four audit phases.

In addition, Firm G, C, and D identified the combination of complex functions and cell references as the next levels of application. Those functions tended to be used in more complex tasks such as the development of predefined models during the tests of balance phase, and advance reporting during the audit reporting phase. Firm F added that instead of using the spreadsheets only for selected clients, the next level of integration included the use of spreadsheets for all clients. In a more advanced integration level in Firm B and E, the use of spreadsheets involved some basic programming that might not be able to be done internally. Firm E chose to seek help from a professional programmer, while Firm B was still advancing the use by the innovator's self-study. The evidence above suggested that the proposed measure succeeded in tapping into this dimension.

#### *Number of designated tasks*

In Chapter 4, the different numbers of tasks to which audit firms were exposed were anticipated. The evidence from the case firms show that the complexity can vary within tasks because of the requirements imposed by humans (Bonner, 2008). Table 6.2B selectively compares existing tasks, and shows into which tasks spreadsheets were.

In Table 6.2.B, the percentages of existing tasks that spreadsheets had been integrated were calculated by dividing extended use score by the number of existing tasks in a particular firm. Then the percentages of spreadsheet-integration into designated tasks were calculated by dividing extended use score by sixteen which is the number of standard audit tasks in the industry. For example, Firm A yielded an extended use score of five out of six existing tasks. The firm exhibited 83.33% of spreadsheet-task integration and might overrank itself if the infusion level was measured by perceived-infusion level as used by Jones et al. (2002). Therefore, the fullest potential use should not be defined by individuals' perception of how IT can be used.

Firms: in order of (extended use score)	Existing tasks (performed by the firm)	Spreadsheet-integrated tasks (indicate extended use score)	% of existing tasks that spreadsheets have been integrated	% of spreadsheet-integration into designated tasks (16)
Firm G (4)	Task I.1, 2, 3, 4 Task II.1, 2, 3, 4 Task III.1, 2, 3, 4 Task IV.1, 2, 3, 4	Task I. None Task II. None Task III.1, 2, 3 Task IV.1	25%	25%
Firm A (5)	Task III.1, 2, 3, 4 Task IV.1, 2*	Task III.1, 2, 3, 4 Task IV.1	83.33%	31.25%
Firm C (7)	Task I.1, 2, 3, 4 Task II.1, 2, 3, 4 Task III.1, 2, 3, 4 Task IV.1, 2, 3, 4	Task I.1 Task II.1, 2 Task III.1, 2, 3 Task IV.1	43.75%	43.75%
Firm D (7)	Task I.1, 2, 3, 4 Task II.1, 2, 3, 4 Task III.1, 2, 3, 4 Task IV.1, 2, 3, 4	Task I.1 Task II.1 Task III.1, 2, 3 Task IV.1, 2	43.75%	43.75%

**Table 6.2B:** Comparisons between percentage of task integrations based on existing tasks and designated tasks.

\*Advanced financial reports are required for clients which are SET's listed. Firm A does not perform service for listed companies.

Table 6.2B showed that the tasks to which Firm A was exposed are different from those of the other firms. When the task variable is controlled by determining 16 task categories based on the concept of task complexity, Firm A received a low extended use score (five out of sixteen tasks or approximately 31.25%). However,

when the human requirements about the numbers of each task needed to be performed were considered, Firm A integrated spreadsheets into the task for approximately 83%. This integration percentage was much more than those of the firms which received a higher extended use score, like Firm C and Firm D. This evidence raised a warning over the analysis of quantitative data in terms of comparability. The number of tasks varied for each firm. Firm G, C, and D had more required tasks than Firm A did. The detailed measure worked well because it assumed that the number of audit tasks was consistent across the industry. However, the perceived measure would vary when the prescribed tasks varied across firms. Firm A's respondent might state that the firm integrated spreadsheets into audit tasks more than Firm G did, if the variable was measured as percentage and based on different numbers of tasks undertaken by each firm.

In conclusion, the findings from the case firms confirmed that the fullest potential use of the spreadsheets should be determined based on the designate/ideal use of spreadsheets within the industry. This allows future IT infusion studies to be comparable.

### **6.2.2 Measuring integrative use: the increased interconnectedness between audit procedures when using spreadsheets**

Integrative use reflects the degree of interconnectedness within organizational work flows. The basic idea is that the data is entered once and flows from one task to others. A closed-loop system is where the data flows from the audit planning phase to the reporting phase. Table 6.2C summarizes extended use and integrative use scores from the case firms.

Firm	Extended use score	Integrative use score	Remark
A	5	1	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers.
B	12	2	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers. <u>Across phase</u> : Test of balance to reporting. Figures from work papers are carried over to prepare financial reports.
C	7	1	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers.
D	7	1	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers.
E	11	4	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers. <u>Across phase</u> : Carried over all phases Data has been stored in the firm database which is updated regularly. Auditors retrieve data in order to perform other phases.
F	9	1	<u>Within phase</u> : Test of balance Data is linked from lead schedules to test of balance work papers.
G	4	0	

Table 6.2C: The summary of extended and integrative use scores



The case studies showed that it was not necessary for firms to record data and carry over the same data to perform other tasks. Most firms simply copied the data to perform further procedures. This evidence did not show interconnectedness among audit-task categories since the single entry concept was absent. Once the original data was changed, the duplicates were not automatically changed. For example, one firm used a lease schedule template to manually input figures in order to test client's lease transactions, instead of linking figures from the lead schedule. Data collected from the interviews also showed attitudes on interconnectedness in audit work flows. For example, Firm E found that it was easy to check figures in financial reports if auditors linked figures from the spreadsheet to the reports. Firm G and Firm D claimed that they preferred completing tasks in separate pieces because it was easier to figure out if something had gone wrong.

The interconnectedness of work flows in the case firms is also reflected in the conversation. Firm E claims *"We can have several copies of data in order to perform different work for example two auditors may perform two different works on the same fixed assets register. Having many auditors working on the same tasks at the same time is the major advantage of Excel."* On the other hand, firms with low interconnectedness prefer to perform audit tasks in separate pieces. Firm G claims *"When I try developing a complex worksheet or systems and we cannot find out if something wrong has happened. Therefore, auditors prefer the simple use with fewer links so that they can correct it if there are errors."* Firm D claims *"I am personally against the use of Excel because people print out all works and may reprint and waste lots of work papers."*

#### Extended use and integrative use

Table 6.2D shows that the extended use score and the integrative use score seem to have some positive relationship. The qualitative data from the case firms enables a closer understanding of the relationship which can be explained as follows.

#### *Low extended use score and low integrative use score*

The lower infusion firms, measured by the extended use score, seem to have lower integrative scores. Firm G had integrative use score of zero. Firms A, C, and D had a score of one. This suggested that the integration of spreadsheets into audit work (extended use) was a prerequisite of integrative use. Another observation was that Firm A, which got a very low extended use score, could still achieve an integrative use at some level. This might reflect the fact that the firm did not perform a full audit procedure; therefore, the firm had less integration of spreadsheets into the audit-task categories. However, the firm had some other factors such as flat structure and the necessary resources to allow firm members to work more closely. These factors enabled collaboration among firm members and lead to the establishment of interconnected workflows.

#### *High extended use score and high integrative use score*

Firms B, E, and F, which had high extended use score, had more opportunities to link spreadsheet-based tasks together. However, integrative use needed to flow through all tasks performed by different auditors within a firm. It was unlikely for interconnectedness to happen when the task, which was earlier performed on spreadsheets, was done manually and switched back to be performed on spreadsheets again. In Firm F, the linkage workflows were broken when the partners asked for print copies of the work papers to be reviewed. Therefore, high degrees of extended use did not guarantee high degrees of integrative use. Firm E, which got the highest integrative use score of four, had routinized the use of spreadsheets as the firm's standard audit procedures. At the same time, external support was hired to establish the firm's databases. All auditors had to use files from the central databases and update the central databases as required by the firm's policies. There was a single set of data for a client. The data was carried over through all audit phases.

### Analysis of integrative use

The measurement of integrative use in this study is objective and concerned on the link of workflows more than the perceived interdependency proposed by Saga (1994). The main findings were consistent with those of Saga (1994) concerning the relationship between extended use and integrative use. That is, extended use appeared to be a “predictor” of integrative use. However, unlike Saga (1994), the current study concluded that extended use was a predecessor of integrative use as there must be a certain level of extended use for integrative use to occur. Even though positive relationships were found in both the study by Saga (1994) and this study, it did not necessarily mean that a firm automatically established workflow linkages after the firm integrated the technology into their work. This difference might be due to the differences between the two studies. For example, spreadsheets are standalone software compared to enterprise-wide software. The study of Saga (1994) of overall information technology usage in organizations may or may not include both standalone and enterprise-wide packages. However, the case studies presented similar results on integrative use enablers, such as the availability of the database and networks in Firm E.

### **6.2.3 Measuring Emergent use: the application of IT to a process/task that could not previously have been performed without the availability of technology**

Data from the case studies show that whether an emergent use exists depends on how the case firms view the use of spreadsheets. Emergent uses specified by the case studies are summarized in Table 6.2D.

Firm	Emergent use	Attitudes on the use of spreadsheets
Firm A	None	0 – Spreadsheets are used to support existing work
Firm B	100% audit	1 – Spreadsheets are used to improve efficiency of existing work
Firm C	None	1 – Spreadsheets are used to improve efficiency of existing work
Firm D	None	0 – Spreadsheets are used to support existing work
Firm E	- Ability for more than one auditor to work on the same data at the same time.	3 – Spreadsheets offers a new approach/ new idea to the work
Firm F	None	1 – Spreadsheets are used to improve efficiency of existing work
Firm G	None	0 – Spreadsheet are used to support limited area of existing work

Table 6.2D: Emergent use of spreadsheets in the case firms

Data from the case firms showed that spreadsheets had been used to support audit work. They had been integrated into existing audit tasks which were previously done by a simple calculator and paper-based work papers. The use of spreadsheets enabled auditors to perform work faster and more accurate. Firms A, D, and G used spreadsheets to replace a manual approach. The firms could not identify other uses offered by the spreadsheets. In more advanced applications, Firms B, C and F believed that spreadsheets allowed auditors to do tasks which auditors might refuse to do manually because it might take a significant of time to perform the tasks. However, those tasks still could be performed without spreadsheets. Firm E was the only firm which invented a new use with the support of IT infrastructure. The identification of emergent use seemed to indicate the users' attitudes toward technology in their firm. For example, Firm E was determining uses for available technologies and spreadsheets. This attitude was more likely to create a new use than those of other firms, who began spreadsheet use with existing tasks. There

were also some differences between firms with scores of one versus zero. Firms B, C, and F (with emergent-use scores of one) were proactive in integrating spreadsheets into more tasks in order to improve effectiveness and efficiency of audit courses. Firms A, D, and G (with emergent-use scores of zero) only integrated spreadsheets into particular tasks when they found the tasks were troublesome or time consuming. Therefore, the proposed measurement may be treated as a proxy for emergent use.

#### Analysis of emergent use

The interviews showed that most firms found it difficult to identify emergent use. It is possible that this reflects a limitation of the study but it also raises a question about the feasibility of measuring the phenomenon. While Saga (1994) measured emergent use by asking questions about whether users used technology to support particular tasks, the following study which adopted the three pathways concept did not measure emergent use. The lack of examples of emergent use may come from an inability to reconceptualize tasks. For example, Firm E stated that the ability for two or more auditors to work on a single database at the same time was an example of emergent use, but it came under this study's definition of integrative use. Emergent use may be a part of the other two pathways, as Saga reported a relationship between integrative use and emergent use. The current study found a relationship between emergent use and other interview data about attitudes to technology. Further investigation is needed to examine whether emergent use is a separate construct of IT infusion and whether it is measurable.

### **6.3 CONCLUSION**

In this chapter, IT infusion measurements based on three pathways of use are reported from seven case studies. The infusion scores from the seven case firms are summarized in Table 6.3A. The results showed that the proposed measure achieved the objectives set in previous chapters. The proposed measure groups audit tasks as categories progressing by task complexity. This approach not only captures all possible tasks that may exist, but also incorporate the important dimensions of IT infusion which are the task integration and sequential levels of task and technological configurations in the measurement of extended use. The measure of integrative use also considers interconnectedness, while the measure of emergent use considers the primary purpose of the use of the technology.

The results indicated that the proposed measures can be applied consistently and can generate data that shows variations across firms which could be analyzed statistically. Extended use and integrative use scores can be measured objectively based on the number of tasks into which spreadsheet technology has been integrated. However, a measure of emergent use needs further investigation.

In-depth interviews could not identify emergent use objectively. Emergent use seemed related to scores of user attitudes toward technology. This raises the question of whether emergent use should be measured as a perceived construct or if the emergent use is indistinguishable from the other two pathways.

Firm	Extended Use (out of 16)	Integrative Use (Out of 15)	Emergent Use (Out of 3)	Infusion (Out of 34)
A	5	1	0	6
B	12	2	1	15
C	7	1	1	9
D	7	1	0	8
E	11	4	3	18
F	9	1	1	11
G	4	0	0	4

Table 6.3A: Extended use, Integrative use, Emergent use, and Infusion score from the case studies.

# CHAPTER 7

## CROSS-CASE ANALYSIS: IT INFUSION ENABLERS

In the previous chapter, the measure of IT infusion in seven case firms is reported through the three pathways of use: extended use, integrative use, and emergent use. The proposed measures tap into the important dimensions of IT infusion and give a reasonable numerical range for further statistical analysis.

In this chapter, IT infusion enablers and inhibitors from the case firms are reported. The case firms are chosen to vary in size, organizational structure, IT support, and implementation strategy that have been found as factors contributing to IT infusion in prior studies. (See Figure 6.1A for descriptive data of the case firms). The data was collected during 2006-2007. Findings from the case studies along with within-case analysis were presented in appendices of this study.

The chapter starts with a brief cross-case comparison of the seven case firms based on organizational characteristics claimed to affect IT infusion in prior studies (Winston and Dologite, 1999; Eder and Igbaria, 2001). The second part shows enablers and inhibitors of IT infusion. These enablers and inhibitors are directly claimed by the respondents in the case firms. Then, the cases are grouped into firms with a lower level of infusion and firms with a higher level of infusion because factors that enable IT infusion in those two categories are obviously different. Finally, other factors that are not directly claimed by the firms are identified using a content analysis technique. In addition, various organizational innovation processes found in the cases are presented. The chapter outline is as follows.

- 7.1 Organizational characteristics of the case firms
- 7.2 IT infusion enablers
- 7.3 Cross-case analysis and a model of IT infusion
- 7.4 Conclusion



## **7.1 ORGANIZATION CHARACTERISTICS OF THE CASE FIRMS**

### **7.1.1 Firm size**

Number of employees is used to determine firm size in many small business studies (e.g. Raymond, 1985; Cragg and King, 1993; Thong et al., 1996). The smallest case firm has approximately 26 staff members and the total income of Baht 15-16 millions. The biggest case firm has approximately 100 staff and the total income of Baht 40 millions. However, there are some discrepancies between sizes being classified by annual income and by number of staff in the cases because of the services they provide and the characteristics of their clients. For example, Firm B which has 50 staff has \$50 million annual income while Firm D which has more staff (100) has less annual income of \$40 millions.

A comparison of the case firms' profiles is shown in Table 6.1A. Smaller firms such as Firm A and F do not provide services to SET-listed clients. Listed-companies are sophisticated and more risky to audit. Smaller firms tend to focus on other services that offer more profit margins and more consistent flows of income to the firms such as accounting services and systems analysis and design. Most firms have expanded by increasing numbers of staff; however, Firm B and E limit the staff expansion. Firm B focuses on the premium services offered while Firm E diversifies its business to consulting and international relation services; such as providing services to first-time business settlement from foreign countries.

### **7.1.2 Firm structure**

Organizational structures are usually defined in terms of authority and control or flat and tall structures (Jones, 2004) which reflect degrees of centralization in organizational innovation studies (Zaltman, 1973; Kwon and Zmud, 1987).

Most smaller firms, A, C, and F, have flat organizational structures with no clear-cut division even though they rank staff member as managers, senior auditors, junior auditors such as other firms do. The chain of authority is not clear. All partners can take turns supervising their staff. Staff have interactions with all others

in the firm. The communication among staff can be made formally and informally within-level and across-level. The bigger firms, such as Firm D, E, and G, have clear-cut divisions. Some of the decision making processes are decentralized to partners or managers of the divisions, but most important decisions are centralized to a senior or an executive partner. The clear-cut division isolates one division from another while staff can communicate informally within a division. The communication across divisions is more formal even though the informal form is also allowed. The staff can rarely form a social community across divisions. Firm B has a very unique structure where divisions are organized as profit centers. Each division has its own budgeting and investing policies, while the audit work quality is controlled by a board of executives which consists of partners from all divisions. Staff rarely communicates across divisions due to the unique structure of the firm. The firm inherits its culture and structure from a large international firm. Most communication within the firm is done formally.

### **7.1.3 IT/IS infrastructure**

Duncan (1995) defines an IT infrastructure as *“a set of shared, tangible, IT resources that provide a foundation to enable present and future business applications”* (pp.39-40). Byrd et al. (2006) state that information systems (IS) infrastructure is the firm-wide IS foundation upon which all other IS applications are built. The IS infrastructure consists of data integration, application functionality, and technology integration. Data integration is similar to a database concept with the ease of communication network and technology. Application functionality allows users to modify the IS applications or programs with little or no effects on other IS resources. Technological integration is concerned with the interconnectedness of the technological platforms in the firm.

Most firms provide necessary IT infrastructures to their staff members, while firm B provides IT infrastructure to all staff members as a firm policy. Each partner can also put in additional investment as required by his/her divisional members. Spreadsheets are used as a common platform of the firm. The firm network is set up to facilitate data sharing. However, staff cannot access data from other

locations. While Firm E has less investment on personal equipment than Firm B, Firm E focuses more on data, application and technological integration. The firm's database is designed to be accessed by the staff appropriately with external communication routed through the firm's firewall. Spreadsheets have been routinized and used as a common platform. These two firms reflect the highest IT/IS infrastructure flexibility that was found to contribute to implementation success in prior studies. On the other hand, Firm C and D exhibit less flexible IT infrastructures relative to all case firms and the investment in personal equipment is limited. Even though the firms set up a local area network, staff rarely share data through the set-up systems. Audit staff perform some tasks manually, although spreadsheets are used as common platforms for some tasks that are performed electronically or for some clients. Firms A, F and G have mixed characteristics of IT/IS flexibility. However, they mostly invest in personal level equipment and are not concerned with the overall firm infrastructure. Spreadsheets are used as common platforms where possible, except with Firms B and E where the uses of spreadsheets are neither harmonized nor standardized. The application of spreadsheets to support audit tasks is not consistent across the platforms.

#### **7.1.4 IT consultants**

Bessant and Rush (1995) studied roles of IT consultants in an innovation process. They defined an IT consultant as an expert in IT who transferred knowledge from suppliers to users. The consultants play a subtle role in developing organizational technology competence and management capability. They are expected to act as key bridging intermediaries across a wide range of users. The consultants played three important roles: knowledge delivering, experience sharing, and options selecting (Bessant and Rush, 1995).

Most cases are consistent with prior study that small firms rely heavily of external IT supports (Premkumar, 2003; Cragg and King, 1993). It is believed that firms with IT consultants have more system usage (Soh et, al, 1992). However, most IT support in the case firms is in the form of systems maintenance. The case firms rarely benefit from knowledge transfers or other contacts to external experts. Firm

E is the only firm which brings in IT consultants who play significant roles in innovating the uses of technology within the firm. A consultant has worked on an overall IT infrastructure such as databases and communication systems while the other works with the partner in developing and standardizing the use of spreadsheets. The consultants bring in the knowledge, share experience, and help select available technology options. These roles are consistent with the three important roles that consultants do in order to help the firm go through the implementation process (Bessant and Rush, 1995). Firm D is the only firm which does not have any IT support or a consultant. The respondent from firm D states that *“Audit work does not require computer support”*

#### **7.1.5 Firm networks and alliances**

Networks and alliances are used interchangeably in many studies. Most firms cooperate in special business activities as alliances in order to enjoy cost sharing, technology transfer, and information sharing (Barnir and Smith, 2002; Chung et al, 2006). There are three forms of alliances that exist in small and medium sized audit firms in Thailand. The least formal alliances are in the form of social networks which is an executive's relations and contacts with others (Burt, 1992). Most of these firms' executives/partners used to work together. The semi-formal form is established through a company named 75CPE which intends to pool small and medium sized firms' resources to training and develop up-to-date audit procedures. The formal form is being a member of international firms.

Firms A, B, C, and F are connected to one another in the form of a social network of executive partners and they enjoy the benefit of clients' references. However, they do not form a knowledge transfer of audit approaches or technologies. Firms D and E are members of 75CPE. They pool some audit knowledge; however, there is no evidence of technological knowledge sharing. At the same time, Firms D and E are joint-developing a new Excel-based risk-assessment application with the pilot firm and these three firms have both social and business relationships. On the other hand, two out of seven cases (Firms E and G) are members of international firms which require the firms to meet standard quality of auditing. The firms can

selectively adopt audit procedures and resources, including technology, from their alliances.

## 7.2 IT INFUSION ENABLERS AND INHIBITORS

This section reports IT infusion enablers and inhibitors directly claimed by respondents in the case firms. The respondents were asked to identify major factors which could or would help them to reach a higher level of use of spreadsheets and use them to their fullest potential. Then, they were asked to identify any inhibitors that hinder the use of spreadsheets. The results are summarized in Table 7.2A. The table presents the results in an ascending order of the case firms' extended-use scores which are presented in parenthesis. The content analysis is used in order to draw the implication from the conversation.

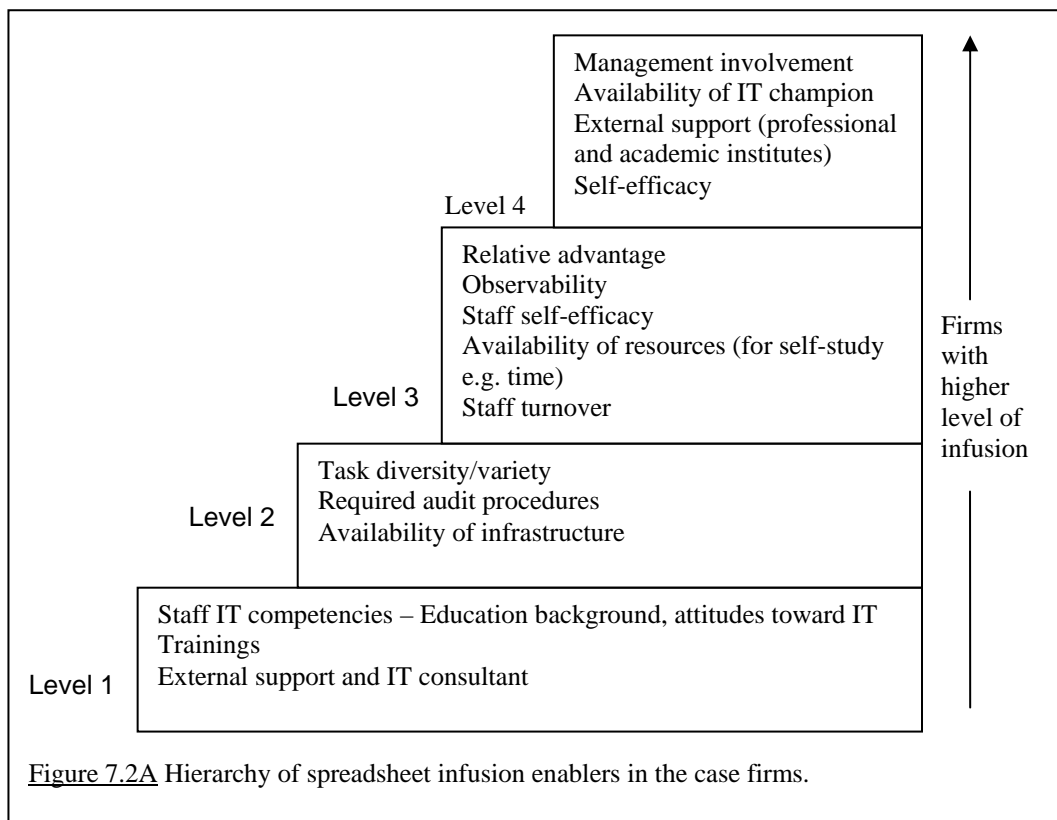
Firm (extended use score)	Enablers	Inhibitors
Firm G (4)	1. Staff IT competence 2. Training from an external expert 3. Routinization	Relative advantage Lack of knowledge/skills
Firm A (5)	1. Training from experienced users 2. More clients which require extensive audit procedures	Not stated
Firm D (7)	1. Availability of infrastructure 2. Staff IT competency 3. Staff attitudes 4. Staff self-efficacy (staff)	1. Management attitude toward technology

Table 7.2A – IT infusion enablers and inhibitors in the case firms

Firm (extended use score)	Enablers	Inhibitors
Firm C (7)	<ol style="list-style-type: none"> <li>1. Relative advantage</li> <li>2. Staff IT competency</li> <li>3. Staff turnover</li> <li>4. Observability</li> <li>5. Variety of clients</li> </ol>	<ol style="list-style-type: none"> <li>1. Staff turnover</li> <li>2. Clients' willingness to give out soft data</li> </ol>
Firm F (9)	<ol style="list-style-type: none"> <li>1. Staff IT competency</li> <li>2. Staff self-efficacy (self-study)</li> <li>3. Relative advantage</li> <li>4. Availability of resources (self-study)</li> <li>5. Observability</li> <li>6. IT Champion</li> </ol>	<ol style="list-style-type: none"> <li>1. Management involvement</li> </ol>
Firm E (11)	<ol style="list-style-type: none"> <li>1. The management involvement</li> <li>2. Staff turnover (the need of standardized process)</li> <li>3. Lower IT cost</li> <li>4. Improvement of audit procedures</li> <li>5. Regulators</li> <li>6. IT champion</li> </ol>	<ol style="list-style-type: none"> <li>1. Availability of alternative software</li> </ol>
Firm B (12)	<ol style="list-style-type: none"> <li>1. Training</li> <li>2. Staff self-efficacy</li> <li>3. Availability of materials</li> <li>4. Support from professional and academic institutes</li> <li>5. IT champion</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of management support</li> <li>2. Regulators</li> <li>3. Complexity of the application</li> </ol>

**Table 7.2A** – IT infusion enablers and inhibitors in the case firms (Continued)

The spreadsheet infusion enablers stated by firms in Table 7.2B are arranged in an order of infusion level. The enablers shown can be classified as enablers that contribute to infusion at an earlier stage or at a lower level and the ones that contribute to a higher stage of infusion. The results from the case firms show that all enablers claimed by the firms which exhibit a lower-level are fundamentally existent in the firms which exhibit a higher-level of infusion. Figure 7.2A shows the hierarchy of spreadsheet infusion enablers in the cases firms.



### 7.2.1 Infusion enablers of the firms that exhibit the lowest level of infusion:

#### Level 1

##### Staff IT competencies

Competencies/competences are “*the knowledge, skills, abilities, and other attributes required to perform desired future behaviors*” (Blancero et al, 1996, pp.387). Competence is a fit between an individual and the task. A skill approach assumes predefined tasks. According to Bassellier et al. (2001), IT competence of a

business manager composes of knowledge (explicit), experience and cognition processes (tacit). The explicit knowledge is that which can be taught, read, and explained. It is about knowledge of IT and how it can be used with an ability to access the source of knowledge. The tacit knowledge focuses on skill development through experiencing IT and business processes. It also includes the vision or attitude toward IT.

Firms with low level of infusion like Firms A and G seem to rely on individual staff to apply the technology in their work because the management does not know how to use the technology or know what help staff needs. The ability to fit technology to a task (IT competence) is claimed as a main enabler by Firm D. The staff may exhibit skills on spreadsheet, but they cannot combine the skills on audit tasks. A reason cited is that some staff were educated from an Opened-University system which does not integrate technology into the courses of study. In addition, staff refuse to learn more than what they need for solving problems. This also exhibits the users' attitude toward technology.

Without staff skills and knowledge, firms cannot realize benefit from an innovation (Leiponen, 2005). People will not adopt innovations even though they are favorably disposed toward them if they lack skills and necessary resources that may be needed (Bandura, 1977, 1986). The management usually expects that staff have necessary skills from their college education. However, small firms tend not to recruit from higher educational Universities for financial reasons (Laforet and Tann, 2006) and usually lack skilled personnel (Scott et al., 1996). At an organizational level, staff IT competence can be seen as a combination of organizational knowledge and members' beliefs about tasks and information technology which are found to causally related to IT infusion (Saga, 1994).

### Trainings

Training promotes greater understanding and more application of technology (Raymond, 1988). It also contributes to reducing operational and cultural issues encountered during an implementation project (Grossman and Walsh, 2004).



Ahearne et al (2005) find that sufficient training increases IT use and effectiveness of tasks.

Firm A and Firm G, which exhibit a lower level of infusion, claim that they need training for their staff. The evidence seems to be parallel to the fact that audit staff of firms at a lower level lack IT competence. These firms require basic training on how to use spreadsheets to assist audit tasks. The expected outcomes are capped by the tasks they perform and what they currently need. Firm G claims that the firm needs training from an external expert who understands the environment and firm culture. This finding is also consistent with Sadler-Smith et al. (1998) on effective trainings for SME firms. Meanwhile, training needed by firms with a higher level of infusion, such as Firm B, are different. The respondent from Firm B requires training that helps him go beyond the current level of use.

Lassila and Brancheau (1999) find that training should involve “both the packaged systems features and related work processes.” They propose archetypes for utilizing equilibrium states which are low-integration, standard adoption, expanding, and high-integration stages. The Utilization model is based on volume of IT use with the low utilization stages being characterized by non-use or limited use with no training provided. Standard adoption stages are characterized by use of basic features of IT and adequate training is provided for users to use basic features. In expanding stages, which are characterized by the use of IT beyond basic capacities by the users’ adaptation of work processes, training is provided in both work procedures and technological features. The high-integration stages, which exhibit the users’ reinvention of both work process and technology, require time to experiment in addition to adequate training. The findings of this study are consistent with those of Lassila and Bracheau. In a lower level of infusion, basic training is required. The higher level of task-integration (extended use) can be gained with training content that includes both technological features and work-procedure. For example, some microcomputer training also helps infuse the technology in term of personal decision support systems (PDSS) (Raymond and Bergeron, 1992). The use of spreadsheets to prepare lease schedules, loan amortization tables, etc., is considered a use PDSS. However, they are not enough

to advance the firms to a higher level. In the highest level of infusion (eg. high-integration stages), the training should be provided in align with time so that auditors (especially Firm B's respondent) can reconceptualize work processes and reinvent the use of spreadsheets which lead to an emergent use (Saga, 1994). The training that involves job activities also convinces the users of the value of the application of IT and technological changes (Bruque and Moyano, 2007).

#### External support and IT consultant

Being consistent with other infusion enabler studies, findings indicate the reliance of external support or IT consultants of the case firms. As being described earlier in this chapter, IT consultants bridge knowledge from industry with an organization. The computer usage in small firms also tends to increase with availability of consultants (Soh et al., 1992). The case firms expect help from external support or IT consultants because their staff lack IT competence. External support and consultants are also found to help implement the use of technology in many firms and can also help staff when needed.

### **7.2.2 Infusion enablers of the firms that exhibit a lower level of infusion:**

#### **Level 2**

##### Availability of infrastructure

As defined by Duncan (1995) earlier that IT infrastructure is a set of computer hardware and software that enables present and future use of business.

Since most small firms have no formal IT plan, IT investment is on request rather than done strategically. Staff from some audit firms, eg. Firm D and Firm F claim inadequate hardware resources in audit work. Presence of organization resources is crucial for organizational innovation (Wan et al., 2005). This evidence contrasts to those of Firm A and Firm G which exhibit a lower level of infusion. Even though Firm A exhibits a lower level of infusion, half of Firm A's income comes from other assurance services which require IT infrastructure. Firm A, therefore, provides full IT supports for the staff. Meanwhile, Firm G does not integrate IT

into audit tasks and claims less need for computing resources. When most staff in the firm use technology and have integrated IT into their work, the demand for infrastructure such as computers exceeds the supply. Firm D and Firm F, which are on a “discovering” period, need adequate IT resources in order to infuse IT into their work. Even though most small firms face limited budget, they need to provide necessary resources in order to promote usage.

#### Task variety and required audit procedures

Task variety can be thought of as process variety and content variety (Pentland, 2003). Process variety is the variety of work process sequences. The content variety is the variety in inputs and outputs of the process. Pentland also states that a task variety indicates flexibility or potential for learning and adaptation. Lievens et al (2005) include task diversity/ variety as one of organizational attributes/characteristics. Applying learning factors of an individual to an organization, the learning potential of an organization is constrained by scope of action and enhanced by task variety (Coetzer, 2006). A pilot test of the interview schedule of a small audit firm also shows that the most important enabler that advance the use of spreadsheets task variety.

In the case firms, when staff have necessary skills to perform routine work, they should be able to integrate more into tasks if there are more tasks. The variety of tasks, therefore, is a prerequisite of task integration. Firm A provides services to smaller clients and does not provide services to SET listed company. This explains why Firm A does not fully follow audit procedures required by audit standards. The number of tasks available to be integrated, therefore, is less than those of any other firms. Even though Firm C provides service to SET listed company, the firm is small and provides services to smaller clients compared to other firms. These two firms are involved in a smaller number and less complex tasks. All these facts can also be explained in terms of task compatibility as studied by Cooper and Zmud (1990).

### **7.2.3 Infusion enablers of the firms that exhibit a higher level of infusion:**

#### **Level 3**

##### Relative advantage

It is logical to assume that an individual will use the best approach to accomplish his or her goal. Relative advantage is the degree to which an innovation (computerized approach auditing), is perceived as being better than the existing method (manually audit approach), and the individual adopts an innovation (Rogers, 2003). According to Rogers, relative advantage can be expressed in term of economic profitability.

In all case firms, the respondents claim that using spreadsheets in audit work can save time and increase efficiency. Auditors clearly enjoy the advantages of using spreadsheets. Firm C and Firm F are two firms that claim this enabler when asked. Why does this enabler happen at a higher level instead of at a lower level? The possible explanation is that users need to have basic skills in order to use spreadsheets before they realize how beneficial spreadsheets are. They, then, compare the use of spreadsheets to what they have done without spreadsheets and choose the best approach. Relative advantage has been found as a factor contributing to diffusion of an innovation in many studies. In addition, IT diffusion is claimed as a determinant of IT infusion (Cooper and Zmud, 1990; Eder and Igbaria, 2001). It can be assumed that an individual cannot infuse the use of spreadsheets without adopting it at the first place.

##### Observability

In IT diffusion studies, observability is defined as “*a degree to which the results of an innovation are visible to others*” (Rogers, 2003, pp.258). However, in IT infusion studies, observability also includes the degree to which an innovation can be used, is visible to others.

An infusion of technology can be gained from observing the use of spreadsheets across firms. The respondent from Firm C claims that when auditors use spreadsheets to their full capability, they will, then, need to gain more knowledge

from external sources. While Firm C states this enabler directly, because the firm rarely connects with other firms in term of strategic alliances or personal friendships, staff skills are still the firm's problem. Meanwhile, Firm F only implies this enabler because there are some staff with inadequate skills in the firm (mainly the partners).

Knowledge acquired by training can partly solve a "how to use" question, but a specific answer applied to auditing needs knowledge, skills, and experience (Libby and Tan, 1994). The next question is from whom an application of spreadsheets can be observed. Rogers (2003) states that individuals seek answers mainly from others who are much like themselves. Combining with uniqueness of firms' structure and how audit teams are organized, individuals channel their observations through colleagues in the same team or division. This may help close the assimilation gap (some individuals of the firm use technology more extensive than the others), but infuse technology at an organizational level. Prior studies have shown that small businesses are better able to innovate when they were part of clusters or networks (Terziovski, 2003). External knowledge leads to an improvement (Massa and Testa 2004)

As described earlier in this chapter, there are three forms of connections that exist in audit firms. The most formal connection is established through a membership of an international firm (Firm E and G). The less formal is the participation in a company called 75 CPE in order to pool resources in terms of training and skills (Firms D and E). The least formal form is personnel friendship (all firms). The knowledge transferred from networking seems to exist between the first two formal forms. This explains why Firm A and C which connect to other firms through personnel friendship do not benefit from networking. What happens to Firm C and G? Even though those two firms have strong networking with other firms, the problem lies on who the linkers are.

Generally, the linkers among audit firms are executives or partners who have less computing skills. Firm C's, D's and G's executive partners are claimed to be computer illiterate. Therefore, they cannot act as intermediaries to diffuse

technology from other firms into their own firms; therefore, there is less observability. The suggestion is that appropriate linkers should be used. The linkers must play two roles in order to infuse the technology. Firstly, they must act as external linkers. Communication channels between similar levels of auditors among firms should be established because adopters seem to communicate horizontally with people in the same level (Rogers, 2003). They can, therefore, observe, and choose to bring a new application of Excel into their firms. The same persons should also play roles as internal linkers who diffuse ideas to other colleagues. This person should be characterized as an opinion leader (Rogers, 2003) and be competent and confident in their own ability (Lin, 2006). They also need support in terms of the facilitation of social interaction from the management (Lin, 2006). In addition, findings from the case firms show that some existing forms of network do not enhance competence. Small firms need to learn to work together in order to make a change in innovation (Hanna and Walsh, 2001). This is identified as a problem by Firm F.

#### Self-efficacy

Self-efficacy beliefs are the beliefs of individuals about how they behave or accomplish their goals based on their capabilities (Bandura, 1977, 1986; Wood and Bandura, 1989). The beliefs influence the choices people make and the courses of action they pursue. Self-efficacy is an individual factor that is claimed to affect adoption and utilization of technology. However, the effect of self-efficacy on an organizational level of analysis has not been investigated.

Data from the case firms shows two perspectives of how perceived self-efficacy affects the use of spreadsheets in audit work. The first perspective comes from the individual level of analysis where there are innovators within the firm. The respondent from Firm D, Firm F, and Firm B claim themselves as innovators. They have spent their personal time on inventing how to use spreadsheets to accomplish audit work. Firm F's and Firm B's respondents have also convinced other users in the firm about the use of what they have invented (They also act as an IT champion). This fact explains the effects of self-efficacy on an organizational level

because where the IT infusion is measured by asking an individual who is the most familiar with spreadsheets. In this case, in order to enhance the positive effects of self-efficacy on IT infusion of the organization, resources in the form of available time should be provided.

On the second perspective, individuals within an organization with some basic skills can apply spreadsheets in their work at a certain level with their self-efficacy. However, the claims from Firm D and Firm F show that staff is problem-solving oriented rather than goal-oriented. The respondent from Firm B complains: *“No matter how much training we provide staff may not want to know. They do not want to do work with a more complicated application.”* Another statement is given: *“Staff can use Excel more efficiently if they are eager to learn.”* Those statements show that the audit staff lacks motivation and self-efficacy in doing their work. In case of Firm D, the role of innovator is neither obvious nor recognized; therefore, the firm relies on an individual to infuse the use of spreadsheets. On the other hand, the unique organizational structure of Firm B makes it hard to diffuse the use across divisions. Even though Firm B’s innovator can infuse the uses of spreadsheets, the uses require routinization in order to survive in the firm. Therefore, individuals’ self-efficacies are needed in other divisions.

#### Resources availability

In this stage, Firms claim resources availability are the forms of time and self-study materials. Firm B’s and Firm F’s respondents claim that they need more time for their own studies which seem to be using non-formal training or materials. Time constraint is claimed as an inhibitor of IT infusion. It partly comes from the fact that small firms use employees in a multi role capacity (Choueke and Armstrong, 1998) and it is difficult to free up the time for employees to leave their work and receive training (Mitra, 2000). Non-formal learning is the dominant form of mastering new technologies (Oyelaran-Oyeyinka and Lal, 2006). Choueke and Armstrong’s (1998) research indicates that SMEs have a preference for “action based” innovation learning as opposed to “off-the-shelf” provision. This applies to both managerial skills and operational skills. Firm E set up a pilot team in 2004.

The team targets initiating new ideas and diffusing them to other members of the firm. The pilot team has been given full support from the management in term of time and other resources. The team works on a limited number of audit projects and spends parts of their time work on new ideas. However, the firm cannot achieve an infusion stage with the help of the pilot team. The respondent claims that the pilot team can still serve as an example that enhance observability and convince other staff about the relative advantage of the technology.

### Staff turnover

Auditors are knowledge workers who use their knowledge, skills, and experience to perform their jobs. However, knowledge, skills, and experience are not stored in an organization, but are held by employees. The evidence from small audit firms in Thailand shows that an average turnover of audit assistants is in line with the practice requirements for being a certified public account. It is currently three years. Half of the case firms claim that they have experienced losing audit staff: the staff takes away knowledge and experience.

Staff turnover is a neutral factor. While Firm A states that the absence of some staff stops the infusion process within the firm; therefore, the firm has to climb up the ladder from the first stage. The factor is claimed to be a push factor in firm E where the development of process-based innovation (on spreadsheets) can help the firm shift its reliance from its personnel to its standardized audit processes. Vera-menoz et al (2006) report how audit firms use IT to enhance knowledge sharing. Assuming that knowledge sharing can reduce the dependency of knowledge/ skills on a specific staff member by sharing them with other staff members within the firm, then IT should be able to reduce negative effects of staff turnover. However, it has to be incorporated with proper organizational structure and employees. Therefore, in firm A, spreadsheets are developed as much as possible in order to establish the processes that can compensate the experienced staff who have left the firm. The processes that are embedded in the spreadsheets are used as a control over audit quality as suggested by Mason et al (2001). Other studies also confirm that IT, such as decision aids, may have decision-making skills retained and



transferred to individuals via the explanatory facilities that are embedded (Gregor and Benbasat, 1999; Arnold et al., 2006).

#### **7.2.4 Infusion enablers of the firms that exhibit the highest level of infusion:**

##### **Level 4**

##### IT champion and management involvement

In the three firms that exhibit the highest level of infusion, there are prominent actors in the organizational innovation process. The actors are called IT champions. IT champions are managers who actively and vigorously promote their personal vision for using information technology and get it investigated and implemented (Buswick, 1990; Beath, 1991). The existence of technology champions who support the technological change are found to be related to the implementation success (Sharma and Rai, 2003; Pitt et al., 2006). Scheepers (2003) claimed that the role of an IT champion was significant during the initiation and disappeared into the background as technology progresses.

IT champions need necessary support from the management (Beath, 1991). In firm F, the management does not give support other than allow the champion to invent and diffuse technology to other firm members as long as it does not affect the partners. In firm B, the support is given in terms of the approval to routinize a new use of spreadsheets in the firm as an informal requirement and the management's perspective on using technology to service clients. This reflects the attitude of the management toward technology and is called executive involvement (Jarvenpaa and Ives, 1991). The role of IT champion is the most outstanding in Firm E.

In Firm E, three partners play different important roles contributing to IT infusion. Two partners give support in term of budget and encouragement and another partner participates in pushing technology through an innovation process. Jarvenpaa and Ives (1991) distinguish the difference between executive involvement and participation where involvement reflects attitudes toward technology and participation reflects activities the executive has done concerning technology. The findings on executive involvement are consistent to those of Barki

and Hartwick (1989) and of Saga (1994) that it contributed to progressive use of technology and IT infusion. However, the contrast comes from the executive participation part. The study of Barki and Hartwick believes that an executive participation seems to be short and temporal. The participation contributes less to the progressive use of technology. This can be explained in that the prior study did not include an IT role of the executives on implementing new technologies. There are two supporting factors that make the IT champion in this case very successful. The champion gets necessary support and his personal characteristics. The champion himself plays two roles which are IT champion and organizational sponsor at the same time. He not only supports himself and his beliefs with necessary resources but also negotiates further resources with other partners. It is crucial that the sponsor does not leave the process before a new idea survives (Scheepers, 2003). When new ideas come from a deeper application of spreadsheets, the ongoing support from the sponsor is very important.

As shown in Table 7.2A, the superior score of Firm B to firm E comes from the fact that Firm B is using a decision support system (DSS) to help assess audit risk during the planning phase. The knowledge transferred from an old international firm explains the use of such a system. Evidentially, the decision-support model is modified and auditors have relied less and less on the model and more and more on their own judgment which exhibits a possibility of discontinuance. Meanwhile, Firm E and Firm D are developing a spreadsheet-based risk assessment application. The developing project was initiated by Firm E's IT champion. However, the project has been paused because of Firm E's IT champion's personal health problem. It is believed that when the project has finished, Firm E will implement and routinize the application into audit work. The application which can be used across the planning and test of control phase not only increases the infusion score with extended use but also improves interconnectedness among audit procedures.

#### External support (professional and academic institutes)

As discussed earlier in this chapter, one of the reasons that small firms gain external support is to enhance their knowledge. Firms with different levels of

infusion seek help from external sources differently. External support is part of a social network (Johnston and Linton, 2000). They can be inter-firm (other audit firms), consultant (an expert in the field), and public (professional and academic institutes).

The evidence from the case firms suggests that at a lower level of use (infusion), the strong presence of social networks does not seem to be important. However, for a more sophisticated level of use, inter-firm and public networks have a significant influence on a success of the implementation. These findings are consistent with those of Johnston and Linton (2000). In a higher level of use, public information is needed through external networks in order to bring in knowledge from other firms or innovative institutes.

Professional and academic institutes are viewed as a pool of resources, research and development, and innovations. They are communities of well-recognized professional and academia in the field. According to Hidalgo and Albors (2008), key participants in the promoting of technologies and supporting innovation management include consultancy firms, academic centers, business schools, and business support organizations. Such agents play crucial roles in the knowledge management industry. Data from the pilot and case firms show that the small audit firms are targeting business schools and business support organizations, such as Thai accounting council, for developing new tools and techniques while IT consultancies are used mostly for system-maintenance purposes.

Audit firms seek help from those institutes in order to get state-of-the art technology. Presently, professional institutes, such as Thai accounting council, provide training courses and cooperate with audit firms to improve accounting, auditing standards and procedures. Businesses can also collaborate with academic institutes on innovative activities in order to diffuse the technology (Loof and Brostrom, 2008). Small firms are responsive to cooperating with Universities (Acs et al., 2002).

### **7.2.5 Other factors**

Besides explicit factors claimed by the Firms, there are also some other factors existing in the literature, and these factors affect the organizational innovation process. These factors are not directly claimed by the case firms' respondents. They are identified using the content analysis technique. These factors are management's attitudes toward technology and the organizational innovation processes. The management's attitudes affect the integration of spreadsheets in some audit tasks and to the extent the management encourages their staff to use the technology; while organizational innovation processes show how a new integration of spreadsheets is diffused and survives or is discontinued within organizations.

#### Management's attitudes toward technology

The management's attitude toward technology can be shown as positive, neutral, or negative (Winston and Dologite, 2000). The attitude is considered positive when the management views technology as a strategic advantage. The view of technology as tools to increase effectiveness and efficiency reflects a neutral attitude; meanwhile, a negative attitude is shown by the view of technology as a tool for solving existing problems. These attitudes are considered parts of infusion measurement in Cooper and Zmud's (1990) study. Positive attitudes seem to relate to technology implementation success in small businesses (Winston and Dologite, 2000).

While Firm C claims that staff demand more computers, Firm E claims that clients push the firm to invest in more technology. Firm B, on the other hand, claims the use of technology as a superior service as viewed by clients. These statements have different hidden meanings. Firm C and Firm E will not invest in innovation without the push from clients which reflects negative to neutral attitudes toward technology while Firm B shows a positive attitude through competitive advantage obtained by using technology. In most firms, the interviews show negative and neutral attitudes toward technology. The management's attitudes toward technology can also be shown in how they invest in technology, how important to the firm they view training to be, and how they live their personal lives.

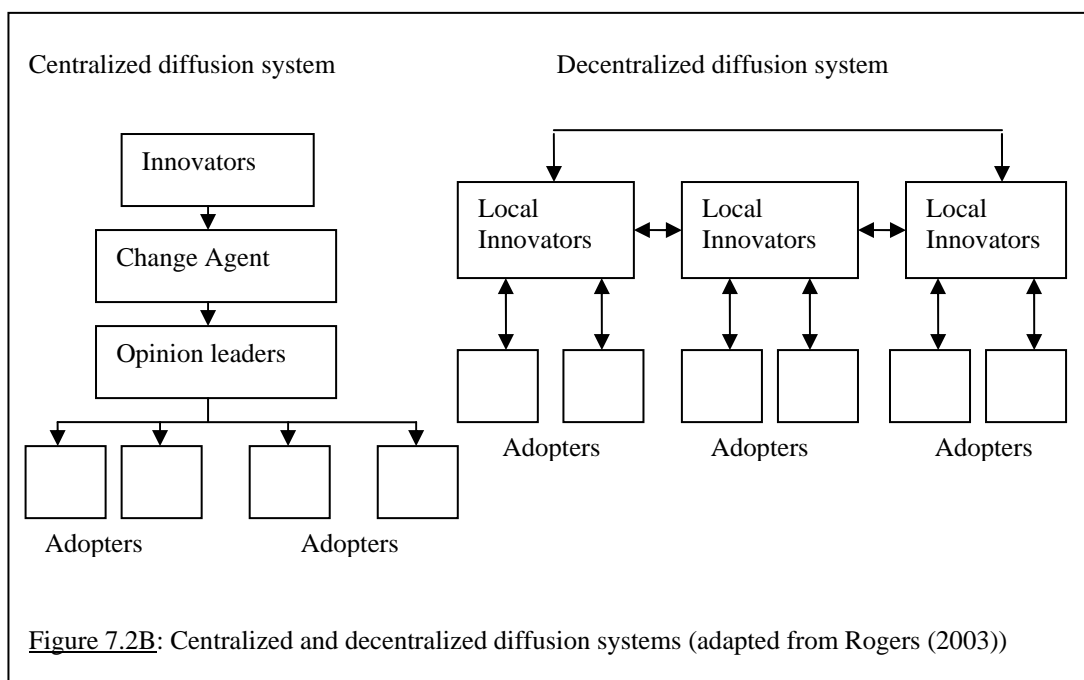
The fact that the partner in Firm F allows auditors to apply approaches that they want to perform tasks as long as they do not affect partners' work promotes staff self-efficacy; however, it also shows the partners' openness to technology that discourages IT infusion. The finding is inconsistent to that of Davidson and Hart (1995) which states that partners' openness to technology is fine and does not affect the adoption. In their studies, the finding may be biased from the fact that they surveyed the partners' opinion. This study, on the other hand, collects data from both partners and their subordinates in order to triangulate the results. The openness of partners to technology in this study not only affects adoption but also infusion since the partners are the most experienced auditors and the only people who deal with high judgment-related tasks. Therefore, spreadsheets cannot be used to the fullest potential without being integrated into those tasks and used by the partners.

While senior management tried to hide basic computer illiteracy by claiming that they are incapable in learning new IT skills, better support and training may help. The perceived fun and enjoyment also helps change management's beliefs and attitudes toward the technology (Pijpers and Montfort, 2005). Pijpers and Montfort also claim that the management does not need to be IT-literate or IT-experienced, but IT-oriented and IT savvy.

#### Organizational innovation processes

A traditional organizational innovation process suggests that an organization follows the path of initiation, adoption, adaptation, acceptance, use, and incorporation (Kwon and Zmud, 1987). Once the firm has adopted the technology, the latter stages deal more with firm members. It is unavoidable that the analysis crosses multiple levels (Gupta et al., 2007). The enablers will be discussed later in this chapter; therefore we need a clarification of the innovation processes within an organization after adoption. A new use needs to survive before becoming a part of infusion measurement. This is consistent with prior studies which find that diffusion is related to infusion (Cooper and Zmud, 1990; Eder and Igbaria, 2001)

Centralized and decentralized diffusion systems (Rogers, 2003) help explain how 6 firms follow innovation processes (See Figure 7.2B). In centralized diffusion systems, certain innovators or a research and development department invent the use of technology and diffuse a new idea to firm members through change agents and opinion leaders. On the other hand, decentralized diffusion systems give opportunities for local innovators who seek to accomplish their work in a more effective and efficient manner. One of the cases follows a hybrid approach which can be explained by an innovation value chain (Hansen and Birkinshaw, 2007) (See Figure 7.2D).

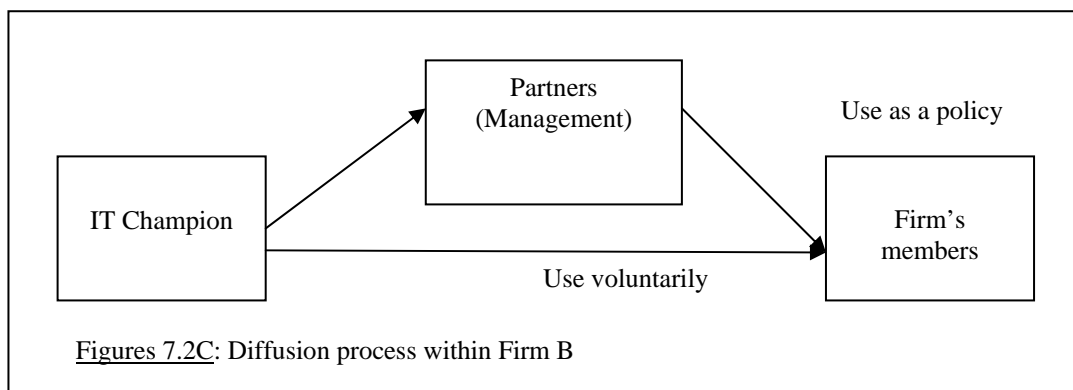


### *Centralized diffusion systems*

Firm B, D, and F follow centralized diffusion systems where an overall control of decision is made by the management level. Innovators invent new uses and diffuse them to staff members. Unlike a big organization, small firms' innovators also play a change agent role. An innovator shows an interest on new technology. He or she is also venturesome and has the ability to understand and apply complex technology. When an innovator tries to convince others to adopt technology, he or she also performs a change agent role (Rogers, 2003). A combined role of an innovator and of a change agent is called an IT champion. IT champions are

managers who actively and vigorously promote their personal vision for using information technology and get it investigated and implemented (Buswick, 1990; Beath, 1991).

Even though these firms follow the same diffusion systems, there are some slightly different processes. The champion in firm B needs support from the management in order to routinize the new use in the firm; however, a voluntary use by other divisional members can also be found (See Figure 7.2C). In case B, a new use involves relatively complex features compared to general use of Excel in auditing. It rarely survives without a routinization. In addition, the firm's organizational structure does not allow convenient communication across divisions. Firm D's and F's champions do not need support from the management. The champions are both middle-level management who have informal authority on other staff members. As long as the invented uses do not affect the management (partners), the uses can be implemented.



From the viewpoint of centralized diffusion systems, the factors enabling higher use (infusion) include the factors that affect the innovators at the individual level and factors that contribute to diffusion of technology to other firm members until the new use survives.

#### *Decentralized diffusion systems*

In Firms A, C, and G, the decentralized diffusion system gives fragmented development use of spreadsheets. As stated by Rogers (2003), the innovations come from experimentation by non-experts; therefore, the uses are not complex. A

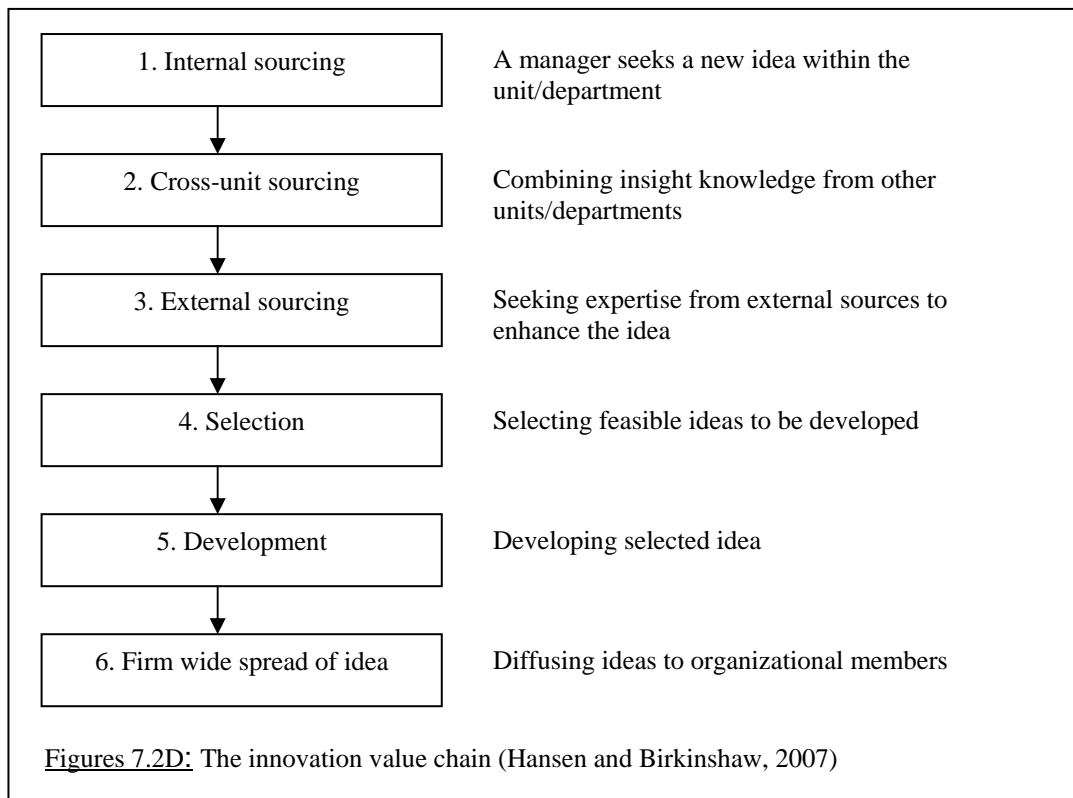
new use is then channeled through informal communications. Since the use is invented by a non-expert without support from the management, the use is simple and problem-solving oriented. These findings are consistent with the characteristics of decentralized systems stated by Rogers (2003). In Firms A, C, and G, the triangulation done by reviewing electronic work papers and interviewing other firm members shows a variety of applications of spreadsheets in the same tasks. For example, in firm C, an auditor uses a function to test depreciation calculations while the other uses mathematical formula to perform the same task. In those firms, the management only provides limited resources to staff members and there is no harmonizing procedure. The infusion of technology is attached to individuals and is discontinued when a particular staff member leaves the firm.

The decentralized diffusion systems give two perspectives on factors enabling infusion of spreadsheets. While organizational factors that support and enable an innovative environment can encourage these local innovators to reach a higher level, the staff competence and self-efficacy are also important.

#### *An innovation value chain*

In Firm E, the organizational innovation process follows an innovation value chain (Hansen and Birkinshaw, 2007). In the value chain, the manager seeks a new idea from his own division. The new idea is, then, combined and harmonized with those from other divisions because the firm realizes the benefits of hybrid organizational structure. While a decentralized decision making structure promotes innovation (Cohn and Turyn, 1980, Wan et al., 2005), the family-like relationship among staff and managers fosters the harmonization of new ideas. The firm also brings in an external source in terms of an expert who can help develop a standardized use of Excel based on gathered ideas. Finally the ideas are diffused and implemented to the firm's members (See Figure 7.2D). In this innovation value chain, factors that foster the process are considered factors enabling technology infusion of the firm.





### 7.2.6 Analysis of inhibitors

The three most important inhibitors identified by the case firms are staff IT competence, users' attitudes toward technology, and an availability of alternative software. The respondents from most case firms turn enablers around and claim the opposite of inhibitors; staff competence is the most claimed. This fact confirms the importance of staff IT competence is a crucial enabler of IT infusion. The same analogy can be applied to the effect of users' attitudes on organizational infusion. Attitudes can not only help users to reach a higher level of use but also negatively prevent users from adopting and using an innovation.

An availability of alternative software has mixed effects on an infusion of spreadsheets. Evidence from the pilot case shows that alternative software gives users an idea of how to apply spreadsheets in their work. The alternative software is hard to use compared to spreadsheets. The users try to apply spreadsheets where possible. The availability of alternative software, therefore, increases infusion. On the other hand, the respondent from Firm E claims explicitly that alternative

software offered by the firm alliance might have stopped the spreadsheet-based risk assessment application. Factors that hide behind alternative software may cause mixed signals. Therefore, this study does not include this factor into the model.

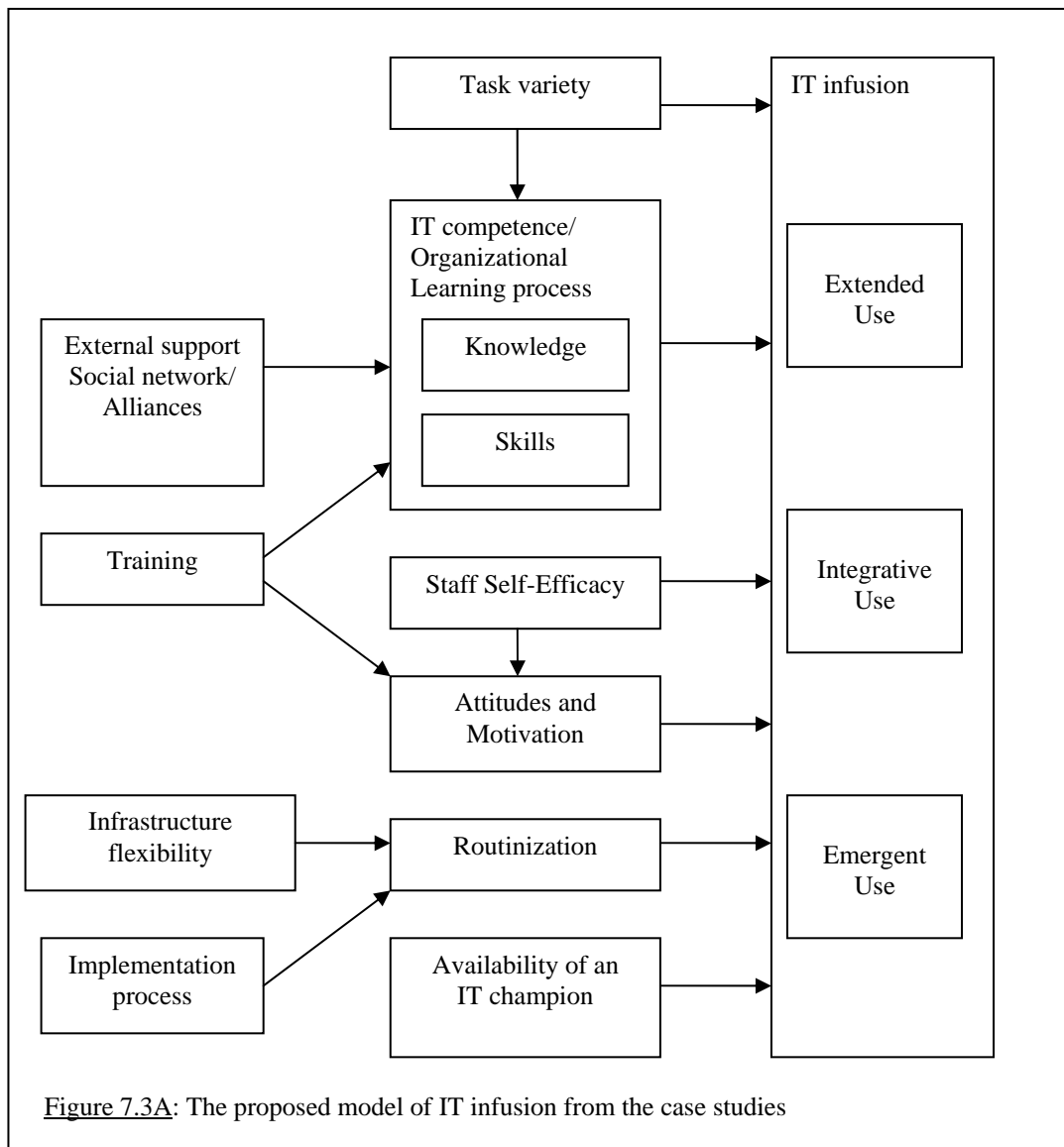
One other factor that logically has a positive effect on infusion is the staff turnover. It is common for audit firms to have high staff-turnover rate. Firm A claims staff turnover as a main reason that the use of spreadsheets cannot reach a higher level. Old staff take away IT knowledge while new staff have to start it all over again. This happens when a firm cannot retain knowledge staff. On the other hand, Firm E solves this problem by bringing knowledge up to an organizational level. Firm E routinizes the use of spreadsheets as part of the audit process. The use was not determined by an individual auditor. In this case, high staff turnover does not stop the infusion process.

### **7.3 CROSS-CASE ANALYSIS AND THE MODEL OF IT INFUSION**

In this section, IT infusion enablers from the case firms are analyzed and the relationships among them are identified based on the previous literature. The proposed model from cross-case analysis is shown in Figure 7.3A.

#### **7.3.1 Defining IT competencies**

Competence is an effective overall performance within an occupation (Cheetham and Chivers, 2001). Competence is also viewed as capability. The organizational IT competence is determined by the availability of IT resources and how well an organization combines and uses those resources (Gordon and Tarafda, 2007). In addition, IT competence enables the organization to effectively acquire, deploy, and leverage IT in pursuit of business strategies to support business activities (Bassellier et al (2001) referring to Sambamurthy and Zmud (1994)). The findings from the case firms focus on individual competency in the form of IS/IT skills. It requires users to be equipped with not only IT skills but also an ability to integrate technology to business (audit) activities effectively.



Bassellier et al (2001) explore the concept of IT competence at an individual level and unify its dimensions and components into a model which consists of explicit IT knowledge and tacit IT knowledge. Explicit IT knowledge is knowledge about technology, applications, IT management, system development, and accessibility to IT knowledge. In its dimensions, an individual has knowledge about how IT can be used to accomplish tasks (task-oriented), what IT should be used (technology-oriented), and how competitors (other audit firms) use IT. Those three dimensions reflect both relative advantage and observability of IT. Assuming that an individual is rational, he or she seeks the most effective and efficient way to accomplish the task. He or she select proper application of IT for the task or seeks an explosion of

IT integration onto the task when IT provides more effectiveness and efficiency. This is also confirmed by Saga's (1994) study that organizational knowledge is a latent factor about IT usefulness. The knowledge about how IT can be used and how competitors use IT in their work provides an observability dimension. Therefore, relative advantage and observability are parts of IT competency. Tacit knowledge, on the other hand, reflects experience and cognitive process of an individual. Users who are equipped with tacit knowledge can envision the role of IT in an organization (the possible application of spreadsheets in audit tasks).

From the reasons stated above, this study considers knowledge, skills, experience, relative advantage and observability as parts of IT competence.

### **7.3.2 The effects of training on IT competencies, attitudes toward technology, and motivation**

When users are claimed to have inadequate IT competence, a basic solution to IT problems is solved by equipping users with additional IT skills (Markus and Benjamin, 1996). IT competence also refers to the knowledge and experience of an individual to perform his or her tasks. Where knowledge can be classified as explicit and tacit as described earlier, Libby and Tan (1994) defines experience as a variety of activities including participating in training exercises. Therefore, knowledge, skills, and experience can be gained through working, learning, and being trained in various activities. In addition, Amoako-Gyampah and Salam (2004) find the effects of trainings on perceived ease of use and perceived usefulness in ERP implementation. This reflects the fact that training also contributes to the relative advantage dimension of IT competence.

Kraiger et al. (1993) suggests that trainees acquire knowledge, skills (such as compilation), and attitudes and motivation through learning. Computer training and education has a positive effect on attitude and computer usage behavior. The trained users have stronger feelings and understanding, higher levels of direct and indirect computer usage, and more diversified computer applications. The study also points out that training is much more effective in promoting attitudes than

organizational experience with computers (Raymond, 1988). However, training may have negative effects to some individuals if not done properly. Baldi (1997) suggests that an inappropriate training strategy may negatively affect older adults' attitudes toward using technology. Shachak and Fine (2008) also gives evidence that hands-on training, which is expected to enhance knowledge and skills and facilitate favorable perception on IT, gives users a perception that may decrease the usage. They suggest a continuous or long-term educational program when it comes to training for complex tasks.

Training can be organized in many forms. The most basic training approach is a lecture-based instruction (Compeau and Higgins, 1995; Simon and Werner, 1996). More sophisticated training methods include computer-aided instruction (Gist, 1988) and a behavior modeling approach (Simon and Werner, 1996; Davis and Yi, 2004) in which trainees watch a model demonstrate computer skills and then the trainees reenact the modeled behavior. Other informal learning modes, such as team work and learning by doing, are also found to improve competence. Work-based-learning happened in interaction situations with colleagues, supervisors, customers etc. However, new challenges encourage the manager to study further and to be trained continuously (Heilmann, 2007). Even though evidence suggests that non-formal learning is a dominant form of mastering new technologies, formal training is found to be positively associated with increasing technological complexity (Oyelaran-Oyeyinka and Lal, 2006).

In this study, training is proposed to be positively related to IT competence and attitudes toward technology.

*Proposition 1a: Training is positively related to IT competence*

*Proposition 1b: Training is positively related to attitudes toward technology.*

### **7.3.3 The acquisition of IT competencies (skills and knowledge) through social networks (external networks/consultants)**

Based on Johnston and Linton's (2000) classification of social networks, an organization can acquire IT competence (knowledge and skills) by obtaining them from external resources. In this study, IT competence can be obtained from various forms of external networks. IT consultants transfer knowledge from hardware and software suppliers to the organization (Bessant and Rush, 1995). Knowledge (include observability) can be shared among small audit firms through interfirm networks and alliances. Strong ties of executives to the network make a reliable source of support (BarNir and Smith, 2002). Small audit firms which are members of international alliances can have knowledge transferred from their alliances. Professional and academic institutes can serve as an innovative organization in order to advance knowledge in the field and transfer the knowledge to industry. Swan et al. (1999) compared evidence from two manufacturing firms in a context of MRP adoption and found that the firm with strong networks with professional associations and educational establishments indicated a higher degree of MRP integration (evidence shows full integration) and reconceptualization with other work process (just-in-time, JIT). Therefore, this study proposes that presence of strong external networks is positively related to IT competence. The external networks/alliances are classified using Johnston and Linton's framework.

*Proposition 2a: Presence of external consultants are positively related to IT competence*

*Proposition 2b: Presence of inter-firm networks are positively related to IT competence*

*Proposition 2c: Presence of communication between firms and professional/ academic institutes is positively related to IT competence*

### **7.3.4 Task variety and its contributions to IT competencies and IT infusion**

Task variety is identified as a factor that enables more tasks for IT to be integrated. This study, however, assumes that all auditors have gone through the same audit procedures in order to perform their tasks. Therefore, task variety does not directly affect the level of IT integration (extended use). Evidence from the case firms suggest that task variety increases auditors' skills in applying spreadsheets to their tasks. Pentland (2003) also claims that a task variety indicates flexibility or potential of learning and adaptation. This study proposes that task variety is positively related to IT competence.

*Proposition 3a: Task variety is positively related to IT competence*

*Proposition 3b: Task variety is positively related to IT infusion*

### **7.3.5 IT competencies and IT infusion**

As this study pointed out earlier, from the case firms, that auditors lack the ability to integrate technology into their tasks. They either lack technological ability or task reconceptualization ability (Saga, 1994). Surprisingly, most earlier published studies do not point out the importance of IT competencies or training. They take on a concept of earliness of adoption (Zmud and Apple, 1992; Eder and Igbaria, 2001). They may assume that users increase their competencies (skills and experience) by how long they are exposed to IT, and therefore, the use increases. Data from the case firms, which is consistent to Gordon and Tarafda's (2007) findings, show that IT competence is found to have a positive relationship with an organizational innovation process. This study proposes that the increase of staff IT competence increase IT infusion.

*Proposition 4: IT competence is positively related to IT infusion*

### **7.3.6 Staff self-efficacy and IT infusion**

Even though Self-efficacy, which is an individual's belief in his or her capability in accomplishing the tasks, is recognized as an enabler at the individual level (Compeau and Higgins, 1995), the infusion in an organization can be measured at

the point where a firm member uses a particular IT to its fullest potential. Most prior scholars (e.g. Cooper and Zmud, 1990; Saga, 1994) imply that fact on their measurement approach. Their questionnaires were sent to a person who is the most familiar with the computer system. This study calls such a person an IT champion. Staff self-efficacy is claimed by the case firms to affect the use of spreadsheets at a lower level of IT infusion. In addition, it affects the so-called IT champion (if any) at a higher level of IT infusion. Bandura and Locke (2003) verified that perceived self-efficacy and personal goals enhance motivation, which leads to IT use, and performance attainments. In addition, self-efficacy has been found to have a relationship with task complexity (Hu et al., 2006), which is used for classifying the level of IT integration (extended use) in this study. This study, therefore, proposes two hypotheses related to self-efficacy as follows.

*Proposition 5a: Perceived self-efficacy is positively related to the attitudes and motivation toward IT use*

*Proposition 5b: Perceived self-efficacy is positively related to IT infusion*

### **7.3.7 Attitudes toward IT and IT infusion**

Attitudes toward IT are found to have a relationship with IT infusion (Jones et al, 2002) and implementation processes (Winston and Dologite, 2000). It is also shown in most adoption theory that attitudes or intention to use result in an actual use of technology. Therefore, this study propose that attitudes and motivation toward IT is positively related to IT infusion

*Proposition 6: Attitudes toward IT are positively related to IT infusion*

### **7.3.8 IT champion and IT infusion**

The presence of IT champions in three case firms and the support from the literatures (Beath, 1991; Premkumar; 2003; Scheepers, 2003; Sharma and Rai, 2003; Pitt et al, 2006) show that IT champions contribute to IT success in an organization especially during the implementation process. This factor, though



important, has never been studied in any other infusion research. This study proposes a presence of a technological champion is critical for an organization to reach an infusion stage.

*Proposition 7: A presence of an IT champion is positively related to IT infusion*

### **7.3.9 Infrastructure flexibility and implementation process as determinants of routinization**

*“Routinizing occurs when an innovation has become incorporated into the regular activities of organization and has lost its separate identity”* (Rogers, 2003, pp.428). Saga and Zmud (1994) proposes three dimensions of routinization. They are: use perceived as being normal, standardize use, and administrative infrastructure development. For a use perceived as being normal, users should frequently use the innovation and/or the use should be standardized within the organization. Basic infrastructures are needed in order to provide necessary resources for users to use the innovation frequently and management intervention is also a push factor for standardizing the use within an organization. Eder and Igbaria (2001) finds a direct positive effect of IT infrastructure flexibility on Intranet infusion; however, they do not state on which path of IT infusion it affects. Buhler and Vidal (2005) also found that IT improved organizational workflows. In addition to providing resources for task integration (extended use), infrastructure flexibility is also needed to provide a linkage on audit work flows. The findings from the case firms indicated that additional resources such as networks and databases are required in order to provide infrastructure for the workflow. Evidence from the case firms with a high level of infusion (Firm B and Firm E) shows availability of IT resources and the use of IT as a standard process within the firm. Auditors in those firms routinize technology in their work. This study, therefore, proposes that IT infrastructure is positively related to routinization.

*Proposition 8: IT infrastructure flexibility is positively related to routinization*

Routinization is dependent on an innovation's functional flexibility which allows the users to interpret and apply an innovation to their work (Yin, 1979, referred by Saga and Zmud, 1994). Spreadsheets which are a general package need to be applied by users to accomplish tasks. Where an implementation process starts off with a few innovators, an innovation may not be accepted by other users or may not fit what the users need. This can be shown by the denial to accept some complex application by Firm B's and Firm F's users. One of the solutions recommended by evidence from Firm E and Compeau et al. (2007) is that the organization needs to increase the communicability and measurability of the use so that the users benefits can be described (communicability) and measured (measurability) by users. All this evidence suggests how implementation is done to affect the application flexibility, and, therefore, routinization.

*Proposition 9: An Implementation process that involves users (such as a bottom-up or a value chain approach) contributes more to routinization*

### **7.3.10 Routinization and IT infusion**

In an earlier chapter, this study argues that routinization might not be a factor determining IT infusion in an organization. However, the case studies show that routinization affects the infusion in one way or the other. The fact that Firm B and F both routinize the use of spreadsheets as informal policies makes staff members become part of the established computerized audit procedures. Therefore, routinization contributes to IT infusion from the integrative use pathway. In order to routinize the use of spreadsheets in the firms, the firms need to provide necessary support such as infrastructure and basic skill training for their staff. Firms B and E both have database and network systems. While Firm B adopted ideas of infrastructure from an international firm, Firm E develops their own. From these findings, the study believes that routinization is one of the determinants of a higher level of infusion even though routinization does not guarantee infusion (Zmud and Apple, 1992).

*Proposition 10: Routinization is positively related IT infusion*

### **7.3.11 Management involvement**

A factor implied by evidence in the case firm is management involvement. While prior studies determined that management support and involvement is one key factor for implementation success, evidence from this study gives a different result. The partners (the management) of audit firms are considered auditors who perform a higher level of task, judgment-related tasks. Therefore, for an infusion to reach the highest level, it deals with the factor of convincing them to use technology. The factor seems to be at more of an individual level which is found to be training that improves competence and self-efficacy of the management (Pijpers and Montfort, 2005). Other effects of management involvement are found as parts of implementation process, routinization, support given to an IT champion (if exists), and the provision of IT infrastructure. Therefore, this study does not examine the management involvement separately.

## **7.4 CONCLUSION**

This chapter reports cross-case analysis from the case firms. The IT infusion enablers can be classified into fundamental enablers, enablers that enable infusion at its early stage, and accelerating enablers, factors that enable infusion to a higher level. These enablers are used for constructing a model using their relationships based on previous literature and evidence from the case firms.

Key enablers include the organizational IT competence and attitude which can be improved by providing necessary training and establishing knowledge networks (with other firms, academic institutes and professional institutes). An IT champion can also help bridge a new use (a higher infusion) to other users if he or she is given enough time and appropriate competence training. Finally, evidence from the case firms shows that infrastructure flexibility, routinization, and implementation process also play key roles in determining IT infusion.

# CHAPTER 8

## THE PROPOSED MODEL OF IT INFUSION AND THE SURVEY QUESTIONNAIRE

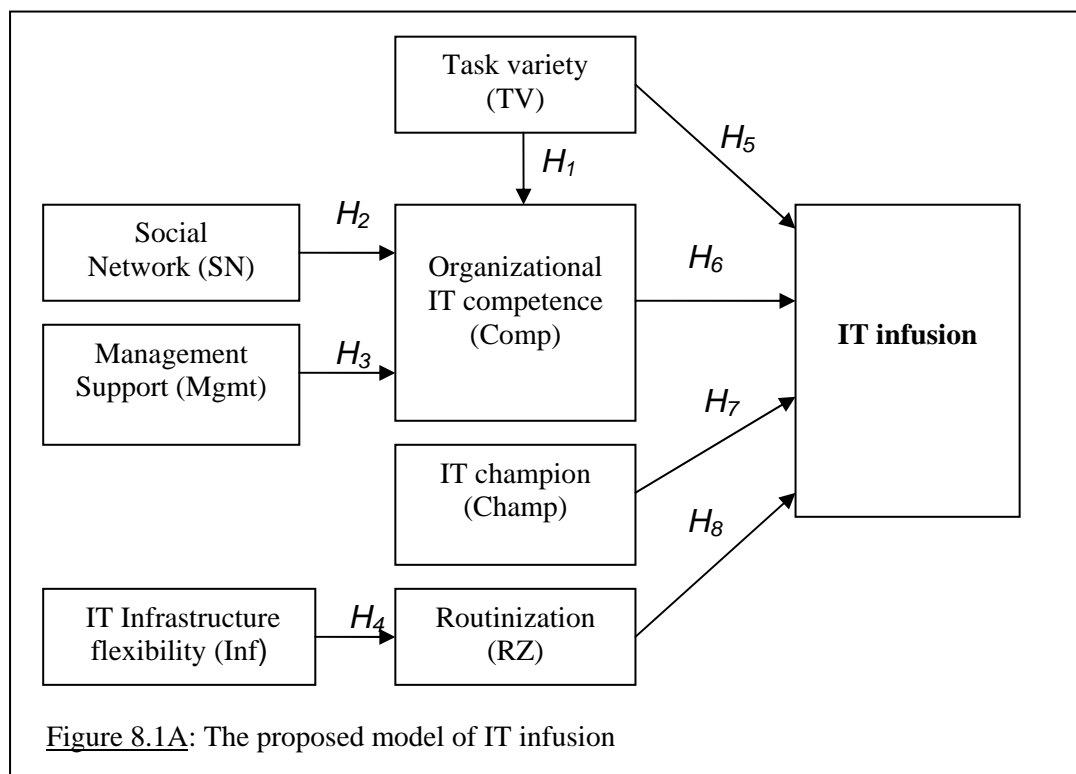
In chapter six, results from the application of the proposed IT infusion measures in seven case firms were reported through the three pathways of use: extended use, integrative use, and emergent use. The proposed measures tapped into the important dimensions of IT infusion and gave a reasonable numerical range for further statistical analysis. A model of IT infusion was constructed in chapter seven based on qualitative data. This chapter transforms the model of IT infusion based on qualitative data into a model that will be tested by a survey instrument.

The chapter begins with the proposal of an adapted model based on the focus of this study which is on organizational-level IT infusion enablers. Then a development of measures for selected factors based on prior studies is detailed. The IT infusion measures are derived from three pathways of use as reported in chapter five. Following this, the measures are initially tested with graduate students and then with two audit professionals in Thailand. The valid questions from the initial tests are sorted to construct a survey instrument. The chapter is outlined as follows:

- 8.1 The adapted model of IT infusion
- 8.2 Developing an instrument
- 8.3 Measuring variables
- 8.4 Measuring IT infusion through three pathways of use
- 8.5 Other measures
- 8.6 Survey design
- 8.7 Conclusion

## 8.1 THE ADAPTED MODEL OF IT INFUSION

In the previous chapter, the qualitative data from the case firms was used for constructing a model of IT infusion (Figure 7.3A). Several propositions were made. Since this study focuses on an organizational level of analysis with a cross-sectional nature, the model has been adapted for statistical testing. IT infusion enablers at an individual level of analysis (e.g. self-efficacy) were dropped from the test and suggested as future research opportunities in Chapter 12. The adapted model (Figure 8.1A) includes the most important IT infusion enablers identified from the case studies. Each enabler's constructs were defined in Chapter 7 and served as guidelines for developing research instruments. For example, training and availability of resources are grouped as the management support construct which is measured by levels of training, availability of resources, and management encouragement (Section 8.3).



The following hypotheses are formed.

- H<sub>1</sub> Task variety will be positively associated with organizational IT competence in an organization.
- H<sub>2</sub> Social network will be positively associated with organizational IT competence in an organization.
- H<sub>3</sub> Management support (include training) will be positively associated with organizational IT competence in an organization.
- H<sub>4</sub> More flexible IT infrastructures will be positively associated with routinization.
- H<sub>5</sub> Task variety will be positively associated with spreadsheet infusion.
- H<sub>6</sub> Organizational IT competence will be positively associated with spreadsheet infusion.
- H<sub>7</sub> The presence of IT Champion will be positively associated with spreadsheet infusion.
- H<sub>8</sub> Routinization will be positively associated with spreadsheet infusion.

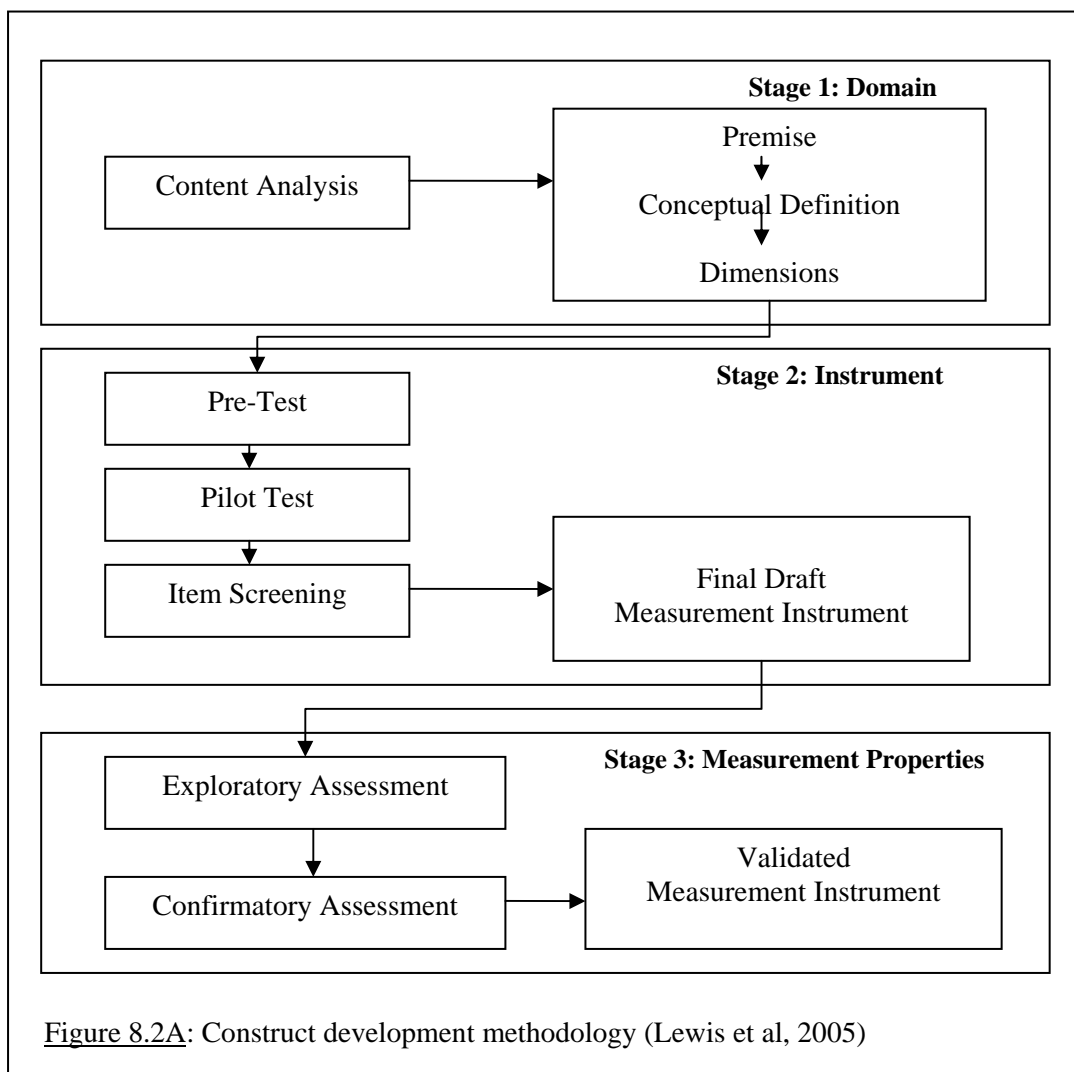
## **8.2 DEVELOPING AN INSTRUMENT**

There have been many studies measuring factors that are related to an organizational innovation. These studies propose and verify several important valid measures of those variables. Zmud and Boynton (1991) suggest researchers not to *“develop an instrument from scratch when a well-developed, or fairly well-developed, instrument that fits the level of analysis and level of detail required by a particular research model already exists (pp.154).”*

Therefore, this study first considers a number of existing measurement instruments from academic and peer reviews, and participant evaluation literature. Where a well-developed instrument exists, which is suitable for the level of analysis and detail required, the instrument is adopted. This study, then, focuses on developing measures of extended use, integrative use, and emergent use which are three

pathways of IT infusion. The new measures developed are one of the main contributions of this study.

Lewis et al (2005) suggest a construct development methodology (Figure 8.2A). The study adapts the methodology for constructs that are not well-developed. The process begins with a content analysis of the premise, conceptual definition, and dimensions of the construct. Then, the instruments are pre-tested and pilot-tested with graduate students. The statistical methods such as reliability analysis and factor analysis are used to validate the measurement instrument.



In the first phase of developing constructs, which are not well established in prior studies, the conceptual definition of the construct is analyzed using the content analysis approach in order to specify the dimensions of the construct.

In the second phase of developing a survey instrument, the initial research instrument and model are reviewed by academics and professionals from audit firms. In the final review phase of the instrument development process, the instruments are administered among academics and graduated students. These participants are required to critically evaluate the research instrument and provide feedback. Discussion is conducted in order to clarify the feedback. Since the instrument needs to be translated into Thai, the rigor approach has been established to ensure that the translation would measure the same ideas as the original. The instrument was first translated into Thai. Two audit professionals were asked to translate the instrument back into English. The results were compared and discussions were made in order to ensure that there was no information lost during the translation.

In the third phase, the instrument is validated for reliability, convergent validity, and discriminant validity. The appropriate adaptation is made before the analysis of the survey results. This procedure is explained in Chapter 10.

### **8.3 MEASURING VARIABLES**

From the proposed model in Figure 8.1A, there are seven independent variables (IT infusion enablers): task variety, external support/network, trainings, IT competence, the availability of IT champion, IT infrastructure flexibility, and routinization. The infusion of spreadsheets (IT infusion) is a dependent variable. The three pathways of use, extended use, integrative use, and emergent use, are used for constructing a total infusion score as a formative construct. The following section discusses how instruments were developed. All instruments measuring independent variables are based on seven-point likert scales that are generally used in IT/IS research.



All independent variables are measured as three-question items using reflective construct indicators. This approach is used widely for studies in this area (Chin, 1998). Three-questions are designed to measure the same construct in various dimensions and are highly correlated. Further discussion about the appropriateness of using formative and reflective construct indicators will be discussed in section 8.4.

### **8.3.1 Task variety**

According to Pentland (2003), task variety composes of content variety and process variety. Content variety is the variety of input and outputs of the process where process variety refers to variety in how inputs are converted to outputs. This study's concern is on the content variety, which is shown by inputs (audit procedures) and outputs (clients). Audit clients, even though operating in various industries, require similar audit procedure: they contribute to various additional tasks. For example, an audit client which operates a hire-purchase business requires an auditor for preparing a template to examine calculations of hire-purchase figures. The concept of task variety sometimes overlaps with task uncertainty. Igbaria (1990) suggests the measurement of task uncertainty in terms of the amount of structure and variety found in the respondent's job. However, the measures focus on an individual level of analysis. Other studies which examine effects of task variety on other dependent variables generally use a likert-scale with various ranges to measure the variables (e.g. Withey et al, 1983).

Combined with the results from qualitative data, task variety can be viewed from the number of services the firm provides. In addition, most case firms claimed that more clients from various businesses would enable the firm to perform new tasks and more required audit procedures. Therefore, three indicators are formed.

- a) Our firm performs a variety of services.
- b) Our firm has a significant number of clients.
- c) Our firm's clients represent many industries.

### **8.3.2 External support/ Social network**

Two dimensions of social network and/or external support have been studied. Johnston and Linton (2000) studied the effects of various types of network on IT implementation (e.g. inter-firm, intra-firm) while Miller et al. (2007) study the degree to which SMEs interact with the network (e.g. how often have you shared information about your new technique, suppliers, customers, or technologies). This study combines the data from the qualitative phase, adopts the social network types of Johnston and Linton (2000) and examines the degree of network dependency based on the seven-point likert scale as follows.

- a) Our firm makes regular use of external IT consultant(s).
- b) Our firm regularly participates and exchanges knowledge and opinions with other audit firms.
- c) Our firm regularly participates and exchanges knowledge and opinions with institutes other than audit firms (e.g. Universities, regulators).

### **8.3.3 Management support and Training**

Data from the qualitative study shows that auditors gain their IT knowledge and skills from many approaches. Two main approaches auditors from the case firms claimed to use the most were training and self-study (self-training). Firms at a lower level of infusion claimed that formal training was necessary where firms at a higher level claimed that on-the-job and self-study were the most effective. However, they need support from the management in form of available resources (e.g. time). Therefore, this study combines training as a part of management support.

Management support refers to the perceived level of general support offered by top management (Igbaria et al., 1997). The existing instruments usually ask the respondent to rank the degree of management support using a likert-scale. The instruments focus on resources allocation (Yoon et al, 1995; Igbaria et al., 1997; Premkumar, 2003; Wan et al, 2005), encouragement from top management (Yoon

et al, 1995; Premkumar, 2003; Wixom and Watson, 2005; Curtis and Payne, 2008), and users' satisfaction (Yoon et al, 1995; Wixom and Watson, 2005)

Most studies measure the effect of training using experimental approach. Subjects are trained with different training methods and the results of the training are evaluated. In survey design, Nelson and Cheney (1987), Igbaria et al. (1989), and Igbaria (1990, 1993) examine different training the users have had. They classify training into four main categories: college course; vendor training; in-house training; and self-training. The respondents were asked to respond with the option from (1) to (5) (Igbaria, 1990) or (1) to (4) (Igbaria, 1993). Bradley and Lee (2007) evaluate users' perception of whether they are adequately trained before and after an implementation of Enterprise Resource Planning (ERP) and the impact of training on Technology Acceptance Model (TAM). Data from the qualitative interview shows that the levels of training are a primary focus. In addition, the training categories proposed by Igbaria (1990, 1993) are included in the external support and network measures. Ahearne et al. (2004) use a common question to measure the perception of current level of training. Therefore, this study measures management support in three dimensions which are top management encouragement, availability of resources (e.g. time, training), and users' satisfaction as follows:

- a) The partner(s) actively encourages audit staff to use IT in their daily tasks.
- b) The partner(s) provides enough IT training and/or time for staff to think of using IT in audit tasks.
- c) User IT satisfaction has been a major concern of the partner(s).

#### **8.3.4 IT competence**

Besellier et al (2001) unify and propose IT competence dimensions and classify them into two types of knowledge: explicit knowledge and tacit knowledge. This study picks up the most important dimensions based on infusion enablers found from the case firms for constructing IT competence measures. Prior studies examine IT competence dimensions in the area of their research and construct

measures for general IT competence of business managers (Chang and Ho, 2006) and for e-business IT competence in organizations (Eikebrokk and Olsen, 2007). Their questionnaires were developed from literature reviews. Each item was measured on a seven-point Likert scale, ranging from “strongly/totally disagree” (extremely unimportant) to “strongly/totally agree” (extremely important). For example, Eikebrokk and Olsen (2007) ask: “*Our company has a high level of knowledge of how e-business technologies can be of value to our business*” (pp.379). This study adopts the measurement approach which starts with examining relevant dimensions based on the prior studies and qualitative data from the case firms. Based on Bessellier et al (2001) and data from the previous chapter, the measures are formed in term of explicit and tacit knowledge of the organization. The technology-based knowledge (Bradley and Lee, 2007) is used as the first indicator. The ability to integrate the spreadsheets and tasks are used as the second indicator. The last indicator also includes the observability construct. The indicators are as follows.

- a) Our firm has sufficient knowledge of all features, functions, and abilities of spreadsheets.
- b) Our firm has sufficient knowledge of how to use spreadsheets to perform audit tasks.
- c) Our firm has sufficient knowledge of how other audit firms use spreadsheets to perform audit tasks.

### **8.3.5 Availability of IT champion**

IT champion has been found to contribute to IT success in many studies. However, most studies have used qualitative approaches to explain how a champion can help a company effectively go through an innovation process (Howell and Higgins, 1990). In more recent study, a measure of IT champion has not been well established. The first measure was operated by Frohman (1978) which surveyed 90 research managers by asking the amount of time the managers had spent on championing activities. In latter studies, Ettlie et al. (1984), and Ungan (2007) only

ask whether there is a presence of an IT champion in an organization. Howell and Higgins (1990), Beath (1991), and Bassellier et al. (2003) define IT champions as managers who actively and vigorously promote their personal vision for using information technology and get it investigated and implemented. There are three major roles of IT champion in the definition: promoting personal vision, getting technology investigate, and pushing for implementation. This study intends to measure the strength of a person(s) who champions the use of technology based on the three major roles. The first question examines the perceived existence of IT champions and to what degree other firm members perceive these individual as champions. The instrument is adapted from Basellier et al's (2003). The original question measures the degree of a manager's championship within his/her division [To what extent do you intend to support/ promote the use of IT in your division]. The second and the third roles involve experimenting IT and convincing/pushing a new use to other firm members. These measures are adapted from Frohman (1978) in term of effort the champions have spent on these roles.

- a) In our firm, there are one or more individuals who vigorously and enthusiastically support/ promote the use of spreadsheets in audit work.
- b) In our firm, these individuals spend significant amounts of time investigating/ experimenting the use of spreadsheets in audit work.
- c) In our firm, these individuals spend significant amounts of time pushing/convincing other firm members to use spreadsheets in audit work.

### **8.3.6 IT infrastructure flexibility**

IT/IS infrastructure is a set of IT resources that provide foundations for enabling current and future business applications. The flexibility is measured in term of the provision for future use (Duncan, 1995; Eikebrokk and Olsen, 2007), data integration and shareability (Eder and Igbaria, 2001; Bryd et al, 2006), IT connectivity (Eder and Igbaria, 2001), and application functionality and technological integration (Eder and Igbaria, 2001; Bryd et al, 2006). The instrument is formed as three statements as follows.

- a) Our firm's IT infrastructure is very flexible in relation to future needs.
- b) Our firm's IT infrastructure allows staff to share data and knowledge.
- c) Our firm's IT infrastructure allows staff to access data from anywhere.

### **8.3.7 Routinization**

Routinization has been measured in many studies. One of the first researches that measure routinization is done by Zmud and Apple (1992). The routinization scores are constructed from four dimensions of routinization which are coordination, policies, budgeting, and training. Most measures indicate the level of integration of technology into the firm. For example, score 1 is given for the integration at a corporate level, 2 is given when the integration is at a divisional level, and 3 is given when the integration is down to the operational and retail units.

On the other side, Johnston and Linton (2000) use at least 16 questions with expected yes-no answers to measure routinization. The questions are formed based on dimensions of routinization. For example, the technology has been accepted as a normal part of the process – yes/no. Sundaram et al. (2007) develop a measure of IT routinization and infusion based on the work of Jones et al. (2002). Three questions 7-point Likert-scale have been asked to the respondents. This study adapted from Jones et al.'s (2002) and Sundaram et al.'s (2007) work. The statements measuring routinization are as follows:

- a) The use of spreadsheets has been incorporated into the firm's work procedures.
- b) The use of spreadsheets is pretty much integrated as part of normal audit work routine.
- c) The use of spreadsheets is a normal part of the firm's procedures.

#### **8.4 MEASURING IT INFUSION THROUGH THREE PATHWAYS OF USE**

The study adopted the concept of three pathways of use as dimensions of IT infusion given by Saga and Zmud (1994). The concept of audit task complexity (Bonner, 1994 and 2008; Abdomolhammed, 2001) is integrated in order to tap all important dimensions of IT infusion into the measure as shown in Chapter 6.

The IT infusion construct is formed by adding scores from three pathways of use, formative construct indicators. Formative constructs are a composite or a linear combination of multiple measures (MacCallum and Browne, 1993; Fichman, 2001). A previous study of IT infusion which used detail measure adopted different approach. Fichman (2001) and Kishore and McLean (2007) used formative construct indicators to measure IT infusion in their studies. The content of their indicators are breadth and depth of use. In addition, most studies focusing on IT use also follow the same direction (e.g. Massetti and Zmud, 1996 and Liang et al, 2007). The only study that used reflective construct indicators was that of Saga (1994). In Saga's study, the number of uses from three pathways of use is counted to establish separate indicators. She, then, used LISREL to do confirmatory factor analysis. Even though the t-value of all three pathways of use which showed their relationships to the IT infusion construct is significant, the factor loadings are low (0.62 for extended use, 0.71 for integrative use, and 0.68 for emergent use). It is still unclear whether the low factor loadings come from the measurement model misspecification or the fact that the measures are not valid because the number of tasks was limited by the research knowledge as discussed in Chapter 4 and 6.

Chin (1998) suggested that the choice between measuring latent constructs with formative or reflective indicators should be based on research objectives, underlying theories, and empirical conditions. Three pathways of use are used as formative construct indicators. The guidelines given by Jarvis et al. (2003), Williams et al. (2003), Petter et al. (2007), and Coltman et al. (2008) are used to justify how an IT infusion construct is operationalized. According to those

researchers, the formative construct indicators are suitable for the following reasons.

- 1) The direction of causality is from three pathways of use to the IT infusion. An organization reaches its infusion stage (product) when it integrates spreadsheets into all tasks, uses spreadsheets to establish the workflow linkages among all tasks, and spreadsheets are used as a strategic tool to create competitive advantage for the business. The formative construct include all parts of the IT infusion definition. Basically, indicators (three pathways of use) define characteristics of the construct rather than manifest the construct.
- 2) Changes in three pathways of use cause change in IT infusion.
- 3) Indicators have different contents and do not share the common theme. They may have different antecedents and consequences.

The formative construct indicators for IT infusion through three pathways of use in this study are based on rigorous literature review and qualitative data from real business setting. The construct indicators were commented on and validated by an expert panel in an international conference<sup>1</sup>.

#### **8.4.1 Extended use measure**

Extended use is measured based on the level of task complexity into which spreadsheets have been integrated. The results from qualitative study indicate that more complex tasks in four major audit steps (audit planning, control testing, substantive testing, and audit report) require more advance features of spreadsheets to be used. The instrument is, therefore, simplified using the measuring scales according to the task complexity as:

<i>Not used (0)</i>	Spreadsheets are not used in auditing.
<i>Low (1)</i>	Spreadsheets are mainly used for evidence recording purposes. Very basic calculations may be found. Very few complex or cell

---

<sup>1</sup> The Fourth Asia Pacific Research Symposium in Accounting Information Systems



references are used. In the audit reporting phase, spreadsheets are used for preparing financial statements in order to compare with the ones prepared by clients.

*Moderately low (2)* Spreadsheets are mainly used for evidence recording and calculating purposes. Some functions and cell references are used. In the audit reporting phase, figures are calculated and cell references are used.

*Moderately high (3)* Spreadsheets are developed to gather data for risk assessment. Some complex features and functions may be used to test account balances. Spreadsheets may be used to perform data mining. In the audit reporting phase, complex features and functions may be used to assemble advanced financial statements (e.g. cash flows statement, consolidation) for comparison purposes to the clients' financial statements.

*High (4)* Spreadsheets are developed as an automatic module. For example, spreadsheets suggest an appropriate audit program and sample size from the risk assessment results, automate work papers by automatically grouping accounts from client's trial balance, provide templates for solution (e.g. tax calculation, loan amortization), and/or suggest an appropriate type of audit report and/or disclosures.

The total highest possible extended use score for each audit phase is four. There are four audit phases, audit planning, control testing, substantive testing and audit report. Therefore, an organization reaches a highest level of extended use when it integrates spreadsheets into the most complex tasks in all four audit phases. The highest level of use shows the extended use score of 16.

#### **8.4.2 Integrative use**

An integrative use is measured by counting the links between the tasks that spreadsheets have been integrated. The respondents are asked whether they carry their work/data over from the previous phases by simply responding "yes" or "no". All "yes" responses are counted as one point. The integrative use scores are

counted both within-audit-phase and across-audit-phase. The total highest possible integrative use score is 15. An organization reaches the highest integrative use level when all work/data is carried over from the beginning (audit planning) until the end of the audit procedure (audit report). The following statements are used and/or adapted in four audit phases to measure integrative use.

- a) If your firm uses spreadsheets for calculations, does your firm electronically incorporate previously recorded data to perform calculations?

Yes

No

- b) If your firm uses spreadsheets for risk assessment, does your firm electronically incorporate previously recorded data and calculated figures to perform risk assessment?

Yes

No

- c) If your firm uses spreadsheets for making judgments and suggesting further procedures, does your firm electronically incorporate previously recorded results as inputs?

Yes

No

### **8.4.3 Emergent use**

As discussed in chapter 4 and chapter 5, the emergent use measure integrates the original definition given by Sullivan (1985) and the concept of IT benefit realization (Fischer, 1996). An organization reaches the highest emergent use level when spreadsheets are used as strategic tools for creating competitive advantage within the firm. During the early phase of this study, the emergent use score starts with 0 (technology is used to assist existing works). The survey instrument score starts 0 as “We do not use spreadsheets in audit work” to avoid confusion. Therefore, the survey score is one-level higher than those of the case studies. The questions used for measuring the level of emergent use are as follows:

Please select one of the following statements that best describes the use of spreadsheets in your firm by circling 0, 1, 2, 3, or 4.

0. We do not use spreadsheets for audit work.
1. Spreadsheets are used to assist audit work.
2. Spreadsheets are used to improve the efficiency of audit work.
3. Spreadsheets have allowed us to use new audit approaches that could not have been done manually.
4. Spreadsheets are a strategic tool for creating competitive advantage for the firm.

## **8.5 OTHER MEASURES**

In addition to independent and dependent variables in section 8.3 and 8.4, this study also developed global measurements for further analysis. The global measures include spreadsheet infusion, three pathways of use, and IT impacts.

### **8.5.1 Spreadsheet infusion**

The study adopted well-developed measure used by Jones et al. (2002) and Sundaram et al. (2007). Since the measures used in the studies focused on an individual level of analysis, the study adapted the measures by replacing the word “me” with “our firm” and “my own” with “audit”. The three-item measures using seven-point likert scales are as follows:

- a) *Our firm* is using [spreadsheets] to its fullest potential for supporting our *audit* work.
- b) *Our firm* is using all capabilities of [spreadsheets] in the best fashion to help us on the job.
- c) I doubt that there are any better ways for our firm to use [spreadsheets] to support our work.

### 8.5.2 Extended use

The global measures for extended use were developed based on the conceptual definition given by Saga and Zmud (1994). They defined extended use as “*Using more of the technology features in order to accommodate a more comprehensive set of work tasks.*” Two dimensions were identified from the definition: spreadsheet features and organizational tasks. The first statement targets the second dimension. The second statement uses reverse coding as done by Jones et al. (2002) and Sundaram et al. (2007). The last statement adopts a measure developed by Hann and Weber (1995) and Castner and Ferguson (2000) and targets the uses of spreadsheet features. The three-item measures using seven-point likert scales are as follows:

- a) Our firm is using spreadsheets in complex ways in audit work.
- b) There are many more possible areas in our audit work where spreadsheets can be used.
- c) The use of spreadsheet software in our firm involves considerable use of pre-saved information, functions, templates or macros.

### 8.5.3 Integrative use

The first study which includes interconnected work flows as an IT infusion dimension was conducted by Zmud and Apple (1992). The examples are: “*Users establish work flow linkages with other individuals, where microcomputer usage by one individual directly precedes or follows that by another individual.*” and “*Certain applications, such as order entry and production control, are designed as distributed systems whereby data and its processing are concurrently distributed across multiple users, each working from a local database that is then integrated as a collective database.*” Saga and Zmud (1994) defined integrative use as “*using the technology in order to establish or enhance work flow linkages among a set of work tasks*” From the conceptual framework above, three statements are formed. The first statement follows the definition given by Saga and Zmud. The other two statements adapt the work flow linkages definition used by Zmud and Apple.

- a) In our firm, audit procedures have been linked by the use of spreadsheets.
- b) Our firm's users establish work flow linkages with other individuals, where spreadsheets used by one individual directly precedes or follows that by another individual.
- c) In our firm, spreadsheets are used as common platforms for audit work.

#### **8.5.4 Emergent use**

The emergent use measure follow the definition given by Saga and Zmud (1994) as *“using the technology in order to accomplish work tasks that were not feasible or recognized prior to the application of spreadsheets to the work system”*. The first two statements divide the process into recognition and action. The last statement is adapted from a measure used by Hann and Weber (1995) and Castner and Ferguson (2000).

- a) The use of spreadsheets enables our firm to perform new audit tasks that were not recognized prior to the existence of the application.
- b) The use of spreadsheets enables our firm to perform work tasks that were not feasible prior to the existence of the application.
- c) Some audit tasks could not be completed [either manually or with the use of other applications], if the spreadsheet software became unavailable. [The unavailability could result from a power failure, a system crash or maintenance being performed].

#### **8.5.5 IT impacts**

This study adopted IT impact measures used by Thong et al. (1996). IT impacts are assessed using four balanced scorecard perspectives developed by Kaplan and Norton (2001). The balance scorecard measure organizational performance in four perspectives: customer's perspective, internal operations, innovation and learning, and financial perspective. The balance scorecard concept enables the study to assess the IT impact within a logical framework instead of over emphasizing in

perspective of some impacts. “*The balanced scorecard translates an organization’s mission and strategy into a comprehensive set of performance measures that provides the framework for a strategic measurement and management system*” (Kaplan and Norton, 2001, pp.2).

*Financial perspectives – revenue growth and cost reduction/ productivity improvement*

- a. Spreadsheets have helped us improve audit revenue.
- b. Spreadsheets have helped us reduce audit time (cost).

*Customer perspective – product and service attributes, customer relationship, and image and reputation*

- c. Spreadsheets have helped increase the quality of our audit services.
- d. Spreadsheets have helped us improve client relationships (e.g. reduce response time).
- e. Spreadsheets have helped us improve firm image.

*Internal business process perspective --innovation and operation*

- f. Spreadsheets have helped improve firm innovativeness.
- g. Spreadsheets have helped improve firm audit processes.

*Learning and growth perspective – employee capabilities*

- h. Spreadsheets have helped us improve staff productivity.

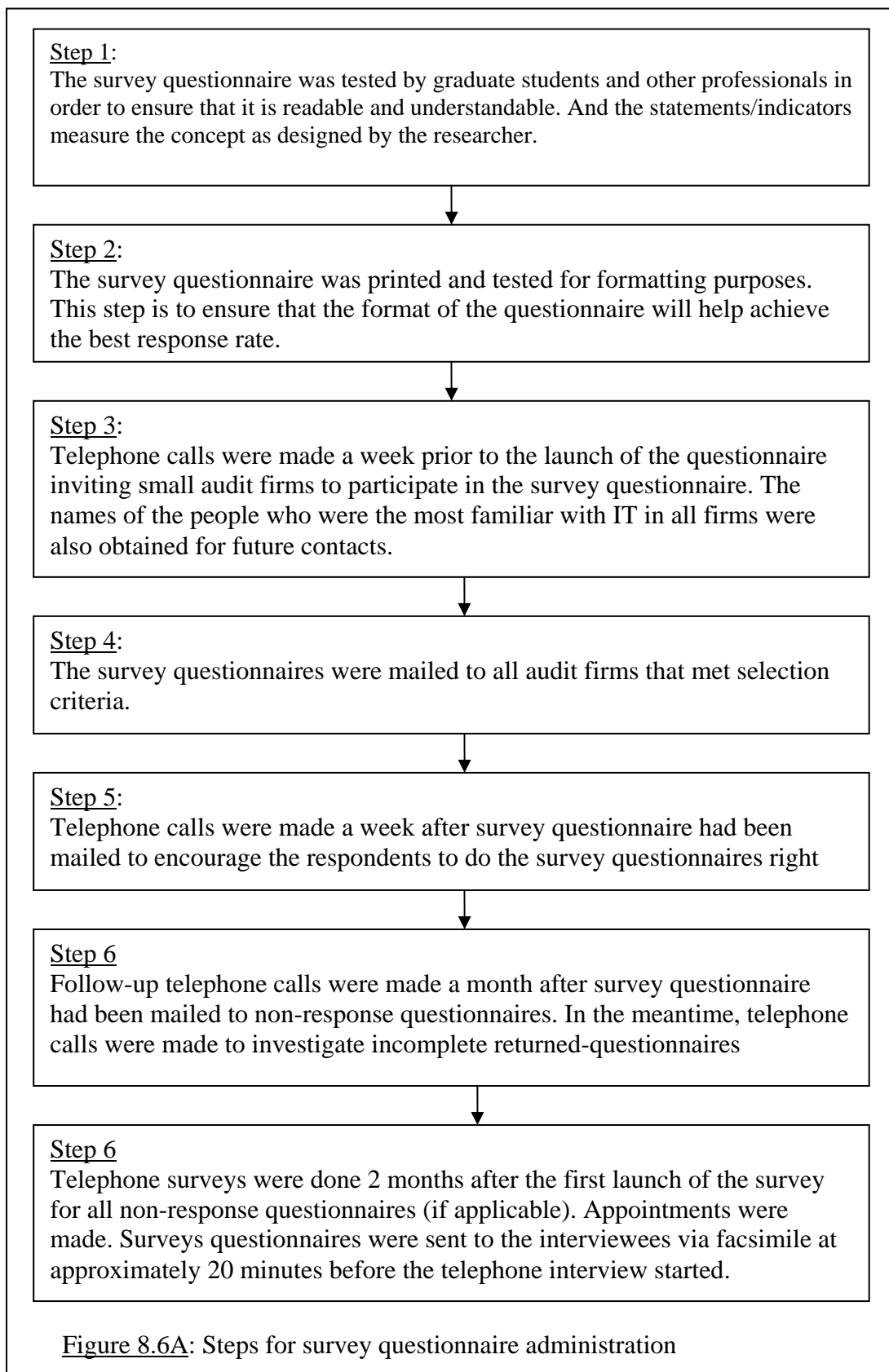
*Overall impacts*

- i. Overall, the use of spreadsheets has had a significant positive impact on the firm.
- j. Overall, spreadsheets have made a strong positive contribution to firm performance.

## **8.6 SURVEY DESIGN**

This study followed guidelines for survey design given by Dillman (2007). Dillman suggests that the most important concept in designing self-administered questionnaires is to apply social exchange ideas. People will be more likely to complete and return the questionnaire if they trust that the rewards of doing so outweigh the costs they expect to incur. This study, therefore, established a shared-knowledge community for small and medium sized audit firms by being sponsored by a top business school in Thailand. The promise has been made to communicate the survey results and help small firms utilize technology to the fullest potential to support their work.

The survey was printed as a booklet using A5 size format in order to make the survey look as short as possible and prevent page loss (Dillman, 2007). The implementation was done as shown in Figure 8.6A.





## **8.7 CONCLUSION**

In this chapter, the spreadsheet infusion model proposed in Chapter 7 was modified in order to suit the organizational level of analysis which is the main focus of this study. Survey instruments were developed for seven independent variables including task variety, IT infrastructure flexibility, social network, organizational IT competence, management support, routinization, and IT champion. The spreadsheet infusion scores were measured by formative construct indicators based on three pathways of use.

The instruments were adopted or adapted where there were well-established instruments at the same level of analysis. Additional global measures for IT infusion, three pathways of use, and IT impacts were also developed for future use. The survey development followed Bradburn et al.'s (2004) and Dillman's guideline in developing survey questionnaire. Finally, the survey instrument was tested with graduate students and audit professionals. The changes were made where appropriate in order to ensure validity of the instrument.

# CHAPTER 9

## SURVEY RESULTS

In the following two chapters, Chapter 9 and Chapter 10, results and analysis from the survey questionnaire are presented. Chapter 9 reports the survey questionnaire results along with descriptive statistics and preliminary findings from the survey. Chapter 10 reports the data analysis of the survey results.

In this chapter, descriptive statistics for each measured variable are reported along with its instrument's validation results. All instruments are tested for internal consistency and convergent and discriminant validity in order to make sure that they fairly measure the constructs. The results show that all instruments fairly measured the constructs of each variable. Additional results from the open-ended questions of the survey are also reported as Appendix C. This chapter is outlined as follows:

- 9.1 Survey questionnaire and the responses
- 9.2 The responses and their characteristics
- 9.3 The use of spreadsheets and spreadsheet infusion
- 9.4 Results of the constructs measured
- 9.5 Results of the global measures
- 9.6 Results of IT impacts
- 9.7 Conclusion

### **9.1 SURVEY QUESTIONNAIRE AND THE RESPONSES**

#### **9.1.1 Population**

The list of certified auditors has been obtained from the Thai Ministry of Commerce. Since Thai regulations recognize auditors as individuals, the list is

filtered in order to identify the population that fits the “organization” definition and criteria as follows:

1. The list is sorted by the names of audit firms in order to identify the firms.
2. The list is then sorted by the addresses in order to eliminate audit firms which are under different names, but are the same organization.
3. The first criterion is to choose firms with two or more certified auditors. Then, the list of auditors with one certified auditor is called to identify whether there are more than 2 full-time staff. If the firm falls into the definition, an additional questionnaire is sent.
4. All certified auditors who provided services to 100 or more clients in the 2007 calendar year will also be selected.
5. There are 203 audit firms meeting the above criteria.

### **9.1.2 The Responses**

The survey questionnaires were sent to 203 small and medium-sized audit firms in Thailand from late July to early August 2008. Eighty six responses (approximately 42.36%) were returned as of 20 October 2008. Out of 86 responses, eight responses claimed that they did not use spreadsheets in audit work and one firm claimed that the spreadsheets were used to view and print clients’ data. This establishes 78 complete responses or approximately a 38.42% response rate of the survey questionnaire sent. In order to increase the research quality, the responses of the firms included in the case study research (six responses) were excluded from the survey results and analysis. The remaining complete data sets for analysis were, therefore, 72 (approximately 35.47%). Table 9.1A summarizes the responses from the survey questionnaire.

Dillman’s (2007) approaches of increasing responses were used to increase the response rate. Telephone calls were made in order to follow the questionnaire. Personal relations were used to contact non-responses of the questionnaire; and telephone surveys were conducted. Where telephone surveys were done, the survey

questionnaire had been sent to the interviewees via facsimile before the interview was conducted in order to reduce errors in verbal communication. The results of the telephone survey were included in the complete data sets above. Where data sets were incomplete or missing, follow-up telephone calls were made with the purpose of thanking and asking for missing answers.

	Samples	%
Total Survey Questionnaire Sent	203	100.00%
Returned with completed results	86	42.36%
Responses excluded (The samples were included as case studies)	6	2.96%
Responses included in the analysis	80	39.41%
Returned – Not using spreadsheets (or for a viewing purpose)	8	3.94%
<b>Total completed responses included in the analysis</b>	<b>72</b>	<b>35.47%</b>

Table 9.1A: Summary of survey responses

Even though the response rate is higher than those of most studies, the small data set limit the generalization of the study.

### **9.1.3 The Non-responses**

Telephone calls made to non-response firms indicate that approximately ten samples were not formally organized as firms. They do not meet a definition of an organization. These auditors worked as freelances but set up legal forms as firms or partnerships for legal and tax purposes. All samples claimed that they did not use computers in auditing. These firms are small (less than 3 or no full-time staff) and are not interested in using the technology. The non-responses are determined as not giving relevant information to this study since they do not adopt technology. Therefore, they have not established infusion process within the firms.

## 9.2 THE RESPONSES AND THEIR CHARACTERISTICS

Out of 75 responses, approximately 40 percent of the responses come from small firms with 2-5 staff and approximately 32 percent come from firms with 6-20 staff (Table 9.2A).

Firm size (Number of full-time staff)	International		Total	Percent (Total)
	Allied	Not allied		
2-5	0	31	31	39.2
6-20	5	21	26	32.9
21-50	3	9	12	15.2
51-80	3	2	5	6.3
81-150	1	2	3	3.8
151-220	1	1	2	2.6
Total	13	66	79	100.0

Table 9.2A: Characteristics of the respondent firms

The results show that most of the responses are small. The generalization of the survey questionnaire may not be fully applicable with medium sized firms. In general, most of the audit firms in Thailand are small with two to twenty staff; there are less than ten firms that have more than one hundred staff. The responses, therefore, proportionately represent the small and medium-sized audit industry in Thailand. While the survey results exhibit a limitation of this study, the qualitative study gives inside information with bigger firms. One of the bigger firms was included as a case study in this research during the qualitative phase. Thirteen response firms have allied with other international firms in term of being members (Table 9.2A). Most of the international-allied firms are smaller firms which have 6-80 staff.

## 9.3 THE USE OF SPREADSHEETS AND SPREADSHEET INFUSION

### 9.3.1 Organizational experience in using spreadsheets

The organizational experience in using spreadsheets is measured by the number of years the organization has been using spreadsheet. This measure is also called earliness of adoption in other studies (Zmud and Apple, 1992; Eder and Igbaria, 2001). Approximately a half of the respondent firms have used spreadsheets for approximately 8-10 years where a few firms have used spreadsheets for more than 16 years. Those firms stated that they used Lotus 1-2-3 dating back to 1990s. Figure 9.3A shows distribution of firms' experience on using spreadsheets. On average, most firms have used spreadsheets in audit work for approximately 8.94 years. The median of the firms' experience in spreadsheets is also 8 years.

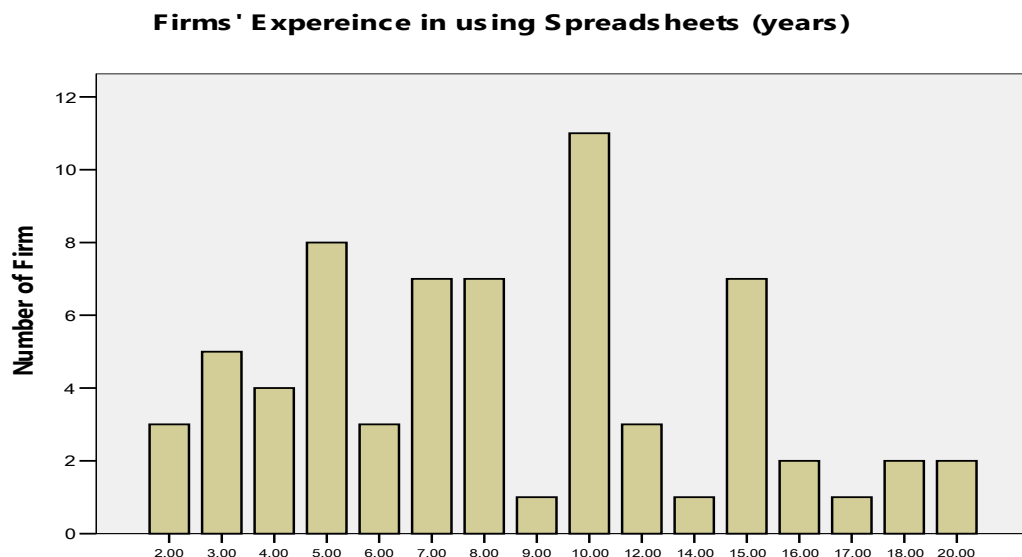


Figure 9.3A: Firms' experience in using spreadsheets

### 9.3.2 IT infusion

The IT infusion scores of the samples are the sum of extended use, integrative use, and emergent use score which are shown later as subsections. The descriptive statistics of IT infusion score is shown in Table 9.3A

	Extended use (out of 16)	Integrative use (out of 15)	Emergent use (out of 4)	IT infusion (out of 35)
Mean	8.21	6.58	1.72	16.51
SD	3.12	3.58	0.87	6.81
Min	1.00	0.00	0.00	2.00
Max	15.00	15.00	4.00	31.00

Table 9.3A: IT infusion scores of the respondent firms

The results show that on average the samples have IT infusion score of 16.51 out of 35. It implies that most firms are half-way through the infusion process. Most firms have high extended use score which indicates that they focus on task-spreadsheet integration. The average integrative use score is less than half of the total score. This may imply that most firms have not connected the work flows using spreadsheets. The low average emergent use score of 1.72 indicates that the samples tend to use spreadsheets to increase efficiency and effectiveness of their work.

The scores of the survey sample are significantly higher than scores measured during the qualitative study. This fact shows a limitation to the self-report survey approach which tends to yield higher scores than those of the benchmark approach used during the case study phase.

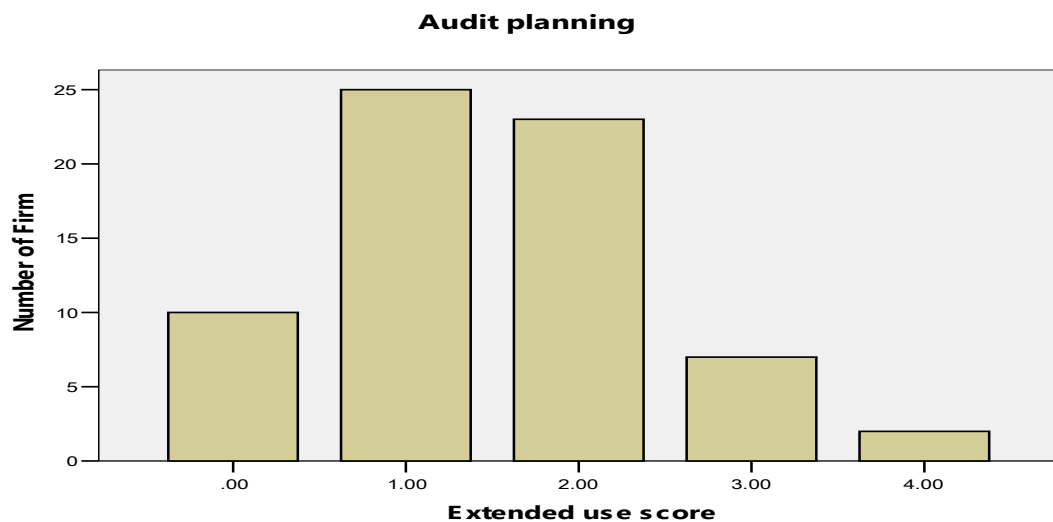
#### *9.3.2a Extended use of spreadsheets*

The result of the survey (Table 9.3B) shows that most firms have the most complex use of spreadsheets during the substantive testing phase and audit report phase with average scores of 2.58 and 2.28 respectively. Spreadsheets have the least complex use during audit planning phase. Ten and eight firms report no use of spreadsheets during the first two phases (audit planning and control testing). This result is consistent with the qualitative studies that most small firms focus on substantive testing and audit report phases.

	Level of spreadsheet complexity use					Mean
	Not used	Low	Moderately Low	Moderately high	High	
Audit Planning	10	25	23	7	2	1.49
Control Testing	8	12	22	23	2	1.99
Substantive Testing	1	5	24	28	9	2.58
Audit report	1	17	20	20	9	2.28
Total	20	59	89	78	22	

**Table 9.3B:** The use of spreadsheets in various audit phases

*Audit planning:* The survey data shows that during the audit planning phase, small audit firms use spreadsheets for tasks with lower complexity. The firms that rank their complex uses as high are firms with six-to-twenty staff and have been using spreadsheets more than ten years.



**Figure 9.3B:** Extended use scores during the audit planning phase

*Control testing:* In the second phase, the level of complex use is greater than the first phase. This may be explained by the fact that the control testing phase



involves testing and manipulating data and numbers compared to the first phase of audit planning where most tasks involve gathering qualitative and quantitative data and making judgments on the results.

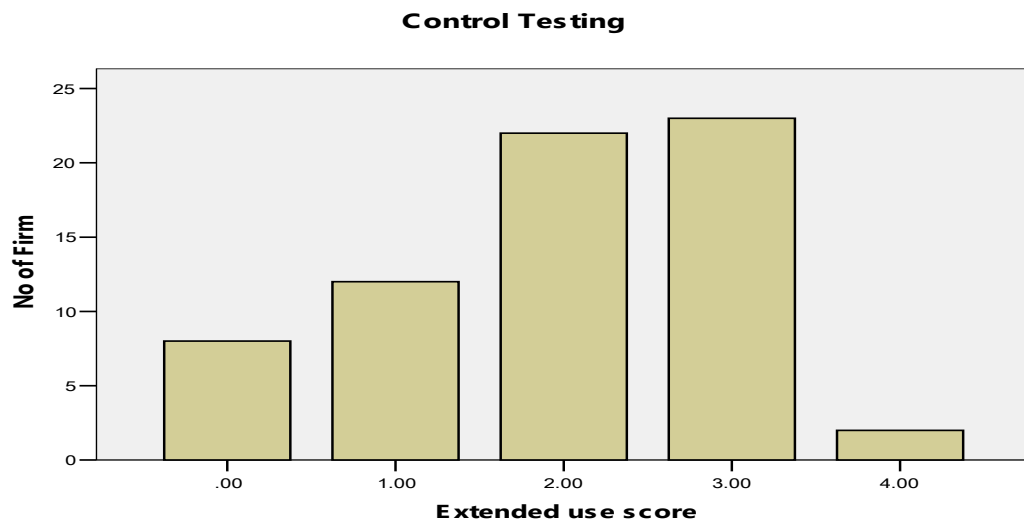


Figure 9.3C: Extended use scores during the control testing phase

*Substantive testing*: During this phase, most firms use spreadsheets from moderately low to moderately high levels of complexity. Nine firms that rank their use as the highest complexity level are mostly mid-sized firms (6-80 staff). Two out of nine firms are included as case studies. And three out of nine have allied with other international firms.

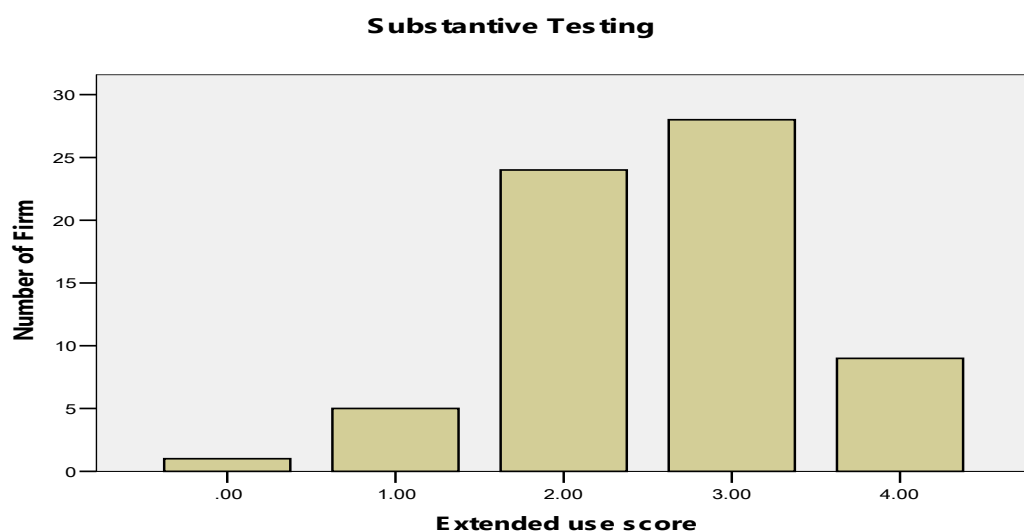


Figure 9.3D: Extended use scores during the substantive testing phase

*Audit Report:* During audit report phase, a significant number of firms use spreadsheets in order to prepare and calculate figures in financial statements (for a comparison purpose). The firms which use spreadsheets to a high complexity level during substantive testing phase usually rate their uses high during audit report phase. However, there are approximately 25.37% of the respondent using spreadsheets mainly for preparing and printing purposes (complexity score = 1).

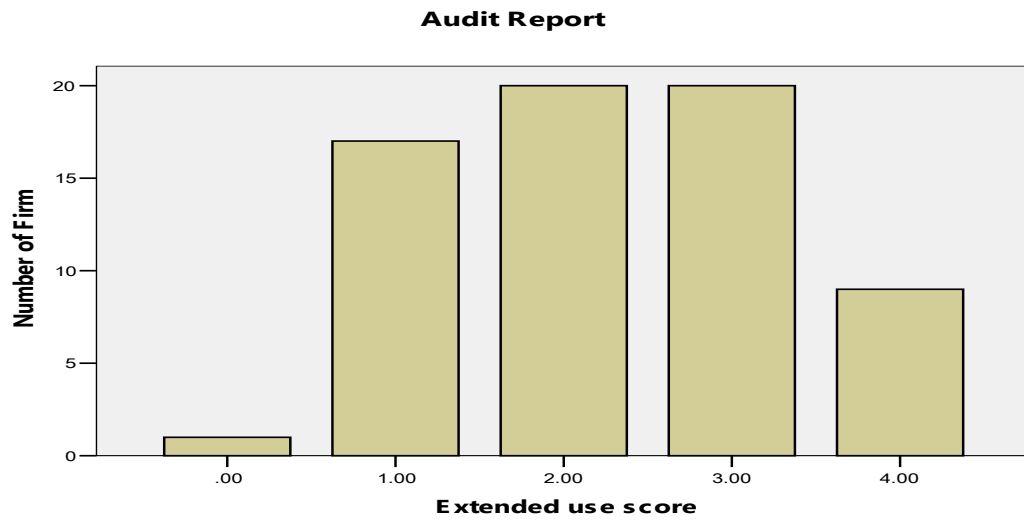


Figure 9.3E: Extended use scores during the audit report phase

### 9.3.2b *Integrative use of spreadsheets*

On average, the survey shows that the use of spreadsheets promotes the interconnectedness among audit phases (score mean = 1.93). Table 9.3C summarizes the mean and SD of integrative use scores of the respondents during each audit phase and across audit phases. In addition, substantive testing and audit report are two phases where work flows can be improved using spreadsheets with mean of 1.55 and 1.36 respectively. Figure 9.3F and 9.3G shows integrative use score of the survey.

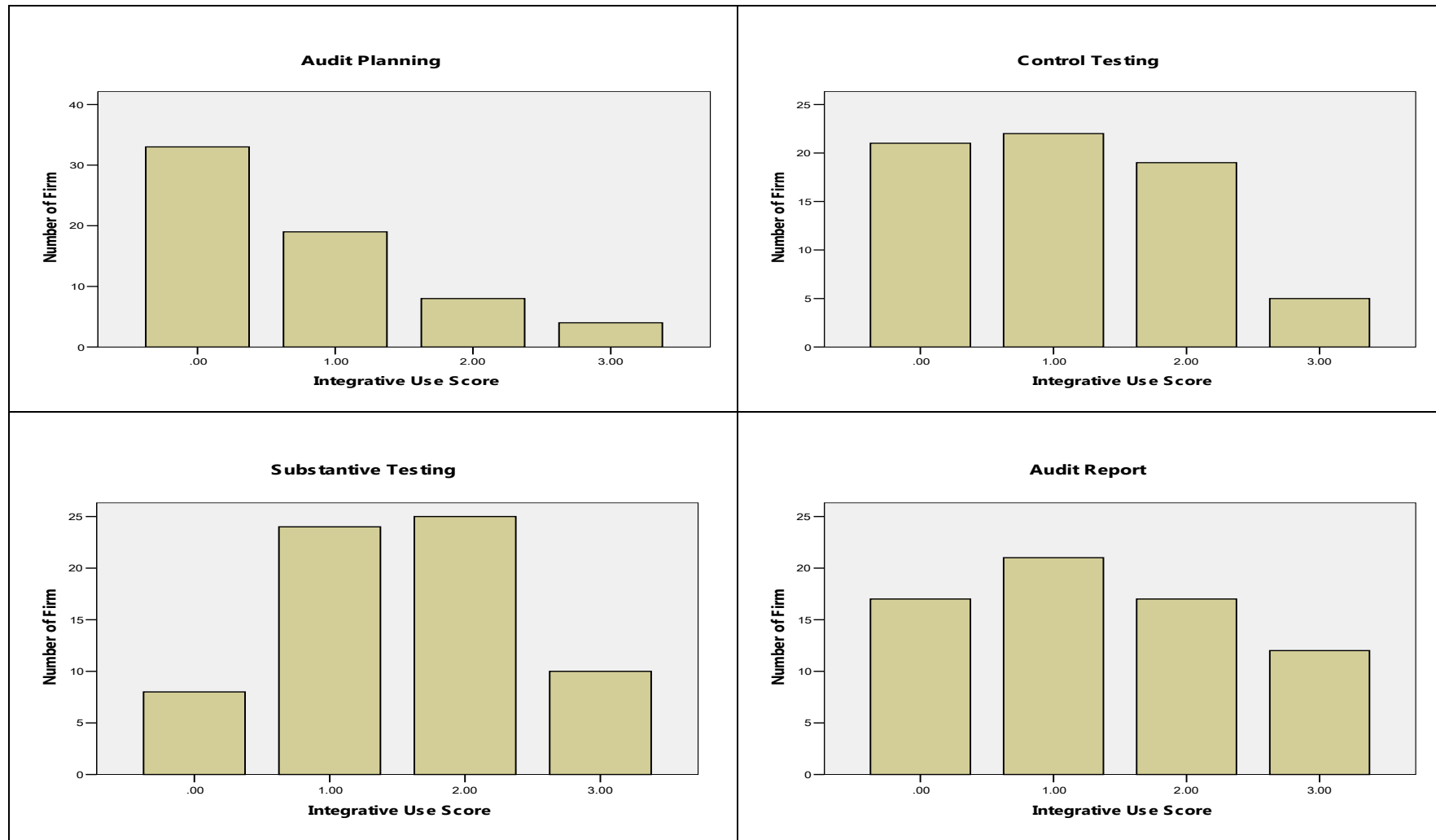


Figure 9.3F: A comparison of integrative use scores in four audit phases

	Audit planning	Control Testing	Substantive Testing	Audit Report	Integration Across Audit Phases	Total score (average)
Mean	0.70	1.12	1.55	1.36	1.93	6.58
SD	0.90	0.95	0.89	1.05	1.05	3.58

Table 9.3C: Means and Standard Deviations (SD) of integrative use scores

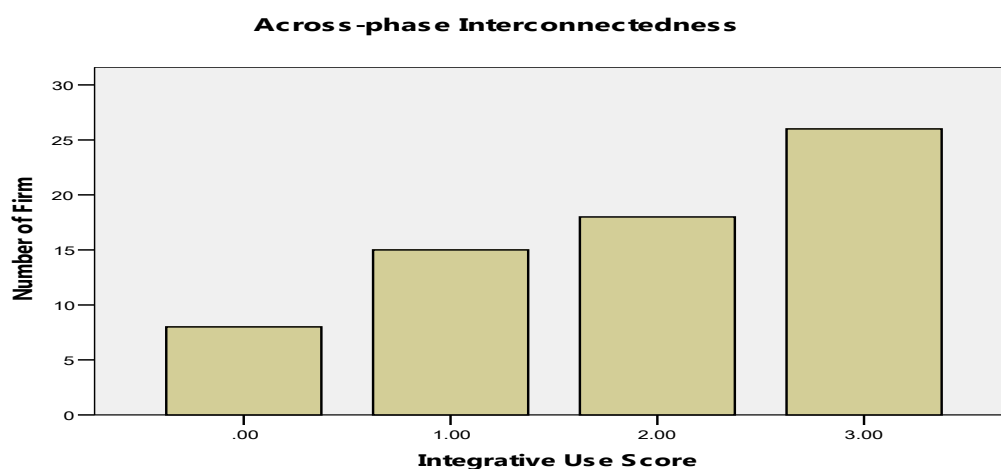


Figure 9.3G: Integrative use scores across audit phases.

### 9.3.2c *Emergent use / objectives of using spreadsheet in audit work*

Most firms use spreadsheets in order to accommodate audit work (approximately 39.24%) or increase effectiveness and efficiency in audit work (approximately 40.51%). This information also exhibits the attitude toward emergent use of the firms. Table 9.3D shows the distribution of spreadsheets use. There are six firms which claimed that spreadsheets have been strategically integrated in the firms.

	Total	Percent
0 - We do not use spreadsheets for audit work	8	10.13
1 - Spreadsheets are used to assist audit work	31	39.24
2 - Spreadsheets are used to improve the efficiency of audit work	32	40.51
3 - Spreadsheets have allowed us to use new audit approaches that could not have been done manually	2	2.53
4 - Spreadsheets are a strategic tool for creating competitive advantage for the firm	6	7.59
Total	79	100.00

Table 9.3D: The survey results - objectives of spreadsheet use

As discussed in section 8.4.3, the emergent use score from the survey instrument is set one-level higher than those of the case studies.

9.3.2d      *Audit tasks/procedures could not have been done without the use/existence of spreadsheets (Emergent use)*

Out of 75 responses, 33 firms responded to this open-ended question. Figure 9.3H shows the audit tasks that it is claimed “cannot-be-done” without using spreadsheets. The survey responses to this question vary widely with the most uses in areas of simple and complex calculation tests, data sorting, and their abilities to manage significant amounts of data. Other uses include preparing tax and lead schedules, importing data, preparing graphs, linking financial statements, preparing consolidation and cash flows statements, enabling of auditing under time constraints, and storing data.

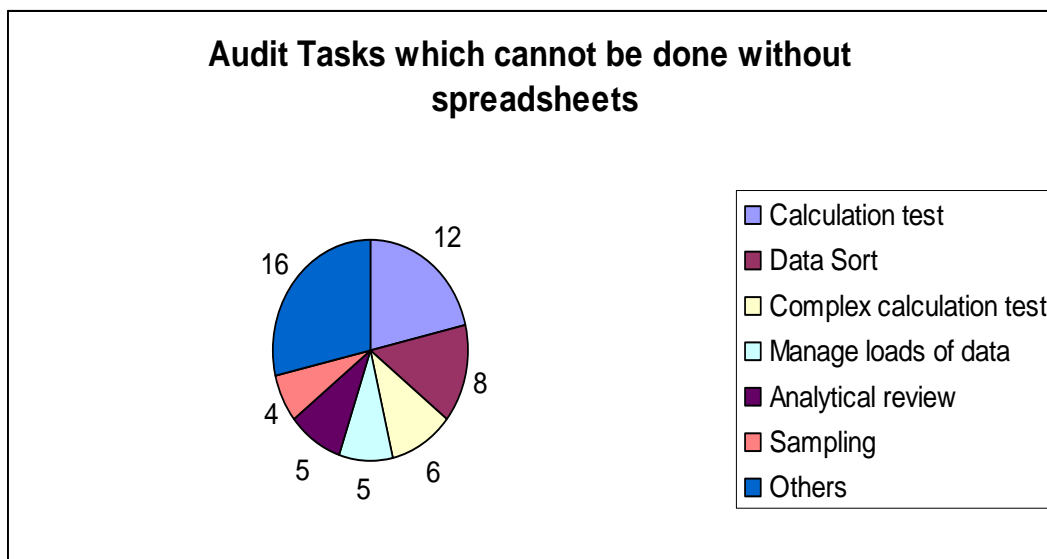


Figure 9.3H: Audit tasks which cannot be done without spreadsheets

## 9.4 RESULTS OF THE CONSTRUCTS MEASURED

Three indicators using seven-point Likert scales were used to measure constructs in this study. This section reports the mean and standard deviation (SD) of the answers of each factor. The second and the third parts report reliability and validity tests of the measures. One remarkable result from the answers is that the SD of all answers is high.

### 9.4.1 Task Variety

The results show that on average, the respondents provide services to a moderate number of clients (mean = 4.19) which operate in many industries (mean 5.07) even though the earlier results show that most of these firms are small. An additional characteristic of small firms found from the survey is that these firms also focus on providing other services such as accounting and tax services.

	Statement	Mean	S.D.
a)	Our firm performs a variety of services	4.84	1.69
b)	Our firm has a significant number of clients.	4.19	1.54
c)	Our firm's clients represent many industries	5.07	1.64

#### 9.4.2 IT infrastructure flexibility

Most firms claimed to have moderate IT infrastructure with means of 4.61 and 4.30. However, they rarely allow data retrieval externally.

	Statement	Mean	S.D.
a)	Our firm's IT infrastructure is very flexible in relation to future needs.	4.61	1.61
b)	Our firm's IT infrastructure allows staff to share data and knowledge.	4.30	1.45
c)	Our firm's IT infrastructure allows staff to access data from anywhere.	3.64	1.73

#### 9.4.3 Organizational IT competence

Most firms claimed that they have moderate knowledge in integrating spreadsheets into audit tasks and the functionalities of spreadsheets (with means of 4.66 for both). Being consistent with qualitative data, the mean score drops significantly when they rank their knowledge on how other audit firms use spreadsheets to perform audit tasks (mean 3.48).

	Statement	Mean	S.D.
a)	Our firm has sufficient knowledge of all features, functions, and abilities of spreadsheets.	4.66	1.29
b)	Our firm has sufficient knowledge of how to use spreadsheets to perform audit tasks.	4.66	1.45
c)	Our firm has sufficient knowledge of how other audit firms use spreadsheets to perform audit tasks.	3.48	1.55

#### 9.4.4 Social network and external support

The results contrast to most prior studies (e.g. Cragg and King, 1993; Soh et al., 1995) on the fact that small firms rely heavily on external IT supports. They tend to seek help from other audit firms or public educational institutes (mean = 3.96). However, overall the respondents have moderate contact with external parties. They also rely less on external IT support. This is consistent with the results found during the qualitative study.

	Statement	Mean	S.D.
a)	Our firm makes regular use of external IT consultant(s).	3.09	1.63
b)	Our firm regularly participates and exchanges knowledge and opinions with other audit firms.	3.43	1.54
c)	Our firm regularly participates and exchanges knowledge and opinions with <b><u>institutes other than audit firms</u></b> (e.g. Universities, regulators).	3.96	1.88

#### 9.4.5 Management support

Most firms claimed that their partners support the use of IT at a high level (mean = 5.24). However, the management takes less action in term of providing training (mean = 4.79) and concerning IT satisfaction (mean 4.84).



	Statement	Mean	S.D.
a)	The partner(s) actively encourages audit staff to use IT in their daily tasks.	5.24	1.52
b)	The partner(s) provides enough IT training and/or time for staff to think of using IT in audit tasks.	4.79	1.75
c)	User IT satisfaction has been a major concern of the partner(s).	4.84	1.63

#### 9.4.6 Routinization

The surveyed firms show a relatively high level of routinization. Using spreadsheets is a normal part of the firms' procedures (mean = 6.13). This shows that the firms normally use spreadsheets. When it comes to audit work, the use of spreadsheets is less integrated but is still at the higher level of routinization.

	Statement	Mean	S.D.
a)	The use of spreadsheets has been incorporated into the firm's work procedures.	5.85	1.16
b)	The use of spreadsheets is pretty much integrated as part of normal audit work routine.	5.73	1.30
c)	The use of spreadsheets is a normal part of the firm's procedures.	6.13	1.15

#### 9.4.7 IT Champion

Most firms identified (an) IT champion (s). However, the champion (s) has spent their time innovating and convincing other colleagues at a moderate level (mean 4.34 and 4.31). This is consistent with the qualitative data that most IT champions are subject to time constraints. They do not have time for innovating new uses of

IT. In addition, the champions mostly take passive roles when they are asked to help others

	Statement	Mean	S.D.
a)	In our firm, there are one or more individuals who vigorously and enthusiastically support/ promote the use of spreadsheets in audit work.	5.00	1.56
b)	In our firm, these individuals spend significant amounts of time investigating/experimenting the use of spreadsheets in audit work.	4.34	1.75
c)	In our firm, these individuals spend significant amounts of time pushing/convincing other firm members to use spreadsheets in audit work.	4.31	1.82

## 9.5 RESULTS OF THE GLOBAL MEASURES

Three statements were used to measure four global measures using seven-point Likert scales. The results also show remarkably high standard deviations in all answers.

### 9.5.1 Infusion of spreadsheets

The survey shows that most firms claimed they use spreadsheets at a moderate-to-high level to support audit work (mean = 5.06). However, they use less capabilities of the application (mean = 4.42). These answers indicate a task-focused perspective of the respondents. The average rank of question c) seems to contrast with question a). This can be interpreted in two ways. The firm may rank the fullest potential use in relation to their tasks, based on their current knowledge of how spreadsheets can be used. Therefore, they expect that more spreadsheet capabilities (question b) can be applied to support more audit work.

		Mean	S.D.
a)	<i>Our firm</i> is using spreadsheets to their fullest potential for supporting <i>audit</i> work.	5.06	1.56
b)	Our firm is using all capabilities of spreadsheets in the best fashion to help us on the job.	4.42	1.65
c)	There are many better ways for our firm to use spreadsheets to support audit work.	5.82	1.37

### 9.5.2 Extended use

The survey shows that most firms think there are many more possible areas that spreadsheets can be used (mean = 5.63) and the current use of spreadsheets is not complex enough (mean = 3.69 and 3.82).

		Mean	S.D.
a)	Our firm is using spreadsheets in complex ways in audit work.	3.69	1.48
b)	There are many more possible areas in our audit work where spreadsheets can be used.	5.63	1.29
c)	The use of spreadsheet software in our firm involves considerable use of pre-saved information, functions, templates or macros.	3.82	1.68

### 9.5.3 Integrative use

Spreadsheets have been used as normal platforms in audit work (mean = 4.51). The spreadsheets also moderately promote the linkage between audit procedures (mean = 4.13 and 3.88 respectively).

		Mean	S.D.
a)	In our firm, audit procedures have been linked by the use of spreadsheets.	4.13	1.67
b)	Our firm's users establish work flow linkages with other individuals, where spreadsheets used by one individual directly precedes or follows that by another individual.	3.88	1.79
c)	In our firm, spreadsheets are used as common platforms for audit work.	4.51	1.70

#### 9.5.4 Emergent use

Most firms claimed that spreadsheets enable them to perform other audit tasks that cannot be done with other approaches. The mean scores are moderate for all three questions

		Mean	S.D.
a)	The use of spreadsheets enables our firm to perform new audit tasks that were not recognized prior to the existence of the application.	3.73	1.62
b)	The use of spreadsheets enables our firm to perform work tasks that were not feasible prior to the existence of the application.	4.42	1.97
c)	Some audit tasks could not be completed [either manually or with the use of other applications], if the spreadsheet software became unavailable. [The unavailability could result from a power failure, a system crash or maintenance being performed].	3.66	1.94

## 9.6 RESULTS OF IT IMPACTS

Most firms believe that overall, the use of the spreadsheets had had significant positive impact on the firm (mean = 5.88). The impacts come mainly from the ability to reduce audit time (cost) (mean = 5.86), increase audit quality (mean 5.56), and improve staff productivity (mean = 5.23). The use of spreadsheets is perceived to have moderate positive impacts all other areas. The least positive impact is on revenue improvement where most auditors believe that audit fees (revenue) are determined by other factors such as market and pressure from clients. Firms seem to respond to the impact of spreadsheets on revenue widely giving the highest SD of 1.98.

		Mean	S.D.
a)	Spreadsheets have helped us improve audit revenue.	4.22	1.98
b)	Spreadsheets have helped us reduce audit time (cost).	5.87	1.37
c)	Spreadsheets have helped increase the quality of our audit services.	5.58	1.52
d)	Spreadsheets have helped us improve client relationships	4.63	1.82
e)	Spreadsheets have helped us improve firm image.	4.87	1.77
f)	Spreadsheets have helped improve firm innovativeness.	4.55	1.47
g)	Spreadsheets have helped improve firm audit processes.	5.07	1.64
h)	Spreadsheets have helped us improve staff productivity.	5.24	1.38
i)	Overall, the use of spreadsheets has had a significant positive impact on the firm.	5.88	1.30
k)	Overall, spreadsheets have made a strong positive contribution to firm performance.	5.10	1.72

## 9.7 CONCLUSION

The returned survey questionnaire establishes 67 completed data sets (32.53% response rate). Approximately 74% of the respondents are small firms which have 2-20 staff. However, the responses can be a proxy of small and medium-sized audit firms in Thailand which consist of a few bigger firms and many smaller firms.

As expected, extended use scores of spreadsheets of most firms are highest during the substantive phase which is the most focused audit procedure and the least during the audit planning phase. Figure 9.3F gives a clear picture of integrative use score which shift from low level during the audit planning phase to the highest level during the substantive phase. Even though the average extended use score during audit report phase is lower than the score of substantive phase, audit firms seem to use spreadsheets to improve interconnectedness during both phases. The global measurements of all three pathways of use (extended, integrative, and emergent use) seem to be consistent with the detail measurement. Most firms focus on IT-task integration more than capability of the IT (spreadsheets).

The instruments for measuring factors vary. The SD of most instruments was high which might lead to reliability and convergent validity problems. Another limitation that this study cannot overcome is that surveys were returned from firms with high routinization (average score of six). Therefore, this study cannot give the results of infusion when the routinization is low. In the next chapter, the survey instruments are evaluated and analyzed.

# CHAPTER 10

## SURVEY RESULT ANALYSIS

In this chapter, instruments are properly tested for internal consistency, convergent and discriminant validity in order to make sure that they fairly measure the constructs. The results show that most instruments fairly measured constructs of each variable. Where necessary, the instruments have been adapted to increase their validity. Partial least square (PLS) regression is used as a statistical tool for the evaluation of the model. The analysis is divided into two steps. The first step shows the analysis of IT infusion enablers. The IT infusion is measured through the task-complexity based instruments developed in Chapter 4 and Chapter 6. The second step shows the analysis of three pathways of use and their enablers.

The chapter is outlined as follows:

- 10.1 Reliability and convergent validity of the instruments
- 10.2 The partial least square regression of IT infusion enablers
- 10.3 The partial least square regression of the three pathways of use
- 10.4 Conclusion

### **10.1 RELIABILITY TEST OF THE INSTRUMENTS**

#### **10.1.1 Instruments' reliability**

The reliability of an instrument refers to the consistency with which it measures a construct. Generally, Cronbach's alpha can be used to test the internal consistency of an instrument (Cronbach, 1951). The alpha is an unbiased estimator of reliability if and only if the components are essentially T-equivalent (Lord and Novick, 1968). Under this concept, means and variance of the component items may vary but their covariance should all be equal. The alpha evaluates the correlations among items measuring the same construct in order to make sure that the items are measuring the same construct. Nunnally (1978) suggests that an alpha value of 0.70

is sufficient to demonstrate a reasonable level of internal consistency for pre-validated scales and 0.60 for non-validated scales.

Most of constructs in this study are measured by a three-item seven-point Likert scale. In order to evaluate the validity of the survey instrument, Cronbach's alphas were calculated for all items. Table 10.1A shows the mean, standard deviation, and alpha for each of the variables in the study.

<b>Variable observed</b>	<b>Mean</b>	<b>S.D.</b>	<b>Cronbach alpha</b>
Task Variety (TV)	4.73	1.21	*0.60
IT Infrastructure Flexibility (Inf)	4.24	1.43	0.80
Organizational IT Competence (Comp)	4.27	1.20	0.80
Social Network and External support (SN)	3.39	1.37	**0.77
Management Support (Mgmt)	5.03	1.53	0.94
Routinization (RZ)	5.98	1.16	0.95
IT Champion (Champ)	4.65	1.65	0.95
IT Infusion (infusion)	5.16	1.15	*0.69
IT infusion (Reversed coding for Q3)	3.89	0.90	*0.18
Extended Use (GEU)	4.41	1.10	*0.60
Extended Use (GEU) (Reversed coding for GEU2)	3.13	0.96	0.87
Integrative Use (GIU)	4.25	1.43	0.80
Emergent Use (GEMU)	3.81	1.63	0.89
IT Impact (impact)	5.13	1.17	0.91

Table 10.1A: Measuring internal consistency of the survey instruments

\* constructs with low alpha

\*\* item which alpha can be improved



Based on Nunnally's (1978) suggestion, most variables exhibit internal consistency amongst measuring items (alpha close to or greater than 0.70) except for items that measure task variety, global measurement of IT infusion, and global measurement of extended use. The items, which measure the social network construct, have an alpha of 0.77; however, deleting an item (SN1) will increase the internal consistency to 0.83.

### **10.1.2 Instruments' validity**

Three types of validity are of concern for instruments used in this study: internal validity, external validity, and convergent validity. Internal validity is concerned with the extent to which inferences can be drawn based upon the causal effects of one variable on another. External validity refers to the degree to which the study results can be generalized from the research setting to other settings. Unlike most studies, this study partly controls some variables by drawing samples from a specific industry. For example, the application of IT to audit tasks is controlled. All samples have the same set of tasks so that the fullest potential use of IT can be compared. However, the setting still allows the interested variables to vary. The external validity is relatively high compared to other specific-industry studies since the study only controls a few variables which are considered to be the weaknesses of prior studies (e.g. inconsistent infusion measures and variables that yield insignificant statistical results), while allowing other variables to vary.

Convergent validity is shown when items that are used to measure the same variable correlate highly with one another. Discriminant validity is shown when items correlate more highly with items intended to measure the same variable than with items used to measure a different variable. This study uses the principal component analysis to test convergent and discriminant validity of these items. The principal component method is based on the concept that items which measure the same constructs are sharing the same principal component. And items which measure different constructs must have different components. Table 10.1B shows the rotated component matrix using the principal component method and varimax rotation with seven factors specified and high loadings emphasized. Items which

measure infrastructure flexibility (Inf), management support (Mgmt), and routinization (RZ) are valid. Further adjustments are required for items measuring task variety (TV), social network (SN), organization IT competence (Comp), and IT champion (Champ).

	Component						
	1	2	3	4	5	6	7
TV1	-.212	.124	.127	-.003	<b>.638</b>	.417	.347
TV2	<b>.741</b>	.044	.275	.021	.206	.206	.227
TV3	.289	.170	.084	.108	.082	.164	<b>.859</b>
Inf1	.373	.072	.468	.113	.053	<b>.664</b>	.204
Inf2	<b>.650</b>	.094	.397	.041	-.069	<b>.413</b>	.300
Inf3	.211	.225	-.079	.172	.212	<b>.797</b>	.065
Comp1	<b>.467</b>	.229	.427	<b>.480</b>	.020	.234	-.103
Comp2	.375	.218	.301	<b>.626</b>	.234	.093	.146
Comp3	.133	-.112	.196	<b>.881</b>	.040	.111	.065
SN1	.196	-.065	<b>.710</b>	.246	.231	.046	-.131
SN2	.372	.081	.111	.269	<b>.812</b>	.056	-.031
SN3	.353	-.006	.443	-.032	<b>.708</b>	.065	.009
Mgmt1	.379	.389	<b>.671</b>	.092	.100	.033	.344
Mgmt2	.293	.299	<b>.773</b>	.215	.130	.017	.102
Mgmt3	.274	.354	<b>.718</b>	.260	.235	.152	.223
RZ1	.183	<b>.909</b>	.156	.001	.016	.084	.077
RZ2	.030	<b>.907</b>	.165	.110	.109	.062	.134
RZ3	.180	<b>.935</b>	.061	-.048	.008	.143	.020
Champ1	<b>.681</b>	.420	.229	.253	.292	.179	.053
Champ2	<b>.741</b>	.257	.282	.374	.158	.042	.100
Champ3	<b>.748</b>	.186	.283	.383	.221	.113	.092

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 16 iterations.

**Table 10.1B:** Rotated component matrix of independent variables

### 10.1.3 Evaluating and refining the instruments

The results from reliability, convergent validity, and discriminant validity tests show that items that measure infrastructure flexibility, management support, and routinization are valid and acceptable. The following parts discuss other measuring items and how those items are refined in order to keep their validity to a satisfactory level. A summary of indicators used or dropped from the analysis is shown in Table 10.1C

#### *10.1.3a Task variety*

In the survey instruments, the task variety constructs were measured using three items. The instruments indicate problems with internal validity ( $\alpha=0.60$ ), convergent and discriminant validity. The second item (TV2: Our firm has a significant number of clients) is moving along with other construct indicators. The first (TV1: Our firm performs a variety of services) and the last (TV3: Our firm's clients represent many industries) items have different components. Statistical results show that the alpha will increase by 6.7% if TV1 is deleted.

In the following analysis, TV3 is used for measuring task variety. It establishes the explicit link to audit work in terms of the application of IT in many areas. TV1 and TV2 are dropped from the measurement model. Even though TV1 is suggested by an interviewee during the case studies, it is dropped because the survey focuses on audit work and some audit firms do not provide other services. The data also shows that audit firms separate the audit staff from staff in other departments. Audit staff are not exposed to other services. Moreover, the standard deviation of TV1 is high at 1.70 which implies that the samples are highly different from each other in terms of other services provided. Therefore, TV1 is less relevant for measuring task variety. Meanwhile, TV2 seems to move along with Inf2 which measures infrastructure flexibility and other indicators of IT champion. There is no explanation of a valid argument that can support TV2 as a measurement of task variety. It is, therefore, dropped from the model.

#### *10.1.3b IT infrastructure flexibility*

The second indicator of an IT infrastructure flexibility construct shares some principal component with IT competence and IT champion. The question (inf2: Our firm's IT infrastructure allows staff to share data and knowledge) is on the knowledge sharing within the firm with the focus on infrastructure. Therefore, it is possible that a part of the indicator is driven by components that influence IT competence and IT champion. Due to a high alpha in IT infrastructure flexibility construct and some shared components with other IT infrastructure indicators, this item remains in the model analysis.

#### *10.1.3c Social network*

Even though items measuring the social network (SN) exhibit a satisfied level of reliability (0.77 based on Nunnally's (1978) suggestion), the statistical results suggest that deleting the first item (SN1: Our firm makes regular use of external IT consultant(s)) will increase alpha by 7%. The rotated component matrix also suggests that SN1 shares the principal component with the management support. It can be explained that using external consultants means providing technical support for organizational staff members, which is similar to providing related training (Mgmt2). However, including SN1 as an indicator of management support will reduce the alpha of the construct from 0.94 to 0.90.

When developed, SN1 was based on a conceptual definition of social network. However, the instrument evaluation in this study implies that SN1 shares the same components as those of the management support. Due to the limited samples of this study, SN1 is dropped. Future research should examine SN1 which indicates an external support as a separate construct.

#### *10.1.3d Organizational IT competence and IT champion*

Both IT competence and IT champion yield high alpha values of 0.94-0.95. The rotated component matrix, however, suggest a potential problem in convergent validity. Comp1, which measures the competence in the technology feature, has shared components between IT champion and organizational IT competence. This problem can be speculated for a study of small business where the IT champion represents the organizational IT competence of the firm. Since the surveys in this area usually target the person who makes the best use of IT in the firm (Cooper and Zmud, 1990; Saga, 1994), the respondents technically evaluate themselves in term of competence and championship roles.

In this study, items that measure both constructs are retained since they have different perspectives. The competence represents the characteristics of an individual whereas the championship represents the actions. This study is believed to be the first study to measure IT champion in terms of actions (Champ2: In our firm, these individuals spend significant amounts of time investigating/experimenting the

use of spreadsheets in audit work, Champ3: In our firm, these individuals spend significant amounts of time pushing/convincing other firm members to use spreadsheets in audit work), instead of measuring the construct only in terms of existence, as in other studies.

*10.1.3e Global measures of infusion, extended use and the problem with reversed coding.*

The results from the reliability test show that global measures of infusion have a problem with reversed coding strategy. The third item measuring infusion (infuse3: There are many better ways for our firm to use spreadsheets to support audit work.) represents a reverse code of infusion where higher scores on likert scale represents lower infusion scores. From the initial observation, the mean and standard deviation of the reversed coding item move the same direction as other items. In addition, the alpha values of non-reverse items are higher than the reversed items. This is from the unreliable responses of the items. When the reversed scores were tested for an alpha, the results suggested a violation of alpha calculation assumption (negative value in items' covariance). The infusion3 which used the reversed coding strategy is, therefore, dropped from the analysis.

On the other hand, the reversed coding strategy used in measuring extended use is valid (GEU2: There are many more possible areas in our audit work where spreadsheets can be used). This implies that the problem with reverse coding strategy is associated with the order of questions presented. Where the reverse coding is used, it should be put on the earlier questions so that the respondents can pick it up. In this case, the reverse coding item is still used in the analysis.

Construct	Indicators used	Note
Task Variety (TV)	TV3: Our firm's clients represent many industries	A single-item-indicator construct.  TV1 and TV2 were dropped.
IT infrastructure flexibility (Inf)	Inf1: Our firm's IT infrastructure is very flexible in relation to future needs  Inf2: Our firm's IT infrastructure allows staff to share data and knowledge  Inf3: Our firm's IT infrastructure allows staff to access data from anywhere	Three-item-indicator construct.  Reflective indicators.
Organizational IT competence (Comp)	Comp1: Our firm has sufficient knowledge of all features, functions, and abilities of spreadsheets.  Comp2: Our firm has sufficient knowledge of how to use spreadsheets to perform audit tasks.  Comp3: Our firm has sufficient knowledge of how other audit firms use spreadsheets to perform audit tasks.	Three-item-indicator construct.  Reflective indicators.
Social Network (SN)	SN2: Our firm regularly participates and exchanges knowledge and opinions with other audit firms.  SN3: Our firm regularly participates and exchanges knowledge and opinions with institutes other than audit firms (e.g. Universities, regulators).	Two-item-indicator construct.  Reflective indicators.  SN1 was dropped.

Table 10.1C: Summary of indicators used

Construct	Indicators used	Note
Management Support (Mgmt)	<p>Mgmt1: The partner(s) actively encourages audit staff to use IT in their daily tasks.</p> <p>Mgmt2: The partner(s) provides enough IT training and/or time for staff to think of using IT in audit tasks.</p> <p>Mgmt3: User IT satisfaction has been a major concern of the partner(s).</p>	<p>Three-item-indicator construct.</p> <p>Reflective indicators.</p>
Routinization (RZ)	<p>RZ1: The use of spreadsheets has been incorporated into the firm's work procedures.</p> <p>RZ2: The use of spreadsheets is pretty much integrated as part of normal audit work routine.</p> <p>RZ3: The use of spreadsheets is a normal part of the firm's procedures.</p>	<p>Three-item-indicator construct.</p> <p>Reflective indicators.</p>
IT Champion (Champ)	<p>Champ1: In our firm, there are one or more individuals who vigorously and enthusiastically support/ promote the use of spreadsheets in audit work.</p> <p>Champ2: In our firm, these individuals spend significant amounts of time investigating/experimenting the use of spreadsheets in audit work.</p> <p>Champ3: In our firm, these individuals spend significant amounts of time pushing/convincing other firm members to use spreadsheets in audit work.</p>	<p>Three-item-indicator construct.</p> <p>Reflective indicators.</p>

Table 10.1C: Summary of indicators used in each construct (Continued)

Construct	Indicators used	Note
IT infusion (Tinfuse)	Extended use score  Integrative use score  Emergent use score.	Three-item-indicator construct.  Formative indicators.
Global measure of IT infusion (infusion)	Infuse1: <i>Our firm</i> is using spreadsheets to their fullest potential for supporting <i>audit</i> work.  Infuse2: Our firm is using all capabilities of spreadsheets in the best fashion to help us on the job.	Two-item-indicator construct.  Reflective indicators.  Infuse3 was dropped.
Global measure of Extended use (GEU)	GEU1: Our firm is using spreadsheets in complex ways in audit work.  GEU3: The use of spreadsheet software in our firm involves considerable use of pre-saved information, functions, templates or macros.	Two-item-indicator construct.  Reflective indicators.  GEU2 was dropped.
Global measure of Integrative use (GIU)	GIU1: In our firm, audit procedures have been linked by the use of spreadsheets.  GIU2: Our firm's users establish work flow linkages with other individuals, where spreadsheets used by one individual directly precedes or follows that by another individual.  GIU3: In our firm, spreadsheets are used as common platforms for audit work.	Three-item-indicator construct.  Reflective indicators.

Table 10.1C: Summary of indicators used in each construct (Continued)



Construct	Indicators used	Note
Global measure of Emergent use (GEMU)	<p>GEMU1: The use of spreadsheets enables our firm to perform new audit tasks that were not recognized prior to the existence of the application.</p> <p>GEMU2: The use of spreadsheets enables our firm to perform work tasks that were not feasible prior to the existence of the application.</p> <p>GEMU3: Some audit tasks could not be completed [either manually or with the use of other applications], if the spreadsheet software became unavailable. [The unavailability could result from a power failure, a system crash or maintenance being performed].</p>	<p>Three-item-indicator construct.</p> <p>Reflective indicators.</p>
IT impact (impact)	<p>Impact1: Spreadsheets have helped us improve audit revenue.</p> <p>Impact2: Spreadsheets have helped us reduce audit time (cost).</p> <p>Impact3: Spreadsheets have helped increase the quality of our audit services.</p> <p>Impact4: Spreadsheets have helped us improve client relationships</p> <p>Impact5: Spreadsheets have helped us improve firm image.</p> <p>Impact6: Spreadsheets have helped improve firm innovativeness.</p>	<p>Ten-item-indicator construct.</p> <p>Reflective indicators.</p>

Table 10.1C: Summary of indicators used in each construct (Continued)

IT impact (impact)  (continued)	<p>Impact7: Spreadsheets have helped improve firm audit processes.</p> <p>Impact8: Spreadsheets have helped us improve staff productivity.</p> <p>Impact9: Overall, the use of spreadsheets has had a significant positive impact on the firm.</p> <p>Impact10: Overall, spreadsheets have made a strong positive contribution to firm performance.</p>	
--	---	--

Table 10.1C: Summary of indicators used in each construct (Continued)

#### **10.1.4 Concurrent validity of the proposed measure of IT infusion**

Concurrent validity refers to the fact that the construct indicators should be associated with preexisting indicators that are judged to be valid (Neuman, 2006).

There are two types of IT infusion measurements in existing literature. The first type focuses on measuring IT infusion at an organizational level of analysis. The measure uses the combination of IT functionalities and task-integration to determine the level of use or the level of infusion. The scholars who follow the first type include Cooper and Zmud (1990), Zmud and Apple (1992), Saga (1994), Kishore and McLean (2007). The second type of measurement refers infusion level to the user perception. The measure asks respondents to rank their use relative to their knowledge and perception of the fullest potential use of IT. The scholars who use this measure include Jones et al. (2002) and Sundaram et al. (2007). Castner and Ferguson (2000) used the combination of the both types in order to measure IT infusion. However, the first type of measurements rarely yielded significant statistical results. The global measure (referred as the second type of measurements) was, therefore, used for testing concurrent validity.

This study compared the proposed measure to well-developed IT infusion construct indicators in Jones et al. (2002). Jones's et al. concept was also used for developing a set of global instruments for extended use, integrative use, and emergent use based on their definitions as given by Saga and Zmud (1994). The results of the regression analysis on associations between the proposed measure and the global measure are shown in Table 10.1D. The global measures are used as reflective indicators.

	R <sup>2</sup>	Beta	Standard Error	t-statistics	p-value 1-tailed
Infusion	0.30	0.55	0.07	7.47	p<0.001
Extended use	0.41	0.64	0.07	9.19	p<0.001
Integrative use	0.22	0.47	0.1	4.88	p<0.001
Emergent use	0.07	0.26	0.13	2.08	0.05>p>0.01

Table 10.1D: Concurrent validity of the proposed IT infusion measure.

The results show that there are associations between the proposed measures and the global measures in aspects of infusion, extended use, and integrative use. Two measures for infusion are associated by 30% with each other. The beta coefficient of 0.55 is highly significant. The low R<sup>2</sup> is due to different concepts of IT infusion used by this study which focuses on the real fullest potential use of IT rather than the perceived fullest potential use. The results also hold for extended use and integrative use. However, the low R<sup>2</sup> between two measures for emergent use indicate that two measures may indicate different aspect of emergent use. While the global measure focuses on the task and technology use (e.g. some audit tasks cannot be performed without spreadsheets), the proposed measure takes it to the highest level as “strategically integrated” into the organization. The proposed measure seems to be more consistent with original idea given by Sullivan (1985).

It is beyond this study's primary objective to investigate the differences between the two types of measures; especially when they focus on different level of analysis. This leaves plenty of room for future research.

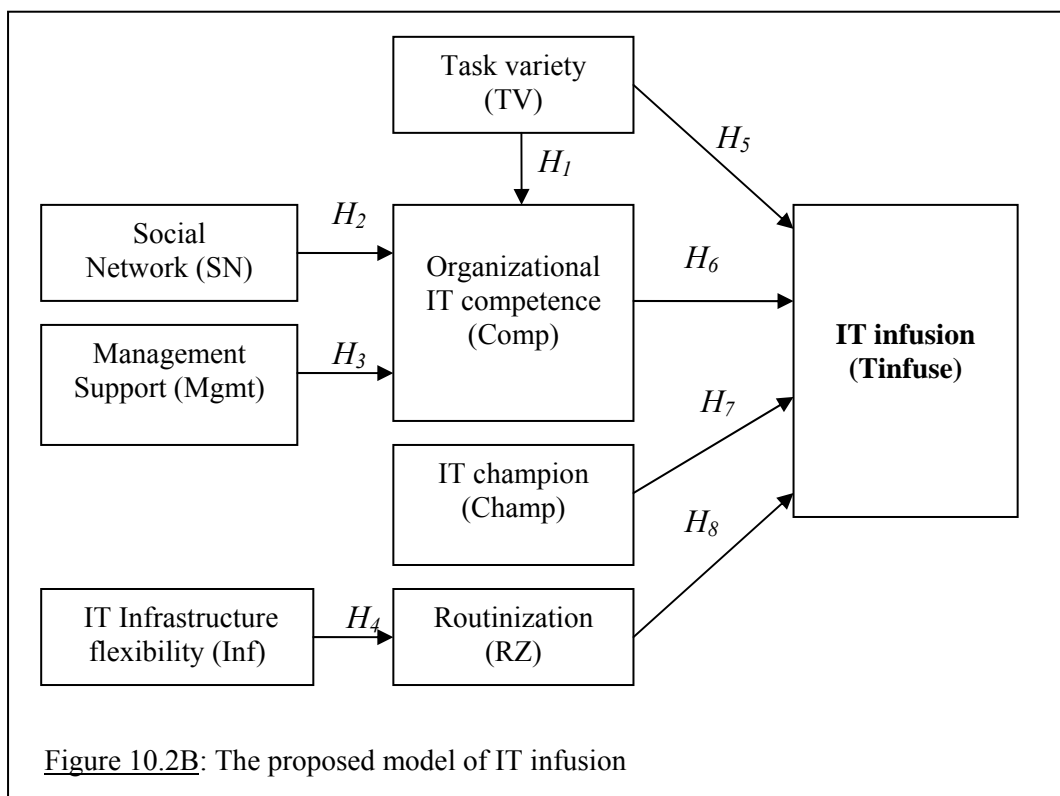
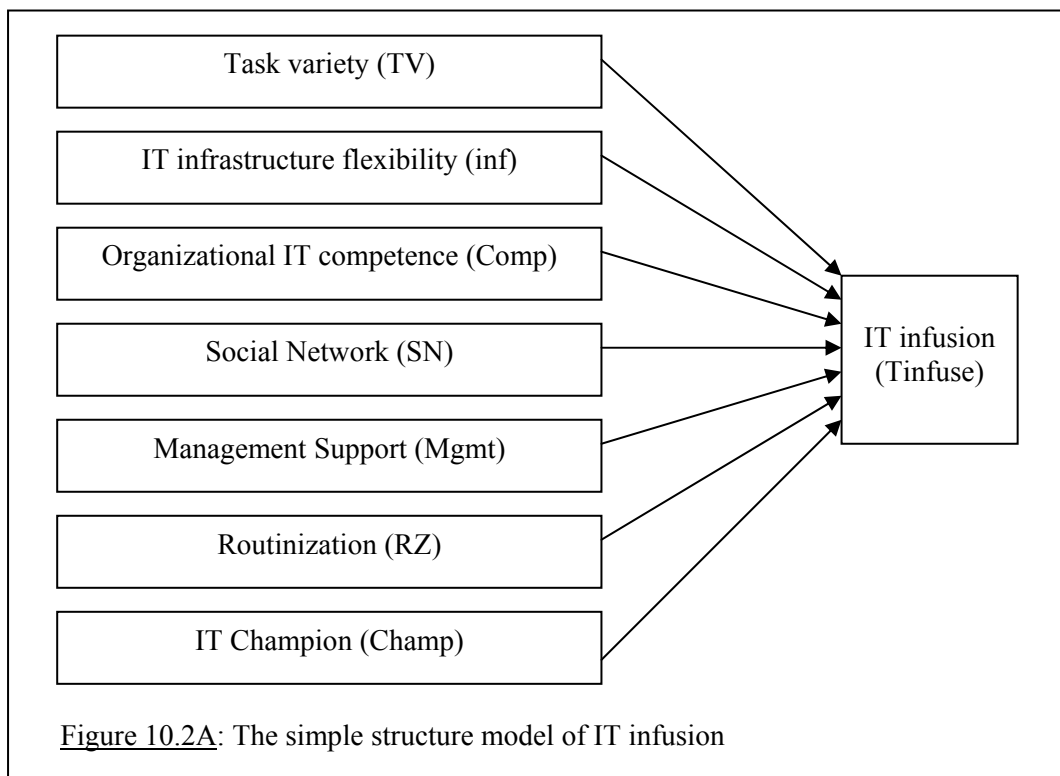
## **10.2 THE PARTIAL LEAST SQUARE REGRESSION AND IT INFUSION ENABLERS**

The partial least square (PLS) regression is a statistical technique that combines the features of principal component analysis with regression (Abdi, 2007). The technique takes into account factor loading of each item when entering value of variables' constructs into the model. An advantage of the partial least square model is that the model can be applied to small numbers of samples. Chin (1998) and Jones et al. (2002) suggest PLS is able to model latent construct under conditions of nonnormality and small sample sizes. This study follows the guideline used by Jones et al. (2002) which adopts the idea from Chin and Newsted (1999) that sample size requirements can be calculated by examining the dependent latent variable with the largest number of independent variables impacting it. The smallest sample sizes that PLS can be used is  $n \times 10$ , where  $n$  is the number of the largest independent variables impacting the dependent variable. In this study, there are seven latent/independent variables. The number of required samples should be at least 70. The 72 complete data sets are, therefore, enough for the analysis. Another advantage of PLS is its ability to construct a more complex structural equation model, therefore, promoting a more understandable model.

Even though the PLS approach has several advantages, Rouse and Corbitt (2008) criticized the components created by PLS as accounting for the error variance in the sample as well as the variance of the underlying construct. In addition, PLS-based tests of reliability and validity are not the mainstream methods used elsewhere. This study took a combination approach that was not done in studies using PLS by firstly examining the construct validity using an exploratory factor analysis in order to reduce the error variance before the model is evaluated. This approach was suggested by Fabrigar et al. (1999) and Gorsuch (1990).

Unlike an original structural equation model (SEM) that uses a goodness-of-fit score to evaluate the model, a bootstrap method (Efron, 1979) is used in order to evaluate the model. Bootstrapping is used for estimation of standard errors and confidence intervals of population parameters. The survey responses are considered samples that are used for estimating model parameters. The basic concept of the bootstrap method is to construct the population based on the parameters generated by samples. The bootstrap idea is simply to replace the unknown population distribution with the known empirical distribution (from the samples). The application of bootstrap technique generally requires the generation of bootstrap samples. For standard error estimation, Efron (1987) suggests the resampling calculation to be at least 100 times (or 100 k). However, most successive statisticians (e.g. Chernick, 2008) recommend 1,000 samples. In this study, the bootstrap technique is used for 1,000 k. The standardize beta coefficient, t statistic, and p-value are reported along with the original models.

The models were analyzed using a bootstrap procedure with 1,000 times resampling in PLS. The software used for the analysis was PLSGraph Version 3.0 developed by Professor Wynne Chin. Since this study is exploratory in nature, the independent variables identified during the qualitative phase are first analyzed in a simple model, in which all independent variables are proposed to be directly associated with IT infusion (Figure 10.2A). Then, the adapted model (as shown in Figure 10.2B) is evaluated.



### 10.2.1 The simple model of IT infusion enablers

In order to test the hypothesized relationship between independent variables on IT infusion, a simple regression model is used. The regression model is correspondent to Figure 10.2A.

$$T_{\text{infuse}} = \beta_0 + \beta_1 TV + \beta_2 \text{Inf} + \beta_3 \text{Comp} + \beta_4 \text{SN} + \beta_5 \text{Mgmt} + \beta_6 \text{RZ} + \beta_7 \text{Champ} + \varepsilon$$

Where :	$T_{\text{infuse}}$	=	Task-oriented infusion score (TEU+TIU+TEMU)
	TV	=	Task variety
	Inf	=	IT infrastructure flexibility
	Comp	=	Organizational IT competence
	SN	=	Social network
	Mgmt	=	Management support
	RZ	=	Routinization
	Champ	=	IT champion
	$\varepsilon$	=	Error term

#### 10.2.1a *Multicollinearity and the regression model*

Multicollinearity refers to situations in which some of the independent variables are highly correlated with each other. In such situations, collinear variables do not provide new information and it becomes difficult to separate the effect of such variables on the dependent variable. Multicollinearity can be detected by analyzing correlation coefficients between variables and by other techniques. In this study, Table 10.2C shows the Pearson Correlations for the independent and dependent variables. Most variables seem to be highly correlated at a significant level of 0.01 to 0.05. Further multicollinearity analysis is required in order to make sure that the model is valid.

Collinearity diagnostics are also shown in Table 10.2A and 10.2B. Variance inflation factor (VIF) is calculated and shown in Table 10.2A along with the corresponding tolerance. Normally, a value of VIF higher than five or tolerance less than 0.2 indicates the presence of Multicollinearity. The values from Table

10.2A indicate no multicollinearity issue between independent variables. Other assessments include assessing variance proportions and condition index in Table 10.3B which indicate no multicollinearity issue either. The rule of thumb is there is multicollinearity if any two independent variables have variance proportions in excess of 0.9, corresponding to any row in which condition index is in excess of 30.

Variables	Unstandardized Coefficients		Standardized Coefficient	t	p-value 1-tailed	Collinearity Statistics	
	B	Std. Error				Tolerance	VIF
Constant	.509	.729		.699	.244		
TV	-.031	.085	-.037	-.368	.357	.679	1.473
Inf	-.102	.118	-.105	-.865	.195	.469	2.133
Comp	.471	.145	.404	3.259	.001	.446	2.242
SN	-.059	.097	-.066	-.610	.272	.585	1.708
Mgmt	-.029	.126	-.032	-.232	.409	.360	2.776
RZ	.248	.123	.205	2.015	.024	.661	1.512
Champ	.374	.130	.445	2.880	.003	.287	3.484

Table 10.2A: Beta coefficients and Collinearity statistics of independent variables

	Condition index	Variance Proportions							
		Constant	TV	Inf	Comp	SN	Mgmt	RZ	Champ
1	1.000	.00	.00	.00	.00	.00	.00	.00	.00
2	8.015	.02	.07	.00	.00	.47	.00	.02	.01
3	10.708	.10	.13	.20	.00	.12	.00	.05	.04
4	11.366	.00	.44	.00	.12	.29	.01	.00	.07
5	14.593	.04	.25	.74	.03	.02	.11	.00	.05
6	15.377	.04	.08	.01	.42	.01	.24	.14	.01
7	17.411	.00	.01	.05	.08	.00	.46	.06	.58
8	25.821	.78	.02	.00	.34	.10	.18	.72	.23

Table 10.2B: Collinearity statistics – condition index and variance proportion



	TV	inf	Comp	SN	Mgmt	RZ	Champ	infuse	GEU	GIU	GEMU	Tinfuse	TEU	TIU	TEMU
TV	1														
Inf	<b>**-.526</b>	1													
Comp	<b>**-.301</b>	<b>**-.535</b>	1												
SN	<b>*.256</b>	<b>**-.440</b>	<b>**-.460</b>	1											
Mgmt	<b>**-.458</b>	<b>**-.593</b>	<b>**-.622</b>	<b>**-.549</b>	1										
RZ	<b>**-.317</b>	<b>**-.359</b>	<b>*.257</b>	<b>.186</b>	<b>**-.516</b>	1									
Champ	<b>**-.431</b>	<b>**-.666</b>	<b>**-.708</b>	<b>**-.595</b>	<b>**-.707</b>	<b>**-.452</b>	1								
Infuse	<b>*.255</b>	<b>**-.414</b>	<b>**-.655</b>	<b>**-.349</b>	<b>**-.525</b>	<b>**-.432</b>	<b>**-.676</b>	1							
GEU	<b>**-.291</b>	<b>**-.447</b>	<b>**-.659</b>	<b>**-.436</b>	<b>**-.521</b>	<b>*.260</b>	<b>**-.682</b>	<b>**-.691</b>	1						
GIU	<b>**-.438</b>	<b>**-.516</b>	<b>**-.425</b>	<b>.045</b>	<b>**-.352</b>	<b>**-.337</b>	<b>**-.452</b>	<b>**-.535</b>	<b>**-.608</b>	1					
GEMU	<b>*.199</b>	<b>**-.292</b>	<b>**-.349</b>	<b>**-.345</b>	<b>**-.388</b>	<b>**-.315</b>	<b>**-.492</b>	<b>**-.619</b>	<b>**-.590</b>	<b>**-.362</b>	1				
TInfuse	<b>**-.389</b>	<b>**-.300</b>	<b>**-.434</b>	<b>**-.279</b>	<b>**-.341</b>	<b>**-.405</b>	<b>**-.513</b>	<b>**-.533</b>	<b>**-.657</b>	<b>**-.498</b>	<b>**-.504</b>	1			
TEU	<b>**-.358</b>	<b>**-.291</b>	<b>**-.402</b>	<b>**-.342</b>	<b>**-.326</b>	<b>**-.345</b>	<b>**-.507</b>	<b>**-.482</b>	<b>**-.643</b>	<b>**-.478</b>	<b>**-.521</b>	<b>**-.946</b>	1		
TIU	<b>**-.355</b>	<b>*.273</b>	<b>**-.391</b>	<b>*.216</b>	<b>**-.304</b>	<b>**-.389</b>	<b>**-.465</b>	<b>**-.516</b>	<b>**-.602</b>	<b>**-.471</b>	<b>**-.449</b>	<b>**-.953</b>	<b>**-.827</b>	1	
TEMU	<b>**-.303</b>	<b>.181</b>	<b>**-.355</b>	<b>.073</b>	<b>*.251</b>	<b>**-.338</b>	<b>**-.286</b>	<b>**-.326</b>	<b>**-.374</b>	<b>*.254</b>	<b>*.239</b>	<b>**-.529</b>	<b>**-.429</b>	<b>**-.390</b>	1

\*\* Correlation is significant at the 0.01 level (1-tailed).

\* Correlation is significant at the 0.05 level (1-tailed).

**Table 10.2C: Pearson correlations among independent and dependent variables**

Note: Infuse = Global measure of IT infusion  
GEU = Global measure of extended use  
GIU = Global measure of integrative use  
GEMU = Global measure of emergent use

10.2.1b

*PLS results on IT infusion and its enablers*

Factor loadings, weights and residual variances of all latent variables are shown in Table 10.2D. Correlations of latent variables are shown in Table 10.2E

Indicators	Factor loading	Weight	Residual Variance
Tinfuse	1.0000	1.0000	0.0000
TV3	1.0000	1.0000	0.0000
Inf1	0.8877	0.2802	0.2119
Inf2	0.8839	0.5073	0.2187
Inf3	0.7569	0.4002	0.4271
Comp1	0.8429	0.3303	0.2896
Comp2	0.8956	0.4712	0.1979
Comp3	0.8056	0.3720	0.3510
SN2	0.9574	0.6580	0.0833
SN3	0.8896	0.4159	0.2085
Mgmt1	0.9319	0.3420	0.1316
Mgmt2	0.9505	0.3423	0.0966
Mgmt3	0.9629	0.3697	0.0728
RZ1	0.9602	0.3791	0.0780
RZ2	0.9353	0.3491	0.1251
RZ3	0.9607	0.3220	0.0771
Champ1	0.9268	0.3294	0.1411
Champ2	0.9660	0.3509	0.0669
Champ3	0.9723	0.3659	0.0547

Table 10.2D: Factor loadings, weights, and residual variances of latent variables

	Tinfuse	TV	Inf	Comp	SN	Mgmt	RZ	Champ
Tinfuse	1							
TV	0.389	1						
Inf	0.318	0.538	1					
Comp	0.440	0.310	0.546	1				
SN	0.300	0.253	0.426	0.494	1			
Mgmt	0.341	0.463	0.604	0.642	0.529	1		
RZ	0.407	0.315	0.365	0.278	0.190	0.518	1	
Champ	0.512	0.432	0.684	0.725	0.606	0.709	0.457	1

Table 10.2E: Correlations of latent variables

The results of the PLS regression for IT infusion and its enablers are presented in Table 10.2F and Figure 10.2C. The adjusted  $R^2$  for the spreadsheet infusion model is 0.3857. This number indicates that approximately 38.57% of the variability in spreadsheet infusion among firms in this study can be accounted for by variables in the model. Routinization is found to be a major IT infusion enabler with a significant level less than 0.01. Task variety, organizational IT competence, and IT champion are found to be IT infusion enablers at the significant level 0.05. Management support is significant at a 0.1 level; however, management support unexpectedly exhibits a negative association on IT infusion.

Since both IT infrastructure flexibility (inf) and management support (mgmt) are found to have negative associations on IT infusion, this study extends the model analysis. The literature and qualitative data from chapter 6 and 7 suggest that IT infrastructure may have an indirect effect on IT infusion through routinization and management support (including IT training) may have an indirect effect on IT infusion through organizational IT competence. The next section will investigate the relationship among those variables through the complex model proposed in Chapter 7 and Chapter 8.

Variable	Path Coefficient (original sample)	Path Coefficient (mean of subsample)	Standard error	T-statistics	p-value 1-tailed
TV	*0.2720	0.2343	0.1391	2.1102	0.05>p>0.01
Inf	-0.1770	-0.1233	0.1634	1.0995	
Comp	*0.2650	0.2686	0.1290	1.9770	0.05>p>0.01
SN	0.0490	0.0968	0.1467	0.3279	
Mgmt	-0.2540	-0.2565	0.1571	1.6164	
RZ	**0.2800	0.3056	0.1101	2.5859	p<0.01
Champ	*0.3610	0.3353	0.2126	1.7074	0.05>p>0.01

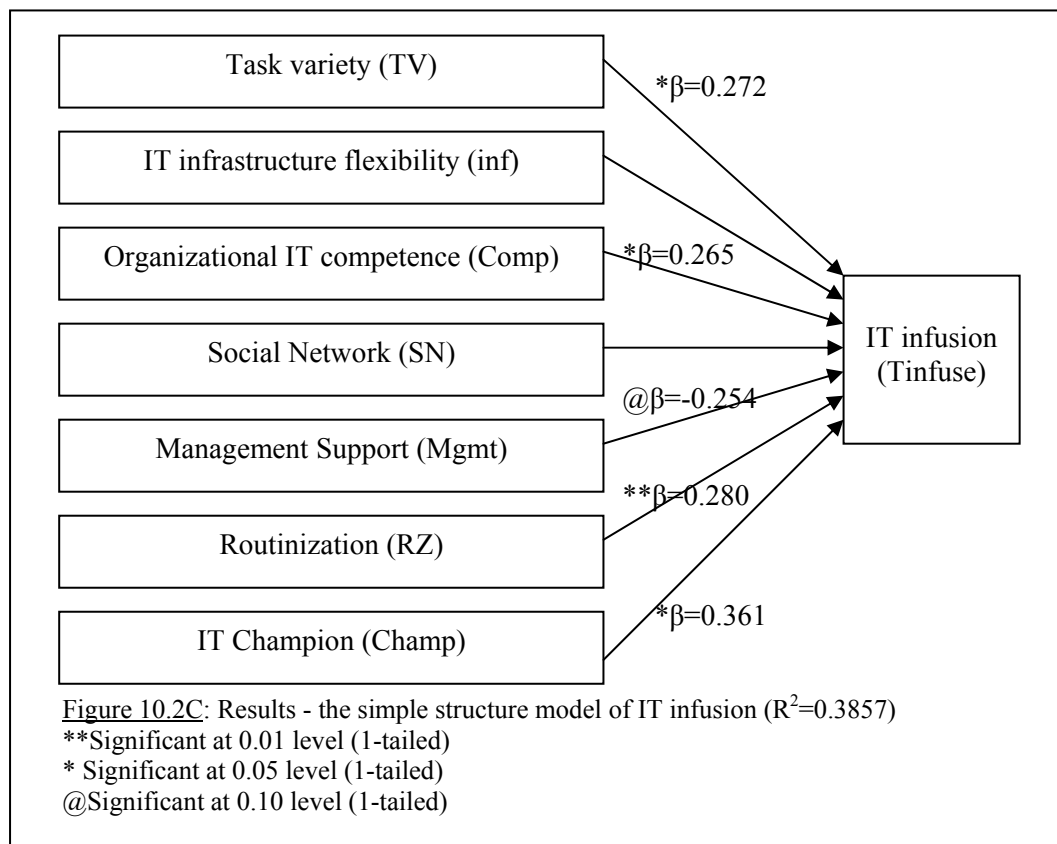
\*\* Significant at the 0.01 level (1-tailed)

\* Significant at the 0.05 level (1-tailed)

@Significant at the 0.05 level (1-tailed)

Multiple R<sup>2</sup> = 0.3857

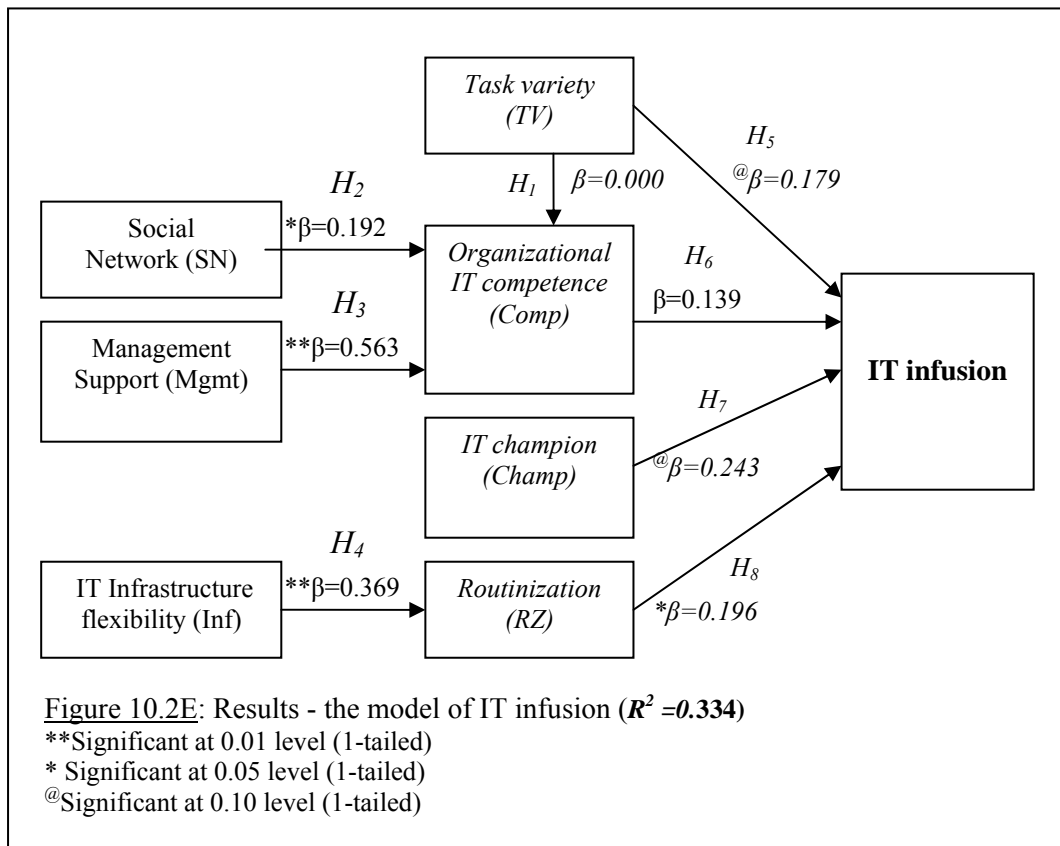
**Table 10.2F:** PLS Results (dependent variable – Tinfuse)



### 10.2.2 The proposed model of IT infusion enablers

Figure 10.2B shows the proposed model. The simple model is modified in order to incorporate the results from the in-depth case studies and existing literature.

Figure 10.2D shows the results of PLS regression with 1,000k bootstrap based on the proposed model. All paths except IT champion are significant at least at a 0.1 level. The adjusted  $R^2$  for the spreadsheet infusion model is 0.3340. This number indicates that approximately 33.40% of the variability in spreadsheet infusion among firms in this study can be accounted for by variables in the model. The most significant IT infusion enabler is routinization which is also an intermediary of IT infrastructure flexibility. Task variety and IT Champion are significant at the 0.1 level. Social network and management support are positively related to organizational IT competence. However, the significant level of organizational IT competence on IT infusion is more than 0.10.



### 10.3 THE PARTIAL LEAST SQUARE REGRESSION AND THE THREE PATHWAYS OF USE

In this section, PLS regression is used to investigate three pathways of use that are claimed to be three perspectives of IT infusion (Saga and Zmud, 1994). The model investigates how independent variables are associated with IT infusion through three pathways of use.

In order to test the hypothesized relationship between independent variables on three pathways of use, three separate regression models are used.

$$TEU = \beta_0 + \beta_1 TV + \beta_2 Inf + \beta_3 Comp + \beta_4 SN + \beta_5 Mgmt + \beta_6 RZ + \beta_7 Champ + \varepsilon$$

$$TIU = \beta_0 + \beta_1 TV + \beta_2 Inf + \beta_3 Comp + \beta_4 SN + \beta_5 Mgmt + \beta_6 RZ + \beta_7 Champ + \varepsilon$$

$$TEMU = \beta_0 + \beta_1 TV + \beta_2 Inf + \beta_3 Comp + \beta_4 SN + \beta_5 Mgmt + \beta_6 RZ + \beta_7 Champ + \varepsilon$$

Where :	TEU	=	Task-oriented extended use
	TIU	=	Task-oriented integrative use
	TEMU	=	Task-oriented emergent use
	TV	=	Task variety
	Inf	=	IT infrastructure flexibility
	Comp	=	Organizational IT competence
	SN	=	Social network
	Mgmt	=	Management support

Factor loadings, weights and residual variances of all latent variables are not significantly different from those of the IT infusion model as shown in Table 10.2D; therefore, this part shows only the statistical results from the structural models.

#### 10.3.1 Extended use enablers (dependent variable = TEU)

The results of the PLS regression for extended use of spreadsheets and its enablers are present in Table 10.3A and Figure 10.3A. The adjusted  $R^2$  for the extended use model is 0.3430. This number indicates that approximately 34.30% of the

variability in extended use of spreadsheets among firms in this study can be accounted for by variables in the model. Task variety, routinization, and IT champion are found to be major extended use enablers at the significant level 0.05.

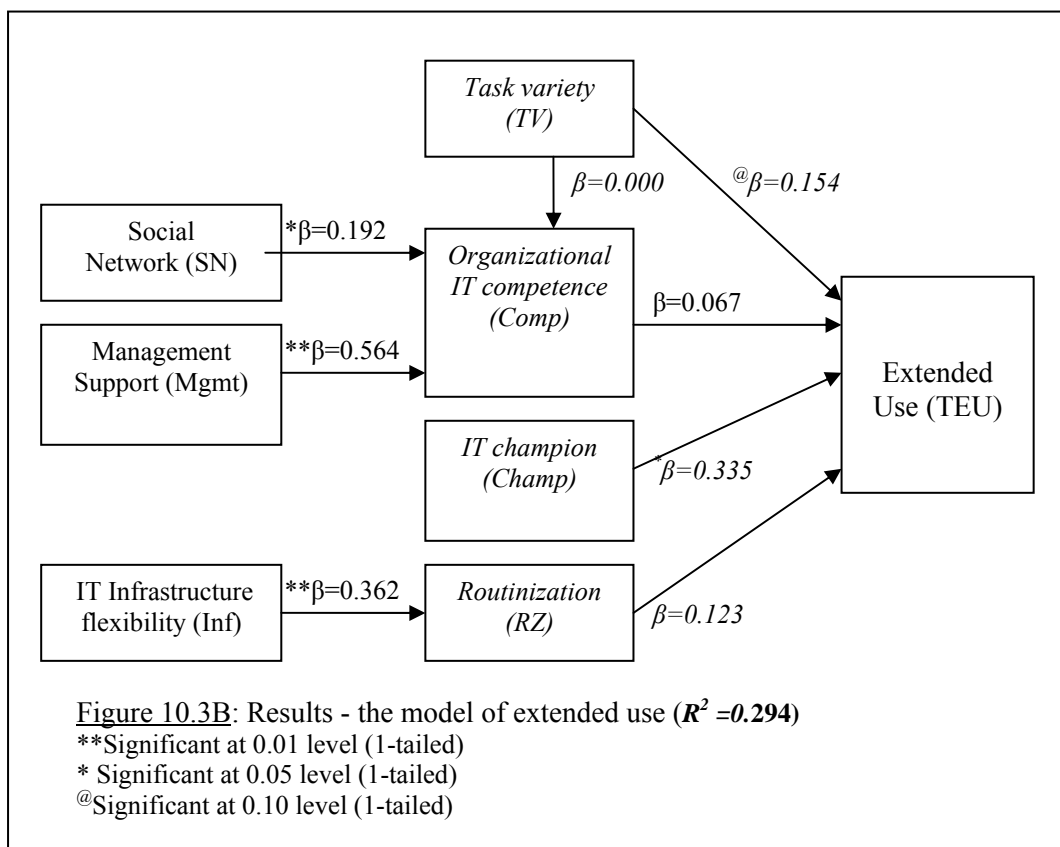
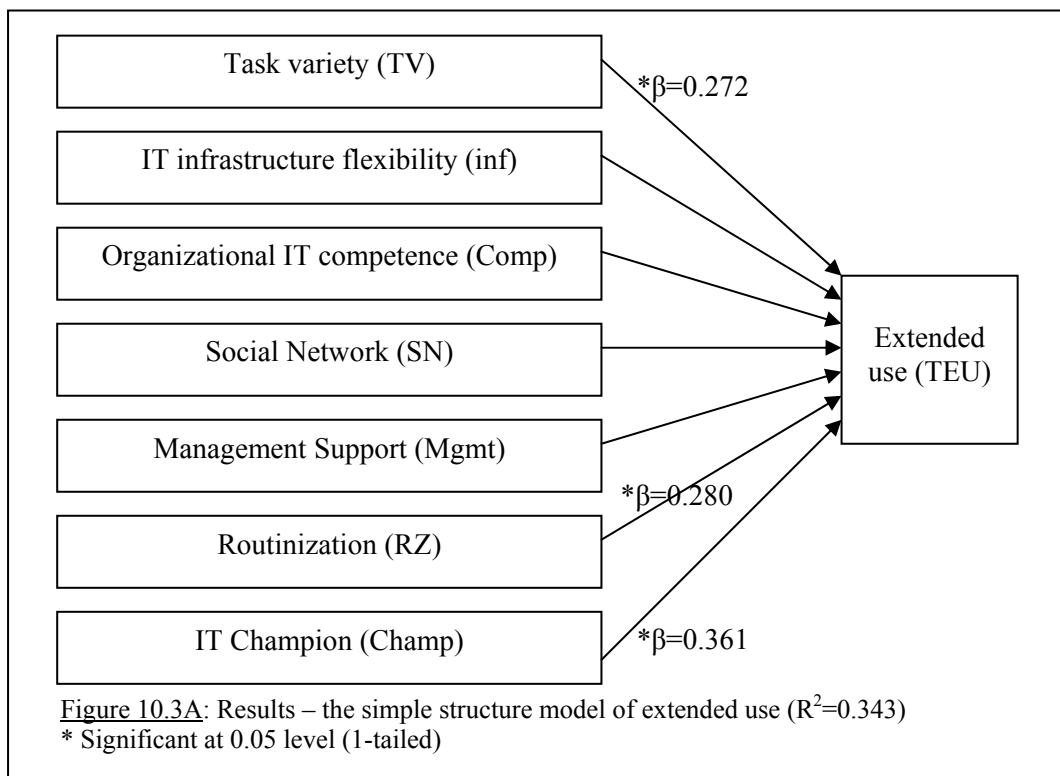
The modified model incorporating results of the qualitative study and previous literature has also been used to evaluate the model. It is also use to validate the negative relationship of some independent variables in the dependent variable. The modified model is shown in Figure 10.3B. The modified model confirms the significant effects of task variety and IT champion on extended use. The effect of routinization is not significant. The adjusted  $R^2$  of the modified model is down to 0.294.

Variable	Path Coefficient (original sample)	Path Coefficient (mean of subsample)	Standard error	T-statistics	p-value 1-tailed
TV	*0.2410	0.2179	0.1355	1.7786	0.05>p>0.01
Inf	-0.1640	-0.1120	0.1596	1.0278	
Comp	0.1780	0.1972	0.1437	1.2384	
SN	0.1430	0.2008	0.1586	0.9017	
Mgmt	-0.2610	-0.2880	0.1591	1.6405	
RZ	*0.2130	0.2441	0.1187	1.7951	0.05>p>0.01
Champ	*0.3870	0.3433	0.2302	1.6812	0.05>p>0.01

\* Significant at the 0.05 level (1-tailed)

Multiple  $R^2 = 0.3430$

Table 10.3A: PLS Results (dependent variable – TEU)





### 10.3.2 Integrative use enablers (dependent variable = TIU)

The results of the PLS regression for integrative use of spreadsheets and its enablers are presented in Table 10.3B. The adjusted  $R^2$  for the integrative use model is 0.3303. This number indicates that approximately 33.03% of the variability in integrative use of spreadsheets among firms in this study can be accounted for by variables in the model. Routinization is found to be the major integrative use enabler at the significant level 0.01. Task variety, organizational IT competence, and IT champion are found to be significant at the 0.05 level.

The modified model is shown in Figure 10.3D. The modified model confirms the significant effects of task variety, IT champion, and routinization on integrative use. The effect of IT competence is not significant. The adjusted  $R^2$  of the modified model is down to 0.283.

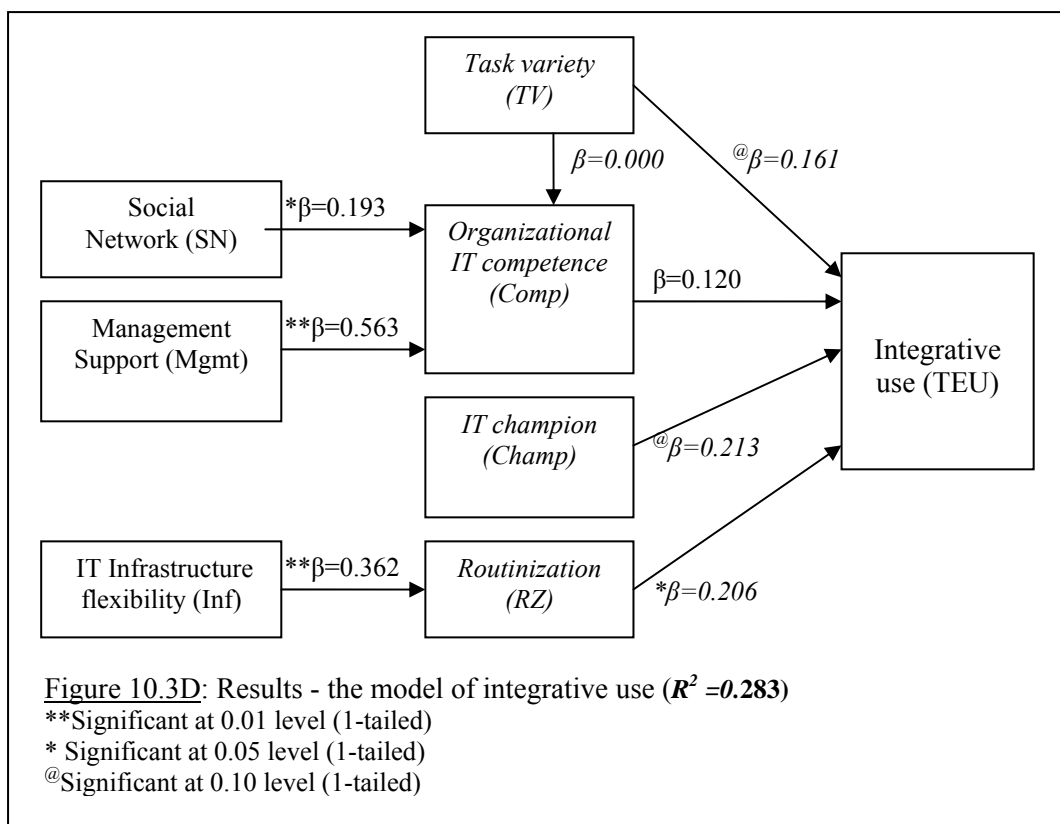
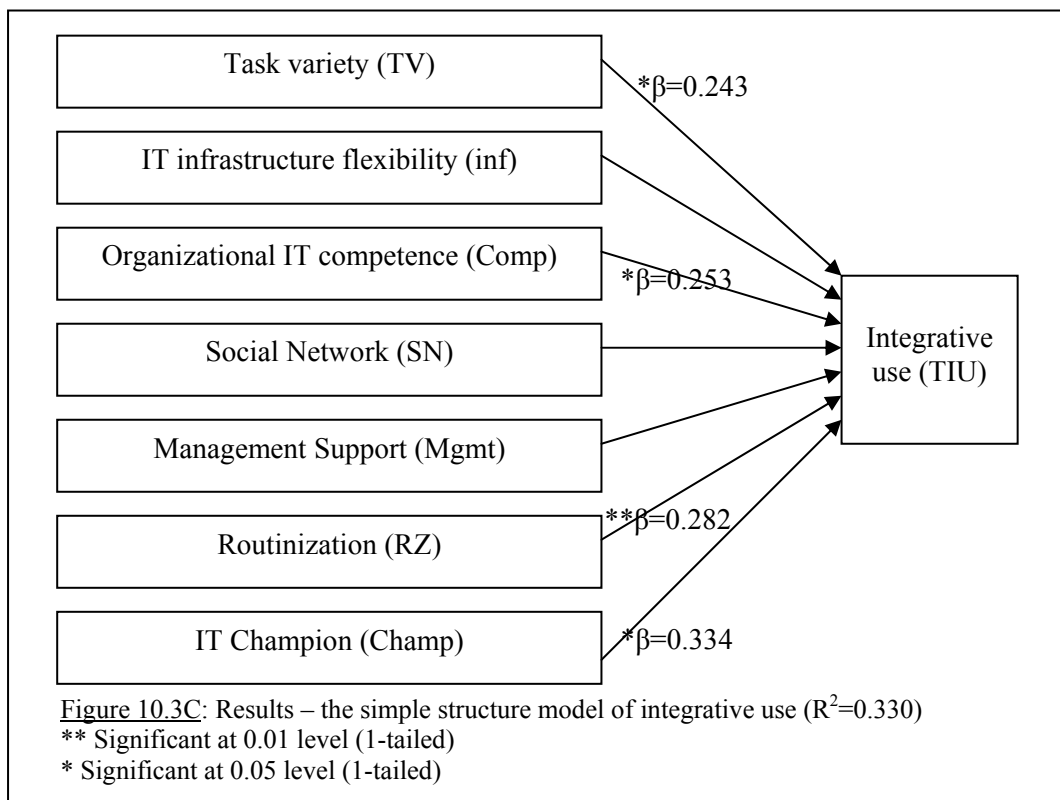
Variable	Path Coefficient (original sample)	Path Coefficient (mean of subsample)	Standard error	T-statistics	p-value 1-tailed
TV	*0.2430	0.1832	0.1456	1.6691	0.05>p>0.01
Inf	-0.1490	-0.0669	0.1758	0.8475	
Comp	*0.2530	0.2313	0.1300	1.9458	0.05>p>0.01
SN	0.0050	0.0553	0.1492	0.0335	
Mgmt	-0.2650	-0.2774	0.1649	1.6070	
RZ	**0.2820	0.3068	0.1078	2.6159	p<0.01
Champ	*0.3340	0.3020	0.2002	1.6685	0.05>p>0.01

\*\* Significant at the 0.01 level (1-tailed)

\* Significant at the 0.05 level (1-tailed)

Multiple  $R^2 = 0.330$

Table 10.3B: PLS Results (dependent variable – TIU)



### 10.3.3 Emergent use enablers (dependent variable = TEMU)

The results of the PLS regression for emergent use of and its enablers are present in Table 10.3C and Figure 10.3F. The adjusted  $R^2$  for the emergent use model is 0.2390. This number indicates that approximately 23.90% of the variability in emergent use of spreadsheets among firms in this study can be accounted for by variables in the model. Task variety, organizational IT competence, and routinization are found to be major emergent use enablers at the significant level 0.05.

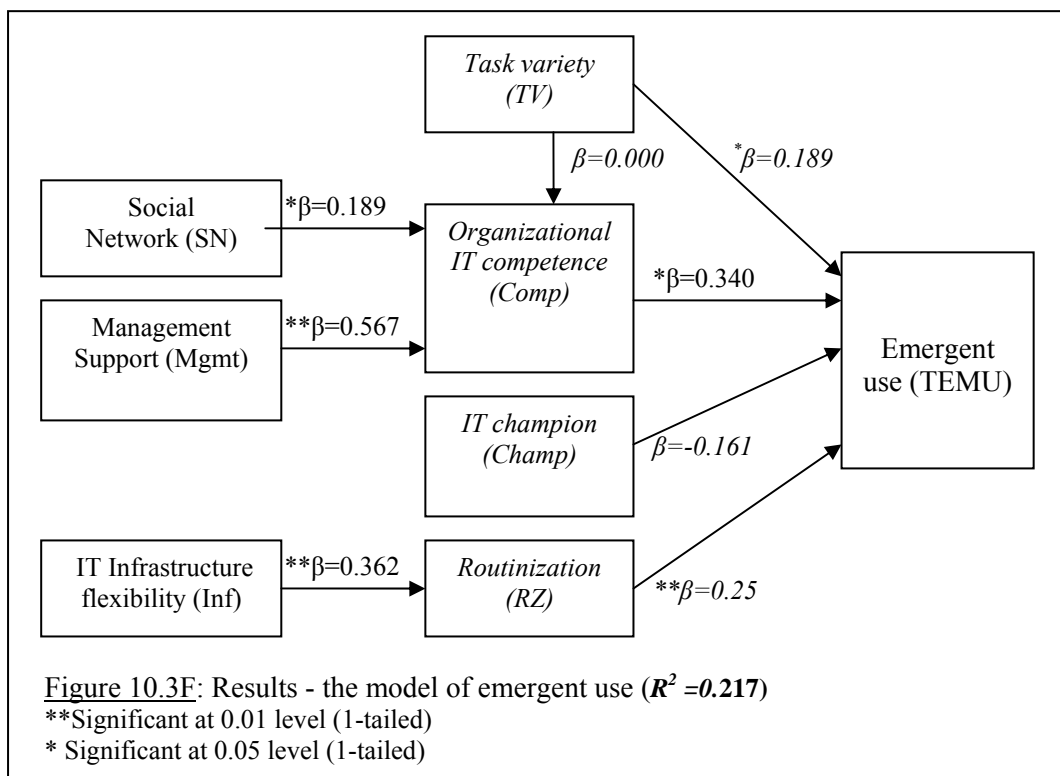
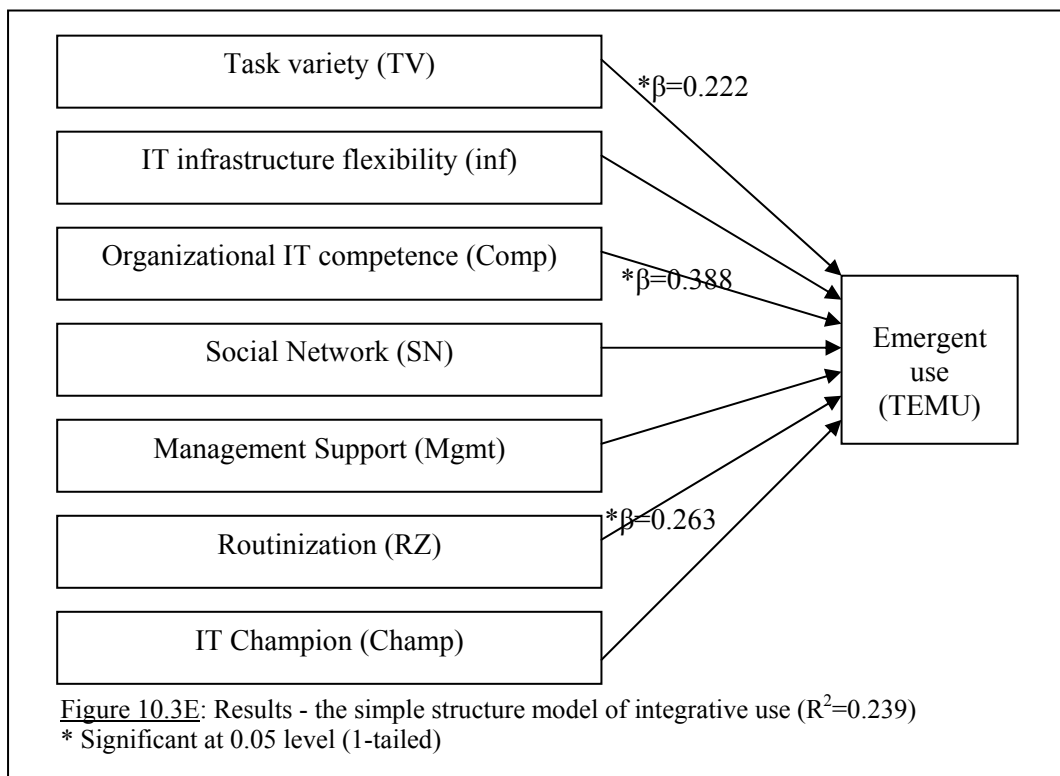
The modified model is shown in Figure 10.3F. The modified model confirms the significant effects of task variety, organizational IT competence, and routinization on emergent use. The adjusted  $R^2$  of the modified model is down to 0.217.

Variable	Path Coefficient (original sample)	Path Coefficient (mean of subsample)	Standard error	T-statistics	p-value 1-tailed
TV	*0.2220	0.1879	0.1113	1.9945	0.05<p<0.01
Inf	-0.0670	0.0135	0.1976	0.3390	
Comp	*0.3880	0.3974	0.1764	2.2002	0.05<p<0.01
SN	-0.1340	-0.0696	0.1456	0.9204	
Mgmt	-0.0820	-0.1228	0.2042	0.4016	
RZ	*0.2630	0.3066	0.1240	2.1209	0.05<p<0.01
Champ	-0.0240	-0.0951	0.1931	0.1243	

\* Significant at the 0.05 level (1-tailed)

Multiple  $R^2 = 0.2390$

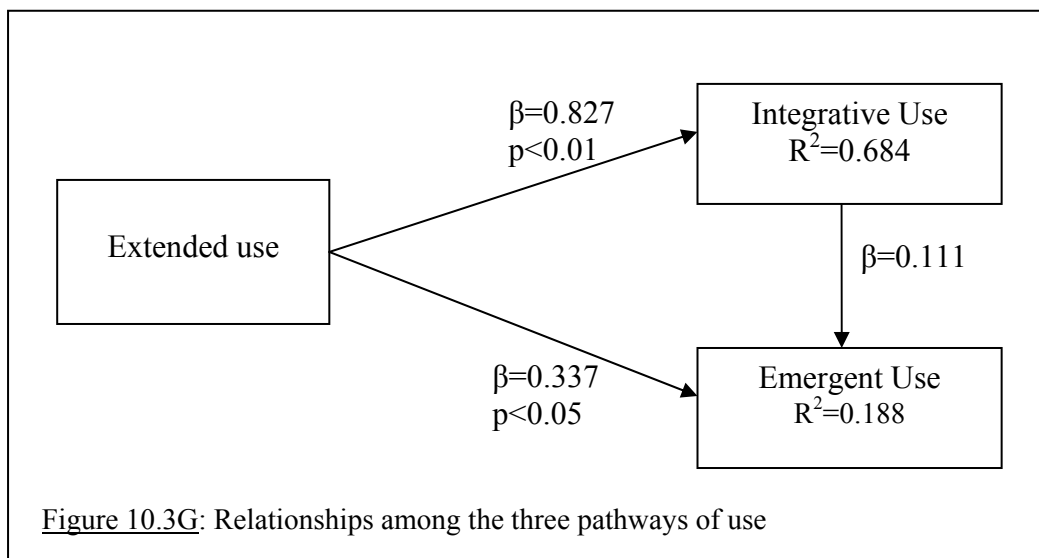
Table 10.3C: PLS Results (dependent variable – TEMU)



### 10.3.3 The integrated model of three pathways of use

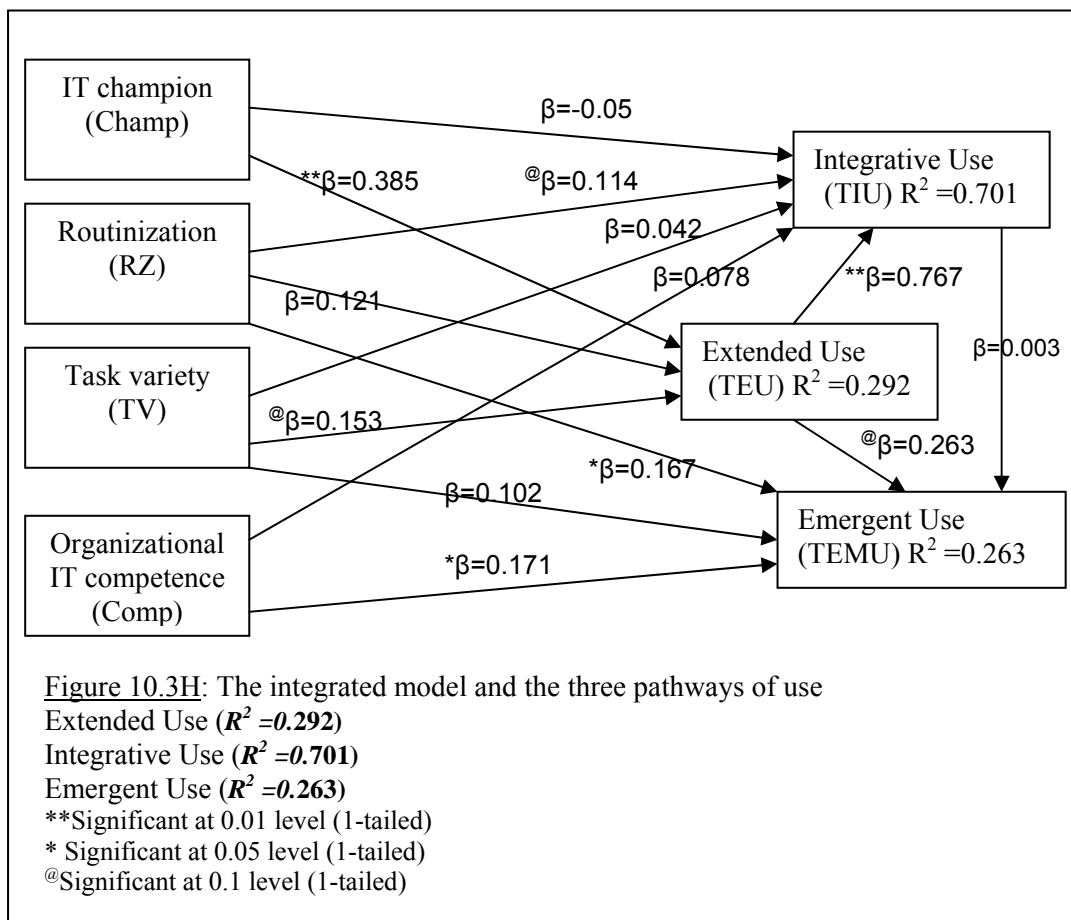
When Saga and Zmud (1994) proposed three pathways of use to evaluate IT infusion, Saga (1994) found a positive relationship between extended use and integrative use and integrative use and emergent use. However, she did not find a positive relationship between extended use and emergent use.

Further hypotheses were set in order to test a more complex structure as shown in Figure 10.3G. This study forms links between extended use, integrative use, and emergent use. The link between integrative use and emergent use is also supported by the qualitative studies explained in Chapter 7.



The correlations between extended use and integrative use are significant at a level less than 0.01 while the extended use and integrative use is positively associated at a level of 0.05. However, there is no statistical significance between integrative use and emergent use.

In the following part, four main enablers that are found to be significantly associated with three pathways of use are integrated into an overall model (Figure 10.3H). They are task variety, organizational IT competence, routinization, and IT champion.



The integrated model gives a picture of the relationship between independent variables and three pathways of use at that same time. The following conclusions can be drawn.

- IT champion is a major extended use enabler at a significant level less than 0.01. Meanwhile, task variety is significantly associated with extended use at a lower level of 0.10.
- The most important integrative use enabler is extended use with a significant level less than 0.01. Another enabler at a significant level of 0.10 is routinization.
- Both routinization and organizational IT competence are emergent use enablers at a significant level of 0.05. Extended use is also positively related to emergent use at a significant level of 0.10.

## 10.4 CONCLUSION

The survey instruments used in the analysis have been tested for internal consistency, convergent and discriminant validity. The measured items were adjusted to the acceptable level of reliability and validity.

Table 10.4A summarizes the results of the statistical analysis of data from the survey questionnaire. Results from the analysis using PLS regression shows that there are four important IT infusion enablers, which are task variety, organizational IT competence, routinization, and IT champion. Among all enablers, routinization has the most statistical significance. When the model is adapted, the enablers which are social network and management support that were identified earlier during the qualitative study have no direct significant effects on IT infusion. Both enablers are positively related to organizational IT competence which is, in turn, an IT infusion enabler. This fact is consistent with the literature and confirms the model developed from the qualitative study in chapter 7.

All four major enablers contribute differently to the three pathways of use. Even though routinization is a main enabler for all three pathways of use, it does not yield a significantly statistical result as an extended use enabler. Extended use enablers include task variety and IT champion. Confirming the qualitative study, the most important enabler for integrative use is extended use. Routinization is also another enabler of integrative use. The enablers of emergent use consist of organizational IT competence, routinization, and extended use. The statistical relationship between integrative use and emergent use is found to be insignificant.

IT infusion enables (Simple structure)	IT infusion enablers (Proposed model)	Enablers for three pathways of use (separate models)	Enablers for three pathways of use (integrated model)
*Task Variety *IT competence **Routinization *IT champion	@Task Variety  *Routinization  @IT Champion	<b><i>Extended use</i></b> *Task Variety *Routinization *IT champion	<b><i>Extended use</i></b> @Task variety **IT champion
		<b><i>Integrative use</i></b> *Task Variety *IT competence **Routinization *IT champion	<b><i>Integrative use</i></b> @Routinization **Extended use
		<b><i>Emergent use</i></b> *Task Variety *IT competence *Routinization	<b><i>Emergent use</i></b> *IT competence *Routinization @Extended use

Table 10.4A: Summary of the Results

\*\* Significant at the 0.01 level (1-tailed)

\* Significant at the 0.05 level (1-tailed)

@Significant at the 0.1 level (1-tailed)



# CHAPTER 11

## DISCUSSION OF RESEACH RESULTS

In this chapter, the results from this study are summarized. This chapter discusses the research results by first reviewing the infusion construct, including an examination of the disparate definitions found in the extant literature, and then reviewing the measurement. This review and analysis highlights the multidimensional nature of the constructs. The available measures are also reconsidered, including the novel approach of incorporating the concept of task complexity. The new measure was developed and tested using both qualitative and quantitative techniques. This study structurally investigates potential reasons for the lack of significance of the statistical results in prior studies. However, it provides evidence to suggest that perhaps some of the previous models found in the literature have been misspecified. The results add to the literature a definition of IT infusion, a new IT infusion measure, and a model of IT infusion.

The first section discusses the definition of IT infusion followed by a discussion of the new IT infusion measure in the second section. The third section provides an analysis of the IT infusion process and enablers. The critical analysis of how each enabler affects IT infusion and the three pathways of use are provided in section 11.4. The survey questionnaire was used to validate/triangulate the enablers from the qualitative studies.

The discussions in this chapter are outlined as follows:

- 11.1 IT infusion
- 11.2 Measuring IT infusion
- 11.3 Analysis of IT infusion process and enablers
- 11.4 Analysis of the IT infusion model and the three pathways of use
- 11.5 Conclusion

## **11.1 IT INFUSION**

From a critical review of the definition, IT infusion had several dimensions and perspectives depending on how prior researchers viewed it. Different definitions led to different measures and therefore, incomparable research results. This study offers an in-depth understanding of IT infusion which future research can use as a guideline. The synthesis of the definition also helps develop an appropriate IT infusion measure for a more sophisticated IT infusion study focusing on an organizational-level of analysis. This study proposes that an organization reaches an infusion stage when the technology is used to its fullest potential. This entails being used in the industry in order to support the highest level of tasks and the technology being strategically integrated into the organization.

### **11.1.1 IT infusion and its dimensions**

As discussed earlier in Chapter 2, the definition of IT infusion can be defined at a conceptual level and an operational level. At the conceptual level, IT must be used as a strategic tool in the organization. This can also be viewed by the significance and impact of IT to the organization (Sullivan, 1985).

The significance and impact were interpreted as the integration of IT into organizational tasks at an operational level (Cooper and Zmud, 1990; Zmud and Apple, 1992). The infusion process referred to a process where IT had been integrated to a progressively higher level of tasks until the task-IT integration reached the fullest potential (an infusion stage). The more complex features of IT are required to perform the higher levels of task (Zmud and Apple, 1992; Castner and Ferguson, 2000). The infusion stage also required an establishment of workflow linkage within the organization (Zmud and Apple, 1992; Saga and Zmud, 1994). Therefore, the IT features, the tasks, and the workflow linkages are three key dimensions at the operational level.

### **11.1.2 The fullest potential use**

The fullest potential use of IT can be viewed as a *perceived*-fullest potential use and a *benchmarked*-fullest potential use. The perceived-fullest potential use is based on individuals' opinion of how IT can be used to the fullest potential. The survey instruments used by Caster and Ferguson (2000) and Jones et al. (2002) reflected the perceived-fullest potential use. This study argued that the perceived-fullest potential use perspective is not valid for an organizational-level of study. It was limited by individuals' knowledge about how to use the technology. The fullest potential use should be set at an industry benchmark. The combination of field experts and software designers should be used to determine the benchmark. This approach was adopted by Cooper and Zmud (1990), Zmud and Apple (1992), Eder and Igarria (2001), and Kishore and McLean (2007). This study additionally clarified the fullest potential use level to avoid incompatibility of results being issued in this study. Even though some IT had been adapted to suit different organizations, the definition of fullest potential use should be based upon the fullest potential use in the industry.

### **11.1.3 Three pathways of use**

Saga and Zmud (1994) proposed three pathways of use as dimensions of IT infusion. They are extended use, integrative use, and emergent use. This study found that these three pathways of use reflected all dimensions discussed earlier. Extended use is an integration of IT into organizational tasks. Integrative use is an establishment of work flow linkage through the use of IT. Emergent use is the use of the technology in areas that were not possible without the technology. Viewing infusion in terms of three pathways of use allowed this study to understand the organizational implementation process from different perspectives. It also helped interpret the IT infusion enablers that had different effects on various dimensions of infusion.

## **11.2 MEASURING IT INFUSION**

One of very important contributions of this study is the development of an IT infusion measure that incorporates the most important IT infusion dimensions. Since prior studies (e.g. Cooper and Zmud, 1990; Zmud and Apple, 1992) relied on small discrete scales to measure IT infusion (e.g. low, medium, and high), the statistical application of the measures was limited. These narrow-ranged measures also tapped into too many dimensions at a time making it hard for a valid assessment of infusion level. This might be a cause for the statistically insignificant results in previous studies. Another set of existing measures used seven-point Likert scales to measure *perceived* infusion level. Jones et al. (2002) used these measures in their studies, focusing on an individual-level of analysis.

This study offers a measure that can discriminate between IT infusion levels. The new measure was found to (1) incorporate all important dimensions of IT infusion, (2) yield a reasonable range of IT infusion levels for statistical analysis, (3) be suitable for an organizational-level of analysis study, (4) increase comparability among future IT infusion studies, and (5) serve as a guideline for developing measures for other technology or businesses.

### **11.2.1 The proposed measure**

The new measure integrates the concept of task complexity (Wood, 1986; Bonner, 1994; Abdolmohammadi, 1999) and the three pathways of use that form a concept of IT infusion (Saga and Zmud, 1994) in order to tap into the important dimensions of infusion. Extended use was measured from 0-16 depending on the level of task complexity into which spreadsheets were integrated. Links between tasks were counted to form integrative use score, ranging from 0-15. The emergent use score was measured by determining the extent to which spreadsheets were integrated into the business strategy, with results ranging from 0-4. The detailed explanation of how these scores were measured can be found in Section 4.6.

The measure was first tested on seven audit firms. The results show that the proposed measure discriminates well between different levels of infusion, which

makes it more amenable to statistical analyses than previous methods. Then, the measure was operationalized as a survey instrument. The results from the survey yield scores that can be used for the PLS model. Concurrent validity analysis (Section 10.1.4) showed that the proposed measure was significantly (at the level less than 0.001) related to a global IT infusion measure of *perceived* IT infusion. The concurrent validity test also indicated that the respondents from small businesses considered task-IT integration as the fullest potential use of IT or IT infusion but they were not very aware of strategic use of IT in the business.

### **11.2.2 Three pathways of use: formative versus reflective indicators of IT infusion**

IT infusion is a multidimensional construct. The three pathways of use exhibit different dimensions of IT infusion. Extended, integrative, and emergent use items were designed to tap the different sub-constructs, and multicollinearity was safeguarded by ensuring that the items did not incorporate the same aspects. According to Petter et al.'s (2007) discussion, these pathways create a formative relationship with the construct. However, Saga (1994) used the three pathways as reflective indicator in her study.

As suggested by Chin (1998), Jarvis et al. (2003), and Petter et al. (2007), this study concludes that the three pathways of use form IT infusion. The direction of causality is from three pathways of use to the IT infusion. All three pathways have different contents. Therefore, the three pathways of use must be operationalized as formative indicators. Future studies which wish to adopt the three pathways of use as IT infusion indicators should be aware of this confusion.

## **11.3 ANALYSIS OF IT INFUSION PROCESS AND ENABLERS**

In this section, results from the qualitative and quantitative analysis are integrated for a comprehensive discussion of IT infusion enablers. Eder and Igbaria's (2001) and Saga's (1994) studies were two that successfully identified IT infusion enablers. These enablers were earliness of adoption, IT infrastructure flexibility,

individuals' ability to reconceptualize tasks via IT, and manager intervention. However, both studies had significant limitations. The study of Eder and Igbaria (2001) was done in an earlier phase of implementation. The quantitative data reflected IT infusion enablers that existed during the earlier IT implementation period. The study did not investigate the enablers that might help advance the use of IT. On the other hand, Saga's conclusions were based on speculative interpretations of a complex model that included both individual-level and organizational-level factors. This study adds into the literature significant insights of how IT infusion enablers should be provided at various stages of the IT infusion process.

### **11.3.1 Analysis of the IT infusion process and its enablers**

This study added to the literature several previously unidentified IT infusion enablers. The enablers were training, external support and alliances, IT infrastructure flexibility, IT implementation processes, task variety, organizational IT competence, staff self-efficacy, staff attitudes and motivation, routinization, and existence of an IT champion (Figure 7.3A). Other factors included the characteristics of the technology and its substitutes, management attitudes, and management involvement. Of these enablers, IT infrastructure flexibility was consistent with Eder and Igbaria's (2001) finding. Additionally, organizational IT competence partly overlapped with an ability to reconceptualize tasks via IT, as tested by Saga (1994). This study also yielded more insight into how management involvement affected the IT infusion process, instead of whether perceived manager support was related to IT infusion as tested by Saga (1994).

One of the most important contributions of this study is that it identified IT infusion enablers and mapped them to the organizational IT infusion process. The cross-case analysis showed that the organizations had all gone through a similar infusion process. In addition, the enablers vary according to the stage of IT infusion. For example, some enablers contribute to infusion at an early stage while others contribute at a higher stage of infusion. The results showed that all enablers

which exhibited at lower-levels of infusion were also present in firms which exhibited a higher-level of infusion (Figure 7.2B).

#### *11.3.1a An early stage of infusion (Level 1 or 2)*

At an early stage of infusion, staff knowledge and skill are the most important in integrating IT into business tasks. Staff knowledge, skill, and ability are grouped as staff competency (Blancero et al., 1996). Firms with a low level of infusion relied on individual staff to apply the technology in their work because the management did not know how to use the technology or know what help staff needed. However, basic training is necessary, especially during the early phase. This is because it increases users' perception of system quality and intention toward using IT (Bedard et al., 2003). The training can be conducted by an external party or through formal staff education. In addition, necessary IT infrastructure must be provided. As Venkatesh et al. (2008) claimed: no matter how competent (e.g., self-efficacy, knowledge) an individual is in using a system, if the organization does not have adequate resources (e.g., technology infrastructure) to support the system uses, the individual's behavioral expectation to use that system will be lowered.

#### *11.3.1b Later Stages of Infusion (Level 2 or 3)*

During the later stages, staff develop their skills and expand their range of tasks (Pentland, 2003). Variation of tasks and job rotations (so that staff can experience task variety) may be used as a managing strategy at this stage. Management support is also needed in the form of available time and resources. Observation of other software used in auditing or how other firms use IT in auditing also helps auditors to learn new uses. At the firm level, IT was used as a tool for standardizing work processes to avoid relying on individuals to perform audit tasks. Staff turnover, therefore, was identified as a push factor for using IT to its fullest extent. The difference between spreadsheet infusion enablers for the firms in Level 2 and 3 is the shift from organizational-level enablers to individual-level enablers. The firms that exhibit a higher infusion level (Level 3) must not only provide necessary resources but also motivate their staff to investigate and use the spreadsheets.

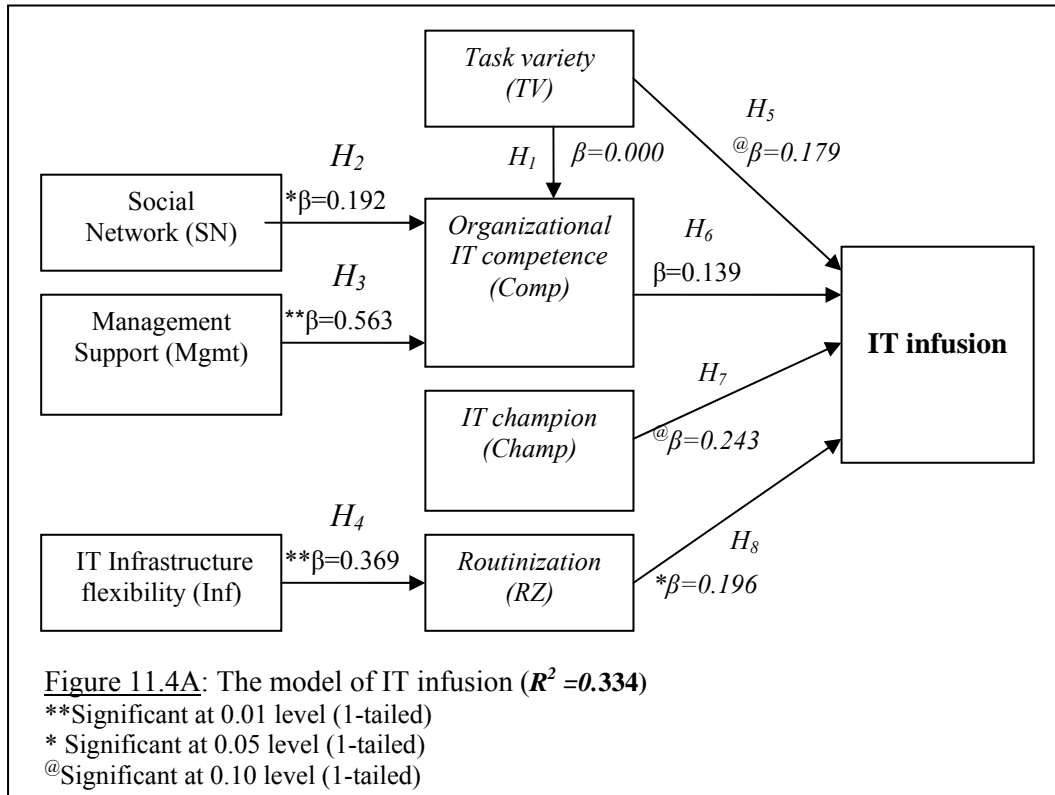
### *11.3.1c      The Infusion Stage (Level 4)*

To achieve this infusion stage, the evidence indicated that audit firms must seek help from external sources. This finding is consistent with those of Vera-Munoz et al. (2006). External sources include other audit firms, professional institutes, and academic institutes. Senior managers and an IT champion also play important roles in bringing in IT knowledge. The self-efficacy identified by the cases was that of the IT champion. An IT champion acts as an intermediary who acquires external knowledge and promotes IT uses in the firm (Beath, 1991).

### **11.3.2      Analysis of the IT infusion model and results from the survey questionnaire**

The model of IT infusion as shown in Figure 8.1A and Figure 10.2E was reproduced with the results from the survey questionnaire as Figure 11.4A. The overall model explained 33 percent of the variance in spreadsheet infusion ( $R^2=0.33$ ). The model not only added into the literature new factors such as social network, task variety, and IT champion, but also showed a significant improvement from those of prior studies that focused on an organizational level of analysis. The prior studies found insignificant statistical results (Cooper and Zmud, 1990; Zmud and Apple, 1992). The overall results showed that except for  $H_1$  and  $H_6$ , other hypotheses were supported at acceptable confidence levels. The most statistically significant supports were found to be the positive relationships between management supports and organizational IT competence ( $H_3$ ) and between IT infrastructure flexibility and routinization ( $H_4$ ). The most important IT infusion enabler is an IT champion ( $H_7$ ). Task variety ( $H_5$ ) and routinization ( $H_8$ ) were also positively related to IT infusion. In the remaining of this section, individual IT infusion enablers are discussed and analyzed.





### 11.3.2a Task variety

H<sub>1</sub>: Task variety and organizational IT competence

In Chapter 8, it was hypothesized that task variety was positively related to organizational IT competence. However, the first hypothesis (H<sub>1</sub>) was not supported. The hypothesis was based on the prior research into task variety. The evidence from the case studies did not imply this relationship. Even though the task variety indicated the flexibility of learning and adaptation (Pentland, 2003), the survey results showed that task variety was not related to IT competence. As given in the explanation by Medcof (1989) who studied task characteristics, skill variety, and extent of IT use, tasks can be divided into two components: one which involves the use of IT, and the other which does not. In this study, task variety which was measured by audit clients who represented various industries includes both IT-related and non-IT related components. The task variety may contribute to skill variety which is a part of the organizational competence, but not IT competence.

Therefore, it does not necessarily hold that task variety increases organizational IT competence.

H<sub>5</sub>: Task variety and IT infusion

Consistent with evidence from the qualitative study, task variety was positively associated with IT infusion at a confidence level of 0.10. Therefore, the fifth hypothesis was supported. The evidence from both the case studies and the survey questionnaire also showed that most firms implemented spreadsheets in order to assist and increase efficiency of existing tasks. Therefore, IT infusion was limited by the number of available tasks. This was consistent with the organizational innovation process, and the diffusion theories that suggest organizations adopt and use IT in order to solve existing problems or to perform existing tasks (Rogers, 2003). Venkatesh et al (2008) also notes that intensity of system use (which is a part of IT infusion) was tied to the nature of the activities that make up a user's job and its demands. For example, higher complexity work activities might require greater intensity of use than simple or routine work activities.

Task variety represents the difference in task characteristics or dimensions across tasks (Bonner, 2008). Since the proposed measures of infusion (especially the extended use measure) were developed based on the task complexity concept which involved different characteristics of tasks, it could be said that the number of different available tasks also affected the number of tasks to which IT could be integrated. The evidence from the case studies was also contrasted with the theoretical effects of task variety on IT competence and IT infusion. The analysis of enablers showed that task variety is a key enabler at a higher IT infusion level than organizational IT competence (Figure 7.2B). The combination of qualitative and quantitative results, therefore, suggested that task variety is directly associated with IT infusion, based on the fact that organizational staff members have basic knowledge about using the technology.

The effects of task variety on IT infusion through the three pathways of use were found on all pathways. However, Figure 9.3H suggested that task variety affected integrative use and emergent use through extended use. As discussed earlier, the

numbers of different tasks determined the IT infusion stage (where IT has been integrated into all tasks), and task variety had higher effects on extended use than on integrative and emergent use.

### *11.3.2b Social Networks*

H<sub>2</sub>: Social networks and organizational IT competence

At an organizational level of analysis, social networks refer to external relationships that can be with sources of other companies and public institutes (Johnston and Linton, 2000). The PLS analysis showed a statistical support for the hypothesis two. The social network was positively related to organizational IT competence at an 0.05 level of confidence. The statistical result was consistent with the results from the case studies and existing literature (e.g. Jonhston and Linton, 2000; Hidalgo and Albers, 2008). Prior research claimed that small firms relied on external IT consultants (e.g. Cragg and King, 1993). IT consultants help transfer knowledge from industry to the firms (Benbasat and Rush, 1995). However, a case firm explicitly explained that simply bringing in an external expert did not help. The evidence from the case studies was also consistent with those of Zinatelli et al. (1996) that small firms usually get help or support from friends or other informal channels. Even though the evidence from the case studies was consistent with those prior studies, it also suggested that organizations with a higher level of infusion relied more on other forms of network such as intra-firm, professional institutes, and academic institutes in acquiring knowledge, both IT and non-IT. On average, organizations that responded to the questionnaire showed an average extended use score of nine which indicated a high IT infusion level in the process. Therefore, it could be assumed that the respondent firms were currently in the stage of seeking competence from the social network. Additional information given by open-ended questions also showed that small firms expected to get help from external networks such as public institutes.

When qualitative and quantitative results were triangulated, they suggested that various types of social network contributed to organizational IT competence

differently during the process of IT infusion. At an earlier stage in the infusion process, external consultants were needed in order to transfer basic IT skills and knowledge to the organizational members. Once an organization had a certain level of knowledge, it would seek more advanced knowledge from other sources, such as professional communities and research. Evidence from the case studies also suggested that firms at a higher level of infusion wanted to observe how other firms used the spreadsheets and know how spreadsheets could be used ideally.

#### *11.3.2c Management support*

H<sub>3</sub>: Management support and organizational IT competence

The result from the quantitative analysis indicated that management support was the most important determinant of organizational IT competence, with a confidence level less than 0.01. Therefore, the hypothesis H<sub>3</sub> was supported.

Prior studies identified management support as a critical success factor in implementing a new technology (e.g. Thong et al., 1996; Igbaria et al., 1997; Wixom and Watson, 2001) and technology infusion (Eder and Igbaria, 2001 and Ramamurthy et al., 2008). Data from the survey and case studies showed that management support contributed to IT infusion, which was a part of IT success through organizational IT competence. Management support in the form of training and time availability were required in order to increase the organizational IT competence. The effects of training and time availability are discussed based on the qualitative data and prior studies as follows.

#### *Training*

Management support in terms of training may have increased organizational IT competence, and therefore, IT infusion, but the training does not play an important role after the post-adoption stage. Since individuals' understanding of IT application develops over time, training strategies should evolve over time too (Jaspersen et al., 2005). Most studies on training (e.g. Venkatesh and Davis, 1996 and Venkatesh, 1999) focused on the early stages of adoption and use. However, there is little understanding of when and how an organization should intervene in

terms of training. The results from the survey questionnaire showed that training and staff knowledge and experience are important in helping the organizations reach a higher level of use of spreadsheets. However, results did not give a clear understanding of how training should be done or conducted and how staff knowledge and experience could be obtained. In fact, the case studies provided strong evidence on what organizations with different level of spreadsheet infusion should be facilitating in order to use spreadsheets to a higher level and to the fullest potential. During the introductory phase, the case firms required formal training to provide basic IT knowledge and skills. Face-to-face formal training also increased users' perception of system quality and their intention of using IT (Bedard et al., 2003). In an advanced application of spreadsheets (a higher level of infusion), other forms of training, such as on-the-job training, were preferred. Bedard et al. also pointed out that training using highly realistic cases made auditors become familiar with technology and resulted in a significant increase of use of the full capabilities of the system.

#### *Time availability for investigating the use of technology*

Management support, in the form of time availability for investigating the use of technology, has two different effects in this study. Results from the case studies were consistent with most IT implementation studies (e.g. Premkumar, 2003) finding that management support in terms of resources (e.g. time) contributed to an implementation success. However, Ahuja and Thatcher (2005) found that a specific overload factor, such as time pressure, could influence the decision to learn a new technology, and therefore, a new use. Loraas and Wolfe (2006) explained this concept further, and that time pressure worked through anticipated emotions to produce an indirect effect on the decision to learn a new use of technology. This may explain the negative correlation between management support and spreadsheet infusion in the simple model, and the low t-value in Ramamurthy et al's (2008) study on management support and IT infusion. The time availability may not give a specific factor that pushes organizational members to seek new uses; however, it contributes to the knowledge and skill improvement of the members. Time pressure can also increase awareness of the relative advantages of the new use. The data

from the survey and case studies also showed that time pressures had forced auditors to use spreadsheets instead of doing their tasks manually.

On the other hand, time pressure can negatively affect the implementation process. Auditors from the case firms claimed that they need more time in order to figure out how spreadsheets can be used. Banji and Kaushalesh (2006) identified learning-by-doing as the most effective mode of knowledge acquisition for small and medium sized organization in developing countries. Second choices include internet searching and in-house training. The management should provide support in the form of time availability carefully. For a simple IT use, time pressure is required in order to force users to adopt the technology. For a more advanced use, for which formal training cannot give the knowledge and skills that users need, time should be provided.

#### *11.3.2d IT infrastructure flexibility*

H<sub>4</sub>: IT infrastructure flexibility and routinization

The statistical findings showed that IT infrastructure itself was not significantly associated with spreadsheet infusion. However, it is highly correlated to routinization which is an IT infusion enabler. The hypothesis H<sub>4</sub> is supported. The results were consistent with those of Eder and Igbaria (2001) which found a direct positive effect of IT infrastructure flexibility on intranet infusion. However, Eder and Igbaria's study did not include routinization which was found to be an important IT infusion enabler in other studies.

The possible explanations of the different findings can be shown by the survey respondents and the evidence from the qualitative study. The case studies showed that IT infrastructure was required at an earlier stage of IT infusion. This evidence is consistent to those of Eder and Igbaria's study, which claimed that they were studying intranet diffusion and infusion during an early year of its introduction. As Venkatesh et al (2008) claimed: no matter how competent (e.g., self-efficacy, knowledge) an individual was in using a system, if the organization did not have adequate resources (e.g., technology infrastructure) to support system use, the

individual's behavioral expectation to use that system would be lowered. Although the individual might still have a behavioral intention to use the system, he or she might not have a high behavioral expectation to do so given the lack of necessary resources. Even though this study cannot assume a causal relationship between IT infrastructure flexibility and normal use (routinization), those two variables are highly correlated. There would not be routinization without the existence of basic IT infrastructure.

As shown by the statistical samples, most firms claimed that they had moderate infrastructure flexibility (means range from 3.6 to 4.6 out of 7) and high routinization (means range from 5.7 to 6.1 out of 7). These samples indicated that most firms were not in an early stage of spreadsheet implementation. They had fulfilled their infrastructure needs. Once an organization had routinized IT, IT infrastructure seemed to have less effect on IT infusion. The case studies also showed that firms with a higher level of infusion seemed to have adequate IT infrastructure. They seek resources in other forms to advance the use.

#### *11.3.2e Organizational IT competence*

H<sub>6</sub>: Organizational IT competence and IT infusion

The statistical findings indicate no significant relationship between organizational IT competence and IT infusion. The hypothesis H<sub>6</sub> is not supported. The responses from the open-ended question in the survey did not show organizational IT competence as an IT infusion enabler, but an inhibitor.

The findings were in contrast to those of two prior studies. Organizational IT competence was tested as an earliness of adoption construct in prior studies (Zmud and Apple, 1992; Eder and Igbaria, 2001). The earliness of adoption reflected the organizational experience in IT being measured in number of years. Zmud and Apple and Eder and Igbaria claimed that they conducted their studies during early implementation periods. They both found significant relationship between the earliness of adoption and IT infusion. As discussed earlier, firms at a lower level of infusion viewed organizational IT competence as an IT infusion enabler. This was

also consistent with the IT infusion measure developed that at an early stage of extended use (which is a part of IT infusion): the firm required basic IT skills to assimilate the IT. Once the firm reached a certain infusion level, basic IT skills could advance the use. According to the survey questionnaire, most firms claimed that they had sufficient knowledge of spreadsheet features/functionalities and how to use spreadsheets in their work (mean scores are both 4.6 out of 7). Therefore, the surveyed firms might have crossed the threshold. The threshold can be referred to as a *feature-extension* behavior which happens when users have gained experience in using a specific feature that goes beyond the use intended by the application's designers (Jaspersen et al., 2005). In this case, organizational IT competence might no longer be important in advancing the use in the surveyed samples.

Even though there is no statistical relationship between organizational IT competence and IT infusion, the organizational IT competence is positively related to emergent use which is a dimension of IT infusion. Spreadsheets are a general application. Unlike other specific-purpose applications, the use of spreadsheets requires knowledge and skills of both task and IT. An individual's ability to reconceptualize the tasks via IT is important. Saga (1994) also found the same evidence of the positive effects of task reconceptualization of IT infusion. An emergent use is the application of spreadsheets to a process or task that could not previously have been performed without their availability. Therefore, a new task or a new approach of completing a task must be created. Since an emergent use dimension (the highest score of four) is a small part of spreadsheet infusion (the total score of 35), the significant relationship of the emergent use enablers with emergent use can hardly be identified as IT infusion enablers. However, based on the concept this study has developed, organizational IT competence is an IT infusion enabler as an emergent use enabler.

This study also showed that the target respondents of the survey (consistent with most studies) were usually the people who were most familiar with the IT within the organization. Therefore, the level of organizational IT competence was based on those persons' views and reflected the highest use of the firm. There were gaps between the highest and the average level of use in the firm. The responses to



open-ended question implied a few solutions to narrow the gap. These responses mostly indicated individual's motivation and self-efficacy which were consistent with findings from the qualitative evidence reported earlier in Chapter 6.

#### *11.3.2f IT Champion*

H<sub>7</sub>: IT Champion and IT infusion

An IT champion played an important role during the IT infusion process. The hypothesis H<sub>7</sub> was supported. All statistical evidence confirmed the earlier qualitative results. The evidence from the research was consistent with most implementation research that the existence of an IT champion contributed to IT implementation success (e.g. Sharma and Rai, 2003; Pitt et al., 2006). Even though Scheepers (2003) and Ungan (2007) claimed that the role of IT champion was significant during the initiation and disappeared into the background as technology progresses, the evidence from the case firms further suggested that IT champion should continue working and bridging as an intermediary for transferring knowledge from external sources into the firm.

From the analysis, IT champion was significantly related to extended use. The statistical results are consistent with the definition of IT infusion and the indicator of the construct. An IT champion investigates the technology, promotes his or her own personal vision, and pushes the implementation. This is also consistent with qualitative evidence from the case firms. When spreadsheets get investigated, all beneficial functionalities are applied to audit work by the champion. This action reflects extended use. When the champion promotes and gets the new use implemented, the diffusion process starts. Since IT infusion is measured by the highest application of spreadsheets in the firm, the existing use of the champion reflects IT infusion through extended use. The use by the champion reflects an individual use; therefore, the influence of IT champion on integrative use may not be significant if the diffusion within the organization is not successful.

The evidence from the case studies also suggested that the influence of IT champion on the IT infusion process depended on who played the champion role.

The management who also participated and played the championship role had a more significant effect on IT implementation process than any other staff members. This could be explained by the superior political will and power needed for convincing staff members (Yeow and Sia, 2008). The champion who was not the management needed a high social status within the firm in order to gain this power. The support from the management alone (as recommended by Beath, 1991) would not have a high effect on other staff. A respondent from the case study claimed that the most effective way to convince the staff members to routinely integrate spreadsheets into their work was bringing in external experts who were widely accepted in the industry.

#### *11.3.2g          Routinization*

H<sub>8</sub>:      Routinization and IT infusion

Routinization was found to be the most statistically important IT infusion enabler. The hypothesis H<sub>8</sub> was supported. Even though routinization was not mentioned by the interviewees in the case firm, the evidence (especially from Firm F) exhibited high routinization, high workflows integration, and high infusion. The findings confirmed the prior studies (Cooper and Zmud, 1990; Zmud and Apple, 1992; Jones et al, 2002; Sundaram et al, 2007) that routinization is positively related to IT.

One of the main contributions of this study is that routinization has the highest positive effect on IT infusion as an integrative use enabler. As shown in Figure 10.3H, the analysis of IT infusion through the relationship of the three pathways of use indicated that routinization has no significant effect on extended use, but does affect integrative use and emergent use. This is consistent with the expectation formed, based on the literature review, that routinization is not required as a prerequisite of beginning the IT infusion process as stated by Kwon and Zmud (1987). But in order to achieve an “IT infusion stage”, an organization must routinize the technology within its work process, since the statistical evidence showed that routinization is positively related to integrative use. An organization

did not establish a workflow linkage unless staff members along the workflows routinize the technology in their work.

Routinization is also positively related to emergent use. The evidence from the case studies showed that some emergent use involved the construction of a database to which staff members who had routinized spreadsheets in their work contributed. The database included the average financial ratios stored in the firm database and web-based application that allowed users to share their work and knowledge.

#### **11.4 ANALYSIS OF IT INFUSION MODEL AND THE THREE PATHWAYS OF USE**

The results from the study showed that the IT infusion enablers contributed to IT infusion via one of more of the pathways of use differently. For an organization to achieve a higher level of infusion, IT infusion enablers should be manipulated or intervened in through the enablers of the three pathways of use which were used as formative indicators of the infusion. The enablers of the three pathways of use were found to be consistent with IT infusion enablers.

##### **11.4.1 IT infusion enablers**

The average IT infusion score measured from the samples is approximately 16 out of 35 (1.58 out of 4 for emergent use; 8.33 out of 16 for extended use; and 6.65 out of 15 for integrative use). These scores exhibit a moderate level of extended use and lower levels of integrative use and emergent use. The statistical analysis indicated IT infusion enablers that brought the samples up to this level. Four main IT infusion enablers were found to be significantly related to IT infusion, with  $R^2$  of 0.334. These were task variety, organizational IT competence, routinization, and IT champion. Among the IT infusion enablers, routinization yields the most statistical significance in enabling IT infusion at a confidence level less than 0.01 for the simple regression model and at the confidence level less than 0.05 for the proposed model.

### **11.4.2 Extended use enablers**

Task variety and IT champion were found to be significantly related to extended use. IT champion exhibited the most significant relationship in the purpose model. This indicates that in order to exhibit high extended use in an organization, an organization will tend to have a variety of tasks and somebody who investigates the application of spreadsheets to accomplish all those tasks.

The qualitative evidence showed that most small firms provided services to small to medium-sized clients who mostly operated in manufacturing and trading industries. Some small and general businesses did not require extensive audit activities such as statistically-based risk assessment and complex financial calculation auditing. Therefore, the number of tasks to which spreadsheets could be applied was less and they obtained a lower score for extended use. The IT champion was also required in order to get new tasks and technology investigated. For a new use to survive in an organization, the champion also needed to promote, convince, and help other organizational members during the implementation process.

Even though there was no statistical relationship between organizational IT competence and IT infusion (or extended use), organizational IT competence was identified as an important enabler from the qualitative evidence. The competence, which consists of skills and knowledge, was also claimed as an inhibitor by 31 out of 50 responses of the open-ended question. As discussed in Chapter 9, IT competence was found to be highly correlated with IT champion (correlation coefficient of 0.72). In fact, the construct was overlapped in the way that the IT champion's competence may represent the organizational IT competence. On the other hand, the competence of the firm's managers also increases an intention to champion the use of technology within the firm (Bassellier et al, 2003). Therefore, without the champion's competence, it is less likely that the champion can get task-technology investigated and promote the use within the firm.

The evidence from the study also implied how an organization should intervene in the implementation process by supporting an IT champion. In addition to authority

support recommended by Beath (1991), the management should provide resources in the form of time and provide communication channels to other firms as social networks. The evidence showed that existing social networks were established through the partners who cannot act as IT knowledge intermediaries effectively. The social networks should be established among champions who are competent in IT.

#### **11.4.3 Integrative use enablers**

The overall analysis among the three pathways of use and IT infusion enablers showed that the most important integrative use enablers were extended use and routinization. Other enablers such as task variety and IT champion had an indirect relationship to integrative use through extended use. Integrative use was defined as an established linkage between tasks or organizational work flows. Therefore, the extended use (task-technology integration) must exist before the linkage is formed. This was consistent with Saga's (1994) finding about the relationship between extended use and integrative use. However, Saga did not give an insight on the information or attempt to explain why such a relationship existed.

As discussed earlier in chapter 6, the statistical results were consistent with the qualitative data that routinization was positively related to IT infusion in term of integrative use. Information technology helped improve organizational workflows in general (Buhler and Vidal, 2005). Consistent with findings on intranet infusion enablers (Eder and Igbaria, 2001), the infrastructure flexibility was also found as an indirect IT infusion enabler (from the integrative use dimension) through routinization. However, Eder and Igbaria did not follow the process model and routinization was omitted from their study. The possible explanation is that their study was conducted during the early introduction of intranet where the diffusion rate was low and intranet had not yet been routinized in the business. The intention to use the system was based mostly on the availability of infrastructure. When the technology was used to a certain level, providing more resources only affected intention and behavioral expectation to use. No available evidence is found for deeper use, especially when an organization has been using the technology for a

certain period of time and struggling to utilize the available resources to the fullest potential. The findings from the case firms indicated that additional resources, such as a network and a database, were required in order to provide infrastructure for the workflow. The use of a database was a new use established because the work flow linkages and infrastructure flexibility. Evidence from a case firm showed that after heavily investing in database infrastructure, audit staff routinized the use of spreadsheets. The standard procedures established by the spreadsheets enabled the firm to have a knowledge database that could be used for complex financial analysis.

The combination of qualitative and quantitative evidence suggested that in the early stages of implementation, staff members should be provided with necessary IT resources. Then, the support should be given to the IT champion in order to help other staff members integrate and routinize IT into their normal work tasks. Once routinization exists, work flows linkage can be done.

#### **11.4.4 Emergent use enablers**

A significant statistical correlation existed between organizational IT competence, routinization, and emergent use. Task variety and extended use are also partially related to emergent use. The statistical evidence was consistent with evidence from the case studies that once the technology had been integrated and routinized into organizational work process, additional IT knowledge and skills were needed in order to advance the use of technology. The average score of organizational IT competence also showed that while most firms claimed that they had sufficient knowledge of spreadsheet features/functionalities and how to use spreadsheets in their work (means score are both 4.6), they had significantly lower scores for what they knew about how the spreadsheets were used in other firms (3.6). This indicates low observability. Evidence from the case firms also showed that this knowledge and skills could be obtained by self-study, knowledge sharing among audit firms (which increased observability), and support from professional and academic institutes.

There is partial support for the relationship between extended use and emergent use. It is expected that a combination of the contextual factors which determine extended use, such as IT champion, extended use itself, and additional knowledge and skills, increases an ability to reconceptualize tasks via IT or so-called emergent use. In contrast with Saga's (1994) finding, this study found no significant relationship between integrative use and emergent use. Even though the relationship existed in Saga's study, she did not explain the relationship.

#### **11.4.5 Other IT infusion enablers and inhibitors**

The proposed model explained 0.334 of the total variance of IT infusion. Other enablers were identified using a qualitative approach. Since this study focused on an organizational level of analysis, some IT infusion enablers were not carried forward or tested by the survey questionnaire. Some scholars mixed multiple-level constructs in their studies. This approach makes the results hard to interpret. For example, Saga (1994) manipulated an organizational knowledge construct by measuring users' beliefs in technology. The perceived ease of use and perceived usefulness were used as indicators for the constructs. The results, therefore, mixed psychological concept with organizational management concept.

One important IT infusion enabler or inhibitor that was not tested in the survey is the management attitude. As discussed in Chapter 7, management attitude had a direct effect on IT infusion since the management performed the most complex tasks. The management attitude also affects what role the management played in the infusion process and how important technology is to the organization. Those effects demonstrated the level of management support and the influence of IT champion.

The individual level factors which are staff self-efficacy and staff motivation, staff attitudes and staff's beliefs toward technology were found to be IT infusion enablers which are consistent with findings of Ph.D. dissertations conducted by Saga (1994), Jaspersen (1999), and Moore (2002). These qualitative findings leave plenty of room for future research on individual level factors of analysis for IT infusion.

Other inhibitors claimed by the case firms included staff turnover and lack of knowledge. The staff turnover was an important issue. For most small firms, the knowledge was retained by individuals. Once the individuals left the firm, the firm lost its knowledge. One of the case firms started investigating the use of spreadsheets all over again once a person who was recognized as an IT champion had left. The quantitative part of this study focused on IT infusion enablers. Future research should investigate and test IT infusion inhibitors and how to mediate them.

## **11.5 CONCLUSION**

The quantitative analysis showed that the proposed IT infusion model based on the qualitative studies can explain 0.334 variance of IT infusion. The most important IT infusion enablers include task variety, IT champion, and routinization. Therefore, the hypothesis H<sub>5</sub>, H<sub>7</sub>, and H<sub>8</sub> were supported. However, H<sub>7</sub> which indicated the relationship between IT champion and IT infusion was only partially supported. Consistent with prior studies, routinization is the most important IT infusion enabler. The new enablers identified in this study were task variety and IT champion. The study proposed that task-technology fit which was studied by other scholars contribute to IT diffusion or adoption. However, IT infusion is related more to task variety. While other studies included IT champion as an IT success enabler, this study added into the literature how IT champion contributed to IT infusion.

Other IT infusion enablers such as social network (H<sub>2</sub>), management support (H<sub>3</sub>), and IT infrastructure flexibility (H<sub>4</sub>) contributed indirectly to IT infusion through organizational IT competence and routinization. The hypotheses, H<sub>2</sub>, H<sub>3</sub>, H<sub>4</sub>, were all supported. These IT infusion enablers help explain how organizational IT competence and routinization contribute to IT infusion and suggest possible management interventions needed in order to infuse the technology in an organization.



While IT champion and task variety were found to be statistically related to extended use, integrative use was more associated with routinization. While most staff members were equipped with basic IT skills, additional knowledge (competence) was also required for emergent use. Significant relationships were also found between extended use and integrative use, and extended use and emergent use. However, there was no significant relationship between integrative and emergent use.

# **CHAPTER 12**

## **CONCLUSIONS, CONTRIBUTIONS, AND FUTURE RESEARCH DIRECTIONS**

This research developed a model explaining IT infusion in small business at an organizational level in the context of small audit firms in Thailand. This research began with a critical review of IT infusion. New IT infusion measures were developed in order to promote consistency among infusion studies. A mix of qualitative and quantitative methods was used to identify IT infusion enablers and to test the model statistically. Unlike prior studies which based their IT enablers on the models in IT adoption literature, a series of case studies allowed this research to identify key IT infusion enablers that had not been found in any previous research. The qualitative data also added in-depth understanding into the literature of IT infusion processes at an organizational level of analysis. The enablers were analyzed and the appropriate models were constructed. A partial least square (PLS) regression (using PLS Graph version 3.0 developed by Professor Wynne Chin) was used to test the models. The outline of this chapter is as follows.

- 12.1 Research summary
- 12.2 Summary of findings
- 12.3 Research contributions
- 12.4 Implications for practitioners
- 12.5 Limitations and implications for future research
- 12.6 Conclusion

## **12.1 RESEARCH SUMMARY**

This section provides a summary of research investigations. The first part summarizes research objectives and research questions as developed in Chapter 3 of this study. The second part describes the research design and research process. The last part briefly shows the summary of the research results from the study.

### **12.1.1 Research objectives and research questions**

This study addressed three important issues regarding existing IT infusion studies. The first issue was that the definition of IT infusion was not unified making it hard to draw conclusions and compare existing literature. Lack of a valid measurement was the second issue. These two issues led to the lack of a valid IT infusion model at an organizational-level of analysis. Prior studies (e.g. Cooper and Zmud, 1990) could not find significant statistical relationships between IT infusion and its determinants. IT infusion is a part of IT success (Sullivan, 1985; Kishore and McLean, 1998). The research on IT infusion is, therefore, crucial for an organization in realizing the full benefit of its IT investment.

The investigation was divided into three parts. The first part involved a synthesis of IT infusion definitions. A critical analysis was conducted as part of the literature review in Chapter 2. In the second part, the qualitative study and the theoretical foundation were used to develop an IT infusion model. A series of case studies enabled this study to form 16 propositions in Chapter 7. The model of IT infusion based on the 16 propositions can be found in Figure 7.3A. In the model, task variety, organizational knowledge and skills, external support and social network, training, staff self-efficacy, user attitude and motivation, IT infrastructure, types of implementation process, availability of an IT champion, and routinization were found to be IT infusion determinants.

A further statistical investigation was undertaken in Chapter 8-11. Since the study focused on an organizational level of analysis, determinants associated with the individual level of analysis were dropped from the model. The proposed model was shown in Figure 8.1A. The results from the statistical analysis (Figure 11.2A) suggested that task variety, routinization, and availability of an IT champion are IT

infusion enablers. The detail analysis showed that these determinants affected three pathways of use which formed IT infusion differently. Previously stated enablers contributed to all three pathways of use. Among those insignificant IT infusion enablers at a global level, organizational IT competence, social network, and management support were required to advance emergent use.

### **12.1.2 Research design**

The research design consisted of two phases. A series of case studies were conducted in order to identify IT infusion enablers in real business settings. The case firms were chosen using a maximum-variation-cases approach based on information-oriented criteria (Flyvbjerg, 2006). This approach allows this study to investigate various factors at different IT infusion levels. A rigorous positivist case study approach (Dube and Pare, 2003) was used as a guideline in conducting the qualitative study. The qualitative study also included a pilot case study which was used for developing a new IT infusion measure based on the concept of audit task complexity (Bonner, 1994).

The second phase of this research involved a research survey. The design and implementation of the survey included sample selection, the development and pre-test evaluation of the research instrument, and the two-way translation (English-Thai-English) in order to ensure the validity of the instrument. The survey instrument was then administered in a population of small and medium sized audit firms in Thailand. Of a total sample of 203 firms that met sample-selection criteria, 86 were returned. Of the responses from the firms included as case studies, six were excluded, as well as eight responses that claimed no use of spreadsheets. This left 72 complete data sets for evaluating the research model (Table 9.1A).

### **11.1.3 Research instruments, research model, and model evaluation**

The results from the case studies identified several IT infusion enablers that were mapped to organizations which showed different levels of IT infusion (Figure 7.2B). Sixteen propositions were made based on the qualitative study and theoretical concepts from the existing literature. Organizational-level enablers from the case studies were statistically investigated by a survey questionnaire.

The survey data was analyzed using the partial least square (PLS) regression. The PLS allowed the simultaneous assessment of the measurement model and the structural model. The technique also provided the ability to analyze a more complex model which was developed in this study. The Cronbach alpha and principal component analysis were also performed in order to confirm the validity of the measurement constructs. Some modifications were made in order to validate the measures of the constructs (Section 10.1.2). The tests of the adjusted measurement model were shown to be adequate, to the extent that model testing and evaluation were considered appropriate. The survey results were shown to provide support for four out of eight hypotheses. In addition, the results provided partial support for another two hypotheses. Further investigations on supported and unsupported hypotheses were found to be consistent with evidence from the case studies. These results provided considerable support for the research model which accounted for 33 per cent of the observed variance for IT infusion. It must be noted that unlike a covariance-based approach using LISREL, PLS technique does not require a goodness-of-fit evaluation of the model.

## **12.2 SUMMARY OF FINDINGS**

A summary of the major findings is shown in Table 12.2A. This section summarized the research findings from the critical analysis of the literature review, the pilot case study, case studies, and the survey questionnaire.

Chapter	Proposition (P) / Hypothesis (H)	Case studies	Survey results
2, 6, 7, 10, 11, 12.2.1	The concept of IT infusion was based on the use perspective. Three pathways of use, extended use, integrative use, and emergent use could be used as formative indicators of IT infusion.	Supported	Supported
2, 7, 12.2.1	IT infusion is the use of technology to its fullest potential in order to support organizational work. The fullest potential was determined by the use in the industry (e.g. audit firms) given the best knowledge of tasks and technology.	Supported	Not Applicable
4, 6, 9, 10, 11 12.2.2	IT infusion can be measured by applying the concept of task complexity through three pathways of use. The new measure tapped into all important IT infusion dimensions and yielded a range of score enabling a statistical analysis.	Supported	Supported
7, 8, 10, 11, 12.2.3	P <sub>1a</sub> and H <sub>3</sub> : Training (management support) is positively related to IT competence.	Supported	Supported
7, 12.2.3	P <sub>1b</sub> : Training is positively related to attitude toward technology.	Supported	Not tested
7, 12.2.3	P <sub>2a</sub> : Presence of external consultant is positively related to IT competence.	Supported	Not tested

Table 12.2A: Summary of findings

Chapter	Proposition (P) / Hypothesis (H)	Case studies	Survey results
7, 12.2.3	P <sub>2b</sub> and H <sub>2</sub> : Presence of inter-firm networks is positively related to IT competence.	Supported	Supported
7, 12.2.3	P <sub>2c</sub> and H <sub>2</sub> : Presence of communication between firm and professional/ academic institutes is positively related to IT competence.	Supported	Supported
7, 8, 10, 11, 12.2.3	P <sub>3a</sub> and H <sub>1</sub> : Task variety is positively related to IT competence.	Not supported	Not supported
7, 8, 10, 11	P <sub>3b</sub> and H <sub>5</sub> : Task variety is positively related to IT infusion.	Supported	Supported
7, 8, 10, 11	P <sub>4</sub> and H <sub>6</sub> : IT competence is positively related to IT infusion.	Supported	Not supported
7, 12.2.3	P <sub>5a</sub> : Perceived self-efficacy is positively related to the attitudes and motivation toward IT use.	Supported	Not tested
7, 12.2.3	P <sub>5b</sub> : Perceived self-efficacy is positively related to IT infusion.	Supported	Not tested
7, 12.2.3	P <sub>6</sub> : Attitudes toward IT is positively related to IT infusion.	Supported	Not tested
7, 8, 10, 11, 12.2.3	P <sub>7</sub> and H <sub>7</sub> : A presence of an IT champion is positively related to IT infusion.	Supported	Supported
7, 8, 10, 11, 12.2.3	P <sub>8</sub> and H <sub>4</sub> : IT infrastructure flexibility is positively related to routinization.	implied	Supported

Table 12.2A: Summary of findings (Continued)

Chapter	Proposition (P) / Hypothesis (H)	Case studies	Survey results
7, 12.2.3	P <sub>9</sub> : An implementation process that involves users (such as a bottom-up or a value chain approach) contributes more to routinization.	Supported	Not tested
7, 8, 10, 11, 12.2.3	P <sub>10</sub> and H <sub>8</sub> : Routinization is positively related to IT infusion.	implied	Supported
4, 7, 12.2.3	Substitute approaches for completing audit tasks (manual or other applications also affect IT infusion of an existing application) has influences on the infusion of a particular technology.	Supported	Not tested

Table 12.2A: Summary of findings (Continued)

### **12.2.1 IT infusion**

IT infusion is defined as the degree to which IT has penetrated a firm in terms of importance and impact. In practice, IT infusion focuses on how an organization uses IT to the fullest potential to support their work. IT infusion could be viewed and measured through extended use, integrative use, and emergent use. Extended use is the extent to which the technology has been integrated into organizational work. Integrative use is the extent to which the technology increases the interconnectedness of the organizational workflows. Emergent use is the application of IT to a process or task that could not previously have been performed without the availability of technology. These dimensions form the concept of IT infusion. Viewing the IT infusion through three pathways of use allowed this study to deeply understand and fully integrate the most important dimensions into a new measure. Table 2.1A summarizes the most important dimensions of IT infusion from prior studies. In addition, research on IT infusion should consistently apply the same definition. Different definitions lead to different



measures and might yield different results. The fullest potential use must be defined as the fullest potential use within the industry. An industrial benchmark allows future research at an organizational level of analysis to be comparable.

### **12.2.2 IT infusion measure**

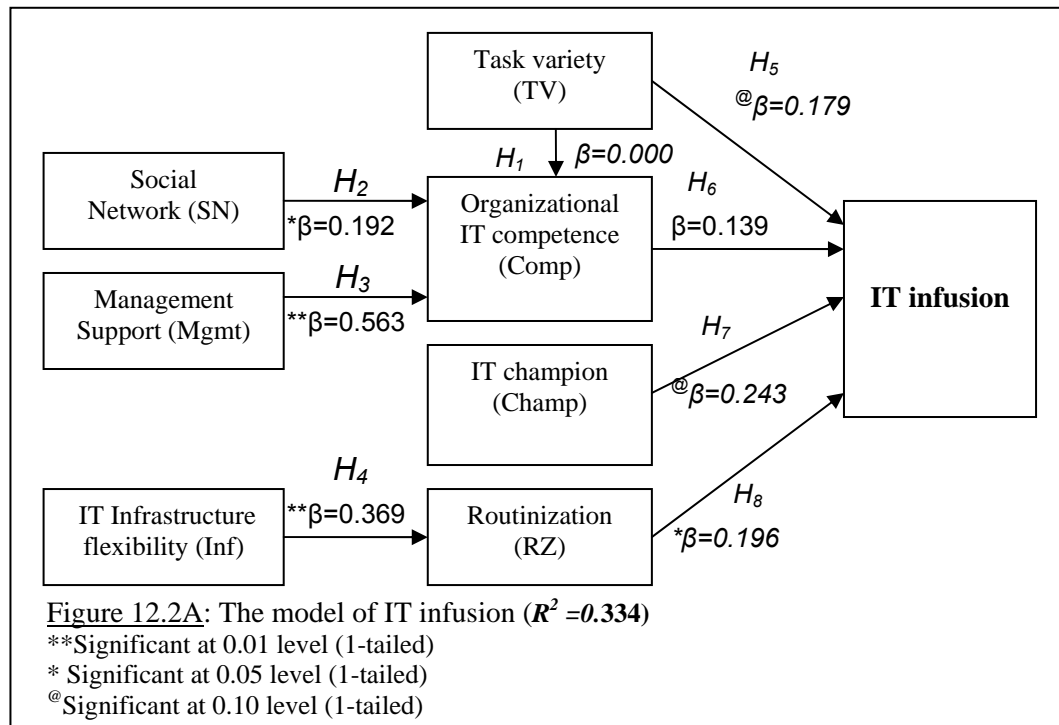
Applying the concept of task complexity through the three pathways of use, the new measure tapped into all important IT infusion dimensions and yielded a range of scores enabling a statistical analysis. As seen in Chapter 5-6, firms included in the case studies showed infusion scores from four to eighteen based on formative indicators of three pathways of use. The range allowed this study to map IT infusion enablers to relevant levels of IT infusion. This evidence gave an in-depth understanding of IT infusion enablers during the organizational IT infusion process. The break-down score from the three pathways of use also gave additional information on the area that organizations should work on to move ahead in the infusion process.

The survey results showed that the average IT infusion score of the samples (Section 9.2) was 17 out of a possible score of 35 (extended use=9, integrative use=7, emergent use=1). The wide range of infusion scores indicated that the samples exhibited various infusion levels and enablers that could be analyzed statistically. This also indicated that most of the firms were approximately half way through the infusion process. These firms focused on task-IT integration (extended use); however, most of them still think of spreadsheets as assisting tools and hardly think of the strategic use of spreadsheets.

### **12.2.3 The model of IT infusion enablers**

The IT infusion enablers were identified from a series of case studies. The enablers included availability of IT infrastructure, staff/organizational IT competence, training, external support, task variety, availability of IT champion and external networks, characteristics of the IT (e.g. relative advantage), and the implementation process. Additional IT infusion enablers were found to affect individuals' behavior. Those are staff self-efficacy, attitude, and motivation. The organizational-level IT

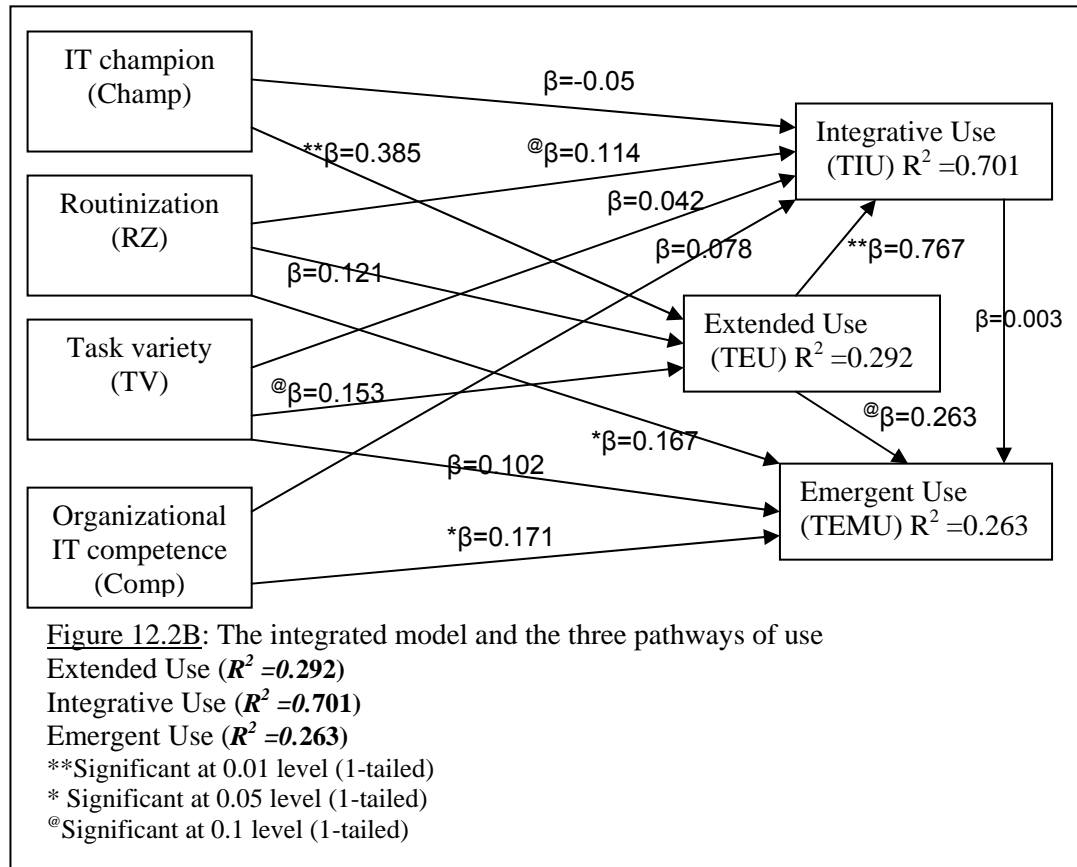
infusion enablers (hypothesis 1 to 8) were tested using survey questionnaire. The tested models (from Figure 11.4A and Figure 10.3H) were reproduced as Figure 12.2A and 12.2B.



### 12.2.3a Training, management support, organizational IT competence, and IT infusion

The evidence from the case studies showed that staff IT competence was one of the most important factors. It was recognized not only as an IT infusion enabler that helped firms reach the current level of infusion but also as an inhibitor that hindered firms from advancing the IT infusion. Training, especially training which combines IT knowledge with work procedure, was claimed to help staff members to advance in the use of spreadsheets. Training was also recognized to have an effect on staff's attitude toward technology. Being consistent with the case studies the structural model showed that training, which was a part of management support, was found to be positively related to organizational IT competence. Management support in terms of encouragement and user satisfaction was also associated with organizational IT competence.

Even though the structural model did not show a significant relationship between organizational IT competence and IT infusion, it did show the relationship between the competence and emergent use which was a part of IT infusion.



### 12.2.3b Social network, organizational IT competence, and IT infusion

The case analysis was consistent with existing literature about knowledge acquisition in small firms. Small firms rely on external supports such as external consultants, professional institutes, and academic institutes (Thong et al., 1996; Jonhston and Linton, 2002). The evidence from the case studies showed that the presence of an external consultant would contribute to IT competence if and only if a knowledge transfer process was established between the external consultant and the organization. However, most firms had inappropriate intermediaries who served in the social network. The intermediaries were mostly lacking in IT competence. They could not facilitate the knowledge transfer process among social networks. The structural model also confirmed that social networks are positively

related to organizational IT competence. The relationship between the organizational IT competence and emergent use also implied that social networks were an effective source of IT competence for firms at a higher level of infusion.

#### *12.2.3c Task variety and IT infusion*

Evidence from the case studies and structural model supported the proposition and hypothesis on the positive relationship between task variety and IT infusion. However, the relationship between task variety and organizational IT competence was not significant.

#### *12.2.3d Perceived self-efficacy, attitudes and motivation toward IT, and IT infusion*

The case analysis indicated that staff self-efficacy and attitudes and motivation toward IT contributed to IT infusion. The self-efficacy was important when the technology was generic. The use of IT involved an application to suit personal ways of completing tasks. Some users who had less IT skills did not use the technology. These users included senior partners and managers whose tasks involved complex decision making which shows a higher level of infusion. However, they were forced to use IT when they found it easier and more efficient.

#### *12.2.3e IT Champion and IT infusion*

The case analysis indicated an IT champion was one of the most important IT infusion enablers. The case evidence also emphasized the IT champion's competence. The analysis indicated that it was more effective for the management to take an IT champion role instead of supporting someone else to play the role. The structural model showed support for positive relationship between IT champion and IT infusion in terms of extended use and integrative use.

### *12.2.3f IT infrastructure flexibility, routinization, and IT infusion*

The case analysis identified infrastructure as a prerequisite for routinization. The structural model showed a positive relationship between IT infrastructure flexibility and routinization. Routinization was included in the model based on claims made in prior studies. However, the case analysis did not identify it as an IT infusion enabler. The structural model, on the other hand, was consistent with prior studies. Routinization yielded the most significant positive relationship through integrative use.

## **12.3 RESEARCH CONTRIBUTIONS**

This study makes three important theoretical contributions to IS/IT management literature. The first contribution arises from the synthesis of the IT infusion definition. The synthesis helps provide future studies with an in-depth understanding of IT infusion and its dimensions. It also promotes the comparability among IT infusion measures in future studies. Another significant contribution is the new measure of IT infusion which incorporates the concept of task complexity in order to tap the most important dimensions of IT infusion. The measure not only yields a reasonable range of scores that can be used for a statistical analysis but can also be applied to any study context based on the task complexity concept. The last contribution of this research is the model of IT infusion which is based on a grounded study in a real business setting which has never been conducted in any other study. The research identified several new IT infusion enablers which were related to the infusion process in organizations.

### **12.3.1 The synthesis of IT infusion definition for future research**

This study pointed out two important issues in prior research. The first issue was the lack of a definition of what IT infusion was. The second issue was what the fullest potential use was defined in terms of IT infusion. One of the key contributions of this study is to address these issues and propose a proper way of viewing IT infusion which future research can use as a guideline. The unification of the IT infusion definition also promotes the comparability of IT infusion studies.

The first issue was addressed by synthesizing the dimensions of definitions given in the previous studies on IT infusion as shown in Table 2.1A. This study found that IT infusion was defined at two levels. The conceptual level focused on the importance of IT to the organization (Sullivan, 1985) and the second level focused on the use of IT (Coopers and Zmud, 1990; Zmud and Apple, 1992; Jones et al., 2002; Sundaram et al., 2007). However, these two levels overlapped. Ultimately, the organization reaches the infusion stage when it uses IT to its fullest potential to support organizational work and the IT becomes a part of the organization's business strategies. This study also found out that the best way to understand IT infusion was viewing it through three pathways of use; extended use, integrative use, and emergent use (Saga and Zmud, 1994).

The second issue was addressed by reviewing how prior studies measured IT infusion and how prior studies defined the fullest potential use of IT. There were two approaches. The first approach referred the fullest potential use to the perception of the users. The researchers asked the user to rank their use relative to their own perceptions of how the technology can be use to the fullest. Scholars who used this approach include Jones et al. (2002) and Sundaram et al. (2007). Even though this approach directly transformed the definition into practice, it was subjective and it raised a question about the comparability of IT infusion levels ranked by the users. For example, a user who might understand that the technology has two features and used one might rank himself/herself as 50% use while the user who knew that there were ten features in the same technology and used three features might rank himself/herself as 30%. In this case, the second user used IT at a higher level than the first user but rated himself/herself as comparatively low use. This indicated the discrepancies between the real use and the perception of use. As shown in Figure 2.1A, the second approach also posted a few issues in itself. Prior studies relied on the literature, experts, software designers, or the scholar him/herself to define the point where the fullest potential was reached. Some used IT features and some used organizational work tasks as guidelines. However, the fullest potential use defined by the experts, literature, and software designers might not be suitable for a particular type of organization. Where the scholar defined the fullest potential use him/herself, it was not possible that the scholar knew all the

possible features and all tasks in the organization. Therefore, this study proposed that the fullest potential use should be defined using a combination of experts and practitioners as guideline under a real business setting. The evidence from a pilot case study (which was the biggest local audit firm in Thailand) was used to develop the concept of fullest potential. In conclusion, this study overcame the barrier of comparability among sites and research on IT infusion by defining the fullest potential use as the fullest potential use in the industry.

### **12.3.2 The application of task-complexity concept to measure IT infusion**

One of the most important issues in IT infusion studies was that there was no valid IT infusion measure at an organizational level of analysis. Prior studies used three or four discreet levels of use to justify the organizational infusion level. These measures might account for the insignificant statistical relationships formed in most studies. The narrow range of existing measures also made it hard for future research to apply sophisticated quantitative analysis to study IT infusion.

This study contributed significantly in this area by developing an IT infusion measure that yielded and distinguished a reasonable range of IT infusion levels. In addition, the new measure could be used at an organizational level of analysis. The application of task complexity concept not only tapped into all important dimensions of IT infusion, but can also be applied to any research contexts.

### **12.3.3 The in-depth investigation and the process approach for studying IT infusion enablers**

Unlike other studies, this study started with a grounded investigation of IT infusion in real business settings. This approach has two main advantages. It not only serves the objective of identifying missing IT infusion enablers, but also gives an in-depth understanding of how the infusion process takes place and evolves over time. The qualitative approach also helps explain the model constructed based on the real business data rather than guessing the possible explanation from the supported and unsupported hypothesis.

From the in-depth investigation, IT infusion enablers were mapped to the appropriate infusion process using a series of case studies. The process approach enabled the study to identify staff IT competence, training, IT infrastructure, and external support as enablers that should be provided at an early implementation stage. The process-approach investigation also indicated that once an organization passed this stage, management should focus more on other enablers such as other individual behavioral factors (self-efficacy, attitude, and motivation), providing time and other resources, and social networks. Emphasizing wrong IT infusion enablers at the wrong stage may not benefit the organization. For example, promoting social network at an early stage may not bring in knowledge especially if the staff who participate in the network are not competent.

The investigation also explained that some enablers had to be managed in a particular way for the IT implementation process to be a success and reach infusion. For example, an IT champion should be the person who participates in the social network. In addition, the management who played an IT champion role contributed more to IT implementation success than an IT champion with appropriate support from the management because the management may not know what kind of support the IT champion really needs.

Another factor that influenced IT infusion was how an innovation had been implemented in the organization. The analysis of case studies identified the innovation-value-chain approach (Hansen and Birkinshaw, 2007) the most effective. Traditional approaches, such as centralized and decentralized approaches, were less effective.

#### **12.3.4 The support for the research model**

Overall, the investigation provided considerable support for the research model. In particular, the research findings focused on IT infusion enablers at an organizational level of analysis. This research, therefore, extended prior research that focused on one single factor (e.g. Cooper and Zmud (1990) on task-technology compatibility, Jasperson (1999) and Moore (2002) on individual-level factors). The enablers focused on in this research were task variety, social network, management



support, organizational IT competence, IT champion, IT infrastructure flexibility, and routinization. This research also extended the previous work of Saga and Zmud (1994) which proposed the three pathways of use as reflective indicators of IT infusion. An extended investigation on three pathways of use also yielded a considerable amount of support for IT infusion enablers. Table 12.3A summarizes the contribution of the IT infusion enablers at an organizational level of analysis in the research model.

IT infusion enablers	Prior studies	The contribution of this study	Note
Task Variety (H <sub>1</sub> )	None	Not supported	
Social Network (H <sub>2</sub> )	None	Supported by both qualitative and quantitative data	The case analysis also indicated social networks as an IT infusion enabler.
Management support (H <sub>3</sub> )	Saga (1994)	Supported by both qualitative and quantitative data	The case analysis also indicated how management should intervene at various levels of IT infusion.
IT infrastructure flexibility (H <sub>4</sub> )	Eder and Igbaria (2001)	Supported by both qualitative and quantitative data	The relationship was found through routinization which was not tested in prior studies.

**Table 12.3A:** The contributions of the study to the existing literature

IT infusion enablers	Prior studies	The contribution of this study	Note
Task Variety (H <sub>5</sub> )	None	Supported by both qualitative and quantitative data  Task variety was related to extended use.	
Organizational IT competence (H <sub>6</sub> )	Partially supported by Saga (1994)	Supported by qualitative data. Quantitative data showed the relationship with emergent use.	Saga only focuses on ability to reconceptualize tasks via IT and did not state the part of IT infusion that the factor affected.
IT champion (H <sub>7</sub> )	None	Supported by both qualitative and quantitative data. Additional test indicated the relationship with extended use.	Additional data indicated how an IT champion should be incorporated.
Routinization (H <sub>8</sub> )	Assumed by Cooper and Zmud (1990) and Zmud and Apple (1992)	Supported by quantitative data. Additional test indicated the relationship with integrative use.	Prior studies assumed routinization as an IT infusion enabler but they did not fully test it.

Table 12.3A: The contributions of the study to the existing literature (continued)

IT infusion enablers	Prior studies	The contribution of this study	Note
Staff self-efficacy Management/ staff attitude and motivation Implementation process	Jaspersen (1999) and Moore (2002)  However, they did not focus on an organizational level of analysis.	Supported by qualitative data.	The individual level factors were important for research on small and medium enterprises.

**Table 12.3A:** The contributions of the study to the existing literature (continued)

### 12.3.5 The multi-methodology in IS research

This research was designed as a linear combination of qualitative and quantitative studies, unlike other studies which focus on one or the other approach and use the rest to support the results (Creswell, 2003). This research conducted two full studies, both qualitative and quantitative. The samples included in the qualitative studies were excluded from the quantitative analysis. This approach enables the study to confirm the consistency of the qualitative and quantitative research results. In addition, the in-depth qualitative investigation helps explain the quantitative study instead of making speculative interpretations like those offered by a single research approach.

The full qualitative research also gives a complete perspective of how a research can be practically applied to a real business setting. The development of a quantitative research instrument was also focused on a real application rather than an abstract indicator.

## **12.4 IMPLICATIONS FOR PRACTITIONERS**

For practitioners, the research findings highlight the importance of IT infusion enablers and how they can be managed in order to reach the highest potential use of IT. Using a process approach, the following suggestions are offered as examples of how to manage organizational resources that might be useful for encouraging the fullest potential use of technology within the organization.

### **12.4.1 An early implementation stage**

At an early implementation stage, organizational factors are the most important. The management should provide support in the form of training and basic IT infrastructure. The main purpose of training is to increase organizational IT knowledge and skills and to provide a positive attitude and motivation toward the technology. The goal of the early stage is to diffuse the technology to all staff members and existing work tasks. Since work tasks are divided among staff members, providing training to all staff members increases the chance of integration, and therefore, infusion. Training should be provided in the form of task-integration rather than in a form of basic IT skills. An external support could be brought in for training purposes, but the management should make sure that external support can bring in the task-technology integration knowledge, not the technology knowledge alone.

Not only should necessary IT resources or infrastructure be provided, but also the flexibility for future use should be considered. The availability and flexibility will increase the users' intent-to-use behavior. The staff members need to make sure that the resources are there before they rely on the resources. Once the staff members get used to using IT in their work, the technology has lost its identity as an innovation and become routinized in the organizational work process (Rogers, 2003). Providing IT infrastructure does not necessarily contribute directly to IT infusion but it is required as a prerequisite for routinization.

### **12.4.2 An expanding stage**

During the early stage of implementation, technology is integrated into existing work tasks. In the second stage, the goal is to expand the use of technology into more comprehensive tasks. This indicates an advance in the infusion process or extending the use of technology. The number of tasks somehow limits the extended use and infusion process. Therefore, the management should seek a variety of tasks. For example, in professional firms, a variety of clients and cases provides a variety of tasks. Within a firm, the job rotation strategy may also help individuals to be exposed to more task variety. They can either extend their uses by learning what other staff members who are part of the organizational process do or by learning new tasks. Once they learn the overall picture of the work process, they can adjust their uses of technology accordingly to promote the overall effectiveness and efficiency of the work process. In addition, promoting task variety within the firm helps establish the work flows among tasks (integrative use).

### **12.4.3 An advanced stage**

In an advanced stage, an organization seeks to use the technology to the fullest potential within the particular organization. In order to reach an advanced stage, the management should facilitate the use of technology until it becomes routinized in the organization. For example, the management may establish standard work procedures that integrate the technology. Once the technology has been routinized in the firm there is a new opportunity for use especially the uses that exist because of the link between work flows and database. In professional firms where staff turnover is one of the major problems, establishing standard procedures helps integrate knowledge and skills to the system and procedures, not to individuals.

Another important issue at this stage is that an organization tries to seek its own adaptation of technology in order to fully benefit from it. An organization with IT champions may be superior to those that have no champion since IT champions are people that get technology investigated. They seek advanced uses. However, the champion needs full support from the management in terms of resources for self-

study, time for task-technology investigation, and authority to challenge other members of the organization to use the technology. In an organization where the management has a personal interest in technology, the management should play the role of IT champion himself/herself. This is believed to have a psychological effect on staff members. In addition, the process of routinization and infusion can be faster since the IT champion, who also has full authority, can push forward the implementation right away.

Since IT champions as individuals play important roles in advancing the use of technology, factors that influence IT implementation at an individual level must be considered. The management should challenge and motivate the champions and other staff members. The management should also provide resources and time. Providing opportunities for them to learn and study from internal and external sources is also essential.

#### **12.4.4 An infusion stage**

It is noted that the fullest potential use within the organization does not mean the fullest potential use of technology. An organization may limit “the fullest potential use” to the satisfied level of use. At this level, the organization is satisfied with how IT has been used even though IT can be used to a higher level. In addition, the organization views the fullest potential use with the limitation of its knowledge about the technology. The management should seek or encourage the champion to seek information from external sources. This research shows that there are two external sources that help the organization develop its knowledge toward the fullest potential stage of the technology. The first type is social networks among companies in the same industry. The second type is professionals, research, and academic bodies.

The social networks among companies or competitors in the same industry not only encourage knowledge sharing, but also give an opportunity for resource sharing. For example, this research explained how firm networks were established in order to develop a more sophisticated use of spreadsheets for decision making. The

second type of social networks includes professionals, research, and academic institutes. These institutes gather all the researchers and innovators in the industry. They investigate and advance the use of technology as part of their careers. Therefore, an organization should participate with those institutes. For example, an organization may participate in training or research conducted by academic institutes regularly.

As discussed earlier, management should be aware of a person who represents and serves as an intermediary in the social networks. An intermediary who is not competent cannot bring in the knowledge to the organization effectively. An IT champion who is competent is the most desirable.

#### **12.4.5 Implementation process**

An implementation process is also very important. Traditional views of the implementation process are either the top-down or bottom-up approach. Both approaches have different advantages and disadvantages. While the bottom-up approach seems to get more people involved, and therefore is widely accepted by users, the approach is hardly synchronized and lacks an overall perspective. In addition, as discussed earlier, this approach has IT knowledge attached to individuals and the use of IT is discontinued when the individuals leave the firm. Therefore, the management should have a strategy to incorporate or routinize the use in this case. Meanwhile, the top-down approach which focuses on the overall perspective of the organization may be hard and may take a long time to implement.

This research recommends the innovation-value-chain approach (Figure 7.2D). Knowledge sharing, as explained in 12.4.4, can also be done internally. The approach combines advantages of the top-down and bottom up approach by first seeking innovations or ideas within the units, combining them, and obtaining additional knowledge from external sources before implementing them into the organizational routines (as shown in the case Firm E). This approach not only gets both users and management involved so that they are comfortable with the new

use, but it also brings in external knowledge with less resistance from the organizational members.

## **12.5 LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH**

The present research has some limitations, as with any other research, which emanate primarily from its research design, methodology, and results. Therefore, results from this study should be interpreted with caution keeping the limitations and shortcomings of the present research in mind.

### **12.5.1 Contextual constraints**

This research was conducted as a context-specific study. The first limitation lies upon the generalizability of the research (generalizability defined in the usual sense of generalizability to other businesses and other technological applications). Small audit firms in Thailand were chosen in order to control task variability and some organizational characteristics and to focus on other manageable organizational enablers. In addition, a generic application, a spreadsheet, was used as the subject technology. Even though the research is considered industry-specific, the results of the study can be applied to other professional organizations, such as legal firms and medical practices. This research implication may not be applicably generalizable to a large corporation, other computer application, or business environment in other countries. Further considerations of the research application for business practices are required. However, the preliminary results from testing several research instruments with audit firms in New Zealand yielded slightly different results. New Zealand audit firms were found to be relatively small compared to Thai audit firms, had less task variety, and had less technological usage due to a smaller number of clients. Future research can study IT infusion in different contexts; such as in large organizations, in other industries, in other countries, or using different subject software.



## **12.5.2 Research design**

### *12.5.2a Nature of the research process*

Since this research involves a cross-sectional research design, especially the survey, the research provides only a snapshot of the organizational processes that takes place over the extended period of time. Even though the case studies approach provided an in-depth investigation of the implementation process and the use of technology, all data and variables were still subject to the memory and recall bias (Alwin, 1977) of the respondents. However, it was believed that the multiple methods of data collection helped mitigate this weakness to some extent. As suggested by Chin and Marcolin (2001), future research in IT implementation should focus on a longitudinal approach for exploring the IT infusion process.

### *12.5.2b Case studies*

Even though this research made the best effort to have at least two investigators during the data collection process as a good guideline of doing a rigorously positive case study research (Eisenhardt, 1989; Dube and Pare, 2005), at least half of the data collection process was done by a single investigator – this researcher – under the guidance and direction of his dissertation supervisors. Future research studies should overcome this limitation by having multiple investigators on the research team.

### *12.5.2c Survey instrument*

There are some limitations on the instruments that were use in the present research. Even though this research followed Zmud and Kraemer's (1992) guideline by adopting well-developed instruments from existing literature as much as possible, there were some new constructs developed and validated in the present research. While this was done following the guidelines provided in the literature concerning development and validation of measures and scales, it was not the primary goal of this research. Therefore, results of this research should be interpreted with caution as there might be potentially confounding effects, as were detected and discussed in section 10.1. Future research should focus on further development and validation of

scales and measures for those constructs where validated scales are not currently available.

One concern about measuring dependent variables is a high correlation between IT champion and organizational IT competence construct. Even though several techniques were used (section 10.1.3) to ensure that there was no collinearity issue, the high correlation may explain why organizational IT competence did not yield a significant relationship to IT infusion. Meanwhile, a positive relationship was found between an IT champion and IT infusion through extended use and integrative use indicators. This may be the case for small business research where an organizational IT champion represents the organizational IT competence himself or herself. Future research should focus on separating these two constructs in order to find separate effects of these IT infusion enablers.

#### *12.5.2d Target respondents and respondents' bias*

Like other existing studies, this research collected data mainly from the target respondents – the person who was the most familiar with the technology. The assumption was made that the infusion of technology of these individuals represented the firms' IT infusion. This bias in target respondents was substituted by the multiple-method data collection during the qualitative study. The qualitative study involved interviewing three different-level auditors in each firm, reviewing audit work papers, and observing how auditors use the technology (where possible). Since the survey questionnaire results were drawn from the sample that excluded the case firms, this research exhibits similar shortcomings in survey response bias as with other studies.

#### **12.5.3 Sampling constraints and non-response error**

In this research, the interpretation and estimation of the research findings and the ability to generalize from a sample to a population was limited by the representativeness of the samples. Dillman (2007) explains the possible constraints and error in survey research as sampling errors. Sampling errors may derive from

coverage error and non-response error. The coverage error results from every unit in the survey population not being known. Therefore, some may not be included in the sample. Non-response error can be explained as the non-response questionnaires are different from response questionnaires in a way that is relevant to this research.

Even though this research set up an appropriate procedure (see Section 9.1) in order to minimize coverage error by scoping the population using the definition of organization, it is likely that the samples may not cover the whole population due to the nature of the audit environment in Thailand. For example, there are several audit firms which do not have full time auditors. On the other hand, there are several auditors who work for several firms.

The non-response error is another important issue posing a limitation to most mail surveys. Unless the response rate is 100 percent, the potential for non-response bias will always exist regardless of how carefully the initial sample was selected (Shaughnessy and Zechmeister, 1991). In this research, even though the best efforts were made to maximize the number of returns, approximately 42 percent of the total number of achievable returns were received. Further actions were made in order to reduce non-response error as discussed in Section 9.1.3.

#### **12.5.4 Implications for future research**

This research went back to the origin by qualitatively identifying the IT infusion enablers from real business settings. The results showed that there were many missing enablers that have not been identified or examined. Since this research focused on an organizational level of analysis enablers, some identified factors were not included in the model testing leaving room for future research. Future research opportunities are listed as follows.

1. Future research can investigate IT infusion enablers identified by this qualitative study, but have not yet been statistically tested. Those enablers include staff self-efficacy, staff motivation, staff attitudes, and management attitudes.

2. In addition to individual enablers identified in this research, there are no qualitative studies focusing on IT infusion at individual level of analysis. Existing studies (e.g. Saga, 1994; Jones et al., 2002; Sundaram et al., 2007) were conducted using a quantitative approach.
3. As suggested by Chin and Marcolin (2001), future researchers should extend the study time frame and examine this topic longitudinally.
4. In order to overcome contextual constraints, future research can be done in different context such as different industries, cultures, and subject software.
5. The development of the new IT infusion measure in this study is at an early stage. Future research should investigate validity of the measure in a larger scale.
6. Further investigation is also needed to explain the gap between the IT infusion measure developed in this research and global measure.

## **12.6 CONCLUSION**

IT infusion is one of the dimensions of IT success. IT infusion refers to the process by which an innovation or IT is used to the fullest potential within an organization. Where an organization's understanding of how other organizations use IT (IT competence) is limited, the organization may use IT to the level of organizational satisfaction, but not the fullest potential use of technology. The stage of fullest potential use (an infusion stage) is determined by the best use in the areas or industries. This research synthesized the IT infusion definition, identified the missing IT infusion enablers, and proposed an alternative approach to measure IT infusion. Combining qualitative and quantitative approach, this research is able to uncover the organizational infusion process and related IT infusion enablers. The enablers, such as task variety, IT champion, and routinization play important roles during the organizational infusion process.

Although many individual-level IT infusion enablers have not been tested, this research takes an important step toward modeling IT infusion in small businesses. The identified enablers leave plenty of room for future research. This research also

adds into the literature a new measure of IT infusion that calls future research to extend and validate the measure in other contexts.

## APPENDIX A – INTERVIEW PROTOCOL

### Interview schedule

---

Firm: \_\_\_\_\_

Location: \_\_\_\_\_

Interviewers: \_\_\_\_\_

\_\_\_\_\_

Interviewees: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Date/Time: \_\_\_\_\_

---

#### **1. Introduction of the interviewers**

My name is Dichapong Pongpatrachai. I am a Ph.D. student in Accounting, Finance and Information Systems Department, University of Canterbury.

#### **2. Introduction of the study**

I am currently conducting a study with the intention in finding factors that help organizations achieve a higher level of use of technology in order to support the work.

#### **3. Basic questions**

Could you please tell me about your audit firm, profile, services provided, clients, staff, firm structure, IT supports, trainings, etc.?

#### Follow up:

Could you please tell me about yourself, e.g. your rank, your responsibilities within the firm?

#### **4. Use of spreadsheets and measuring infusion.**

4.1 Approximately, how long have you been using spreadsheets to support audit work?

4.2 Could you explain how your firm currently uses spreadsheets to support audit work?

Action: Show a picture of broad audit process and ask the interviewees (Figure 4.2A).

Referring to the auditing process, how does your firm use Excel?

4.3 What audit procedures do you think could not be done without spreadsheets? Please give some example. How would you have performed those tasks in the past?

4.4 What else could your firm be using spreadsheets for that your firm does not currently use?

Why? What could have helped your firm to do that?

4.5 What do you see as your next step in your firm's use of spreadsheets? How does your firm plan to do so?

#### **5. Factors/ Inhibitors of IT infusion**

5.1 What have been major changes in the use of spreadsheets since it has been introduced? When did this happen? How did this happen?

Probes: If there has been no change, why has it not changed?

5.2 What has helped and/or would help your firm use spreadsheets to their fullest potential *to support audit work*?

Follow up: Based on your discussion a) b) and c) to n) are considered the factors. Of these factors, which of these do you think are the most important?

- 5.3 What has prevented or hindered your firm from *achieving the higher level of use of spreadsheets in audit work*? And how do you think these barriers would be resolved?

6. **Conclusion and end of discussion**

- 6.1 Based on our discussion, if you could change anything, what would you change in order to make better use of spreadsheets?
- 6.2 Is there anything else that we have not mentioned that you would like to add?



## **APPENDIX B – THE SURVEY INSTRUMENT**

### ***A Survey of Spreadsheet Use in Local Audit Firms<sup>1</sup>***

***Please address this survey to an auditor who is most familiar with spreadsheet use in your firm.***

My name is Dichapong Pongpatrachai. I am a Ph.D. student in Accounting, Finance, and Information Systems, at University of Canterbury, New Zealand. My dissertation involves investigating how local audit firms can make better use of spreadsheets within audit work. This survey is an important part of a study to assist local audit firms to use technology to the fullest potential.

Your participation in this survey will be a valuable contribution to this study. Your input is very important. Your response will be treated confidentially. No identifying information gathered in this study will be retained or released to any organization, the public or other researchers.

Completion of the questionnaire and its return by 15 September 2008 would be greatly appreciated.

Thank you for your assistance.

Dichapong Pongpatrachai

---

<sup>1</sup> This appendix was reproduced to suit the required margins of thesis format. The actual survey was formatted as 14 pages questionnaire printed on A5 papers. This study followed Dillman's (2007) guidance about a suitable format of survey questionnaire.

***Instructions***

Please endeavor to answer each question as accurately as possible. There are no “right” or “wrong” answers to any of the questions. Please respond based on your current knowledge of the topics. If you find it difficult to determine your exact answer/response, please give your best estimate.

This questionnaire contains 29 topics/questions and should take no more than 20 minutes to complete. Specific instructions precede each section of the questionnaire. If you wish to comment on any of the questions or qualify your answers, please feel free to use the space at the bottom of each page or at the back of this questionnaire.

**Part I: Please select or fill appropriate answers to the following questions**

1. *Please indicate by circling the number of (full-time) staff in your firm.*
  1. Less than 5
  2. 6-20
  3. 21-50
  4. 51-80
  5. 81-150
  6. 151-220
  7. 221 or above
  
2. *Is your firm allied with (an) international firms? Please circle 1 or 2.*
  1. Yes
  2. No

3. *Our firm has been using spreadsheets in audit work for approximately\_\_\_\_\_ years.*
4. *Please select one of the following statements that best describes the use of spreadsheets in your firm by circling 0, 1, 2, 3, or 4.*
- 0. We do not use spreadsheets for audit work.
  - 1. Spreadsheets are used to assist audit work.
  - 2. Spreadsheets are used to improve the efficiency of audit work.
  - 3. Spreadsheets have allowed us to use new audit approaches that could not have been done manually.
  - 4. Spreadsheets are a strategic tool for creating competitive advantage for the firm.

**If your answer to question 4 is “0” – “We do not use spreadsheets for audit work”, please skip pages 3-12 and continue your response in Part V**

Part II: Please read the descriptions below which relate to Questions 5-8.
--

***Descriptions: Levels of task complexity***

<b><i>Low</i></b>	Spreadsheets are mainly used for evidence recording purposes. <b>Very basic calculations may be found.</b> Very few complex or cell references are used. In the audit reporting phase, spreadsheets are used for preparing financial statements in order to compare with the ones prepared by clients.
<b><i>Moderately low</i></b>	Spreadsheets are mainly used for evidence recording and calculating purposes. <b>Some functions and cell references are used.</b> In the audit reporting phase, figures are calculated and cell references are used.
<b><i>Moderately high</i></b>	Spreadsheets are <b>developed to gather data for risk assessment.</b> Some <b>complex features and functions may be used</b> to test account balances. Spreadsheets may be used to perform data mining. In the audit reporting phase, complex features and functions may be used to assemble advanced financial statements (eg. cash flows statement, consolidation) for comparison purposes to the clients' financial statements.
<b><i>High</i></b>	Spreadsheets are <b>developed as an automatic module.</b> For example, spreadsheets suggest an appropriate audit program and sample size from the risk assessment results, automate work papers by automatically grouping accounts from client's trial balance, provide templates for solution (eg. tax calculation, loan amortization), and/or suggest an appropriate type of audit report and/or disclosures.

Using the descriptions above, please select the level of complexity that best indicates the most complex use of spreadsheets in your firm for each of the four audit phases. (Please circle only one for each audit phases).

	<i>(Record) Not used</i>	<i>(Calculation) Low</i>	<i>(Modeling) Moderately Low</i>	<i>(Making decision) Moderately High</i>	<i>High</i>
<b>5. Audit Planning</b>	0	1	2	3	4
<b>6. Control Testing</b>	0	1	2	3	4
<b>7. Substantive Testing</b>	0	1	2	3	4
<b>8. Audit Report</b>	0	1	2	3	4

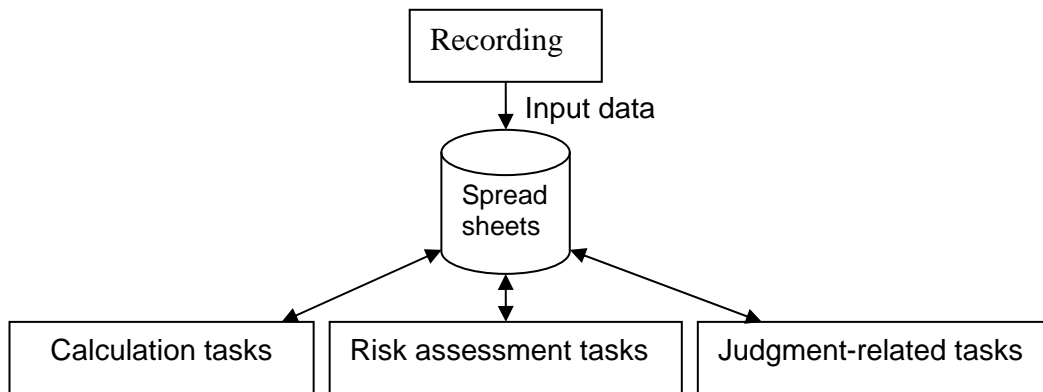
**Part III: Please read the descriptions below which relate to Questions 9-12.**

The use of spreadsheets is expected to promote links within audit work flows. Data is entered into the systems once and is used throughout audit process.

**9. Audit planning:** Please circle yes or no

**Instructions:**

1. If your answer to Question 5 (audit planning) on the previous page is 0 or 1, please skip this page.
2. If your answer to Question 5 (audit planning) on the previous page is 2, please answer question a) only.
3. If your answer to Question 5 (audit planning) on the previous page is 3, please answer questions a) and b) only.
4. If your answer to Question 5 (audit planning) on the previous page is 4, please answer questions a), b) and c).

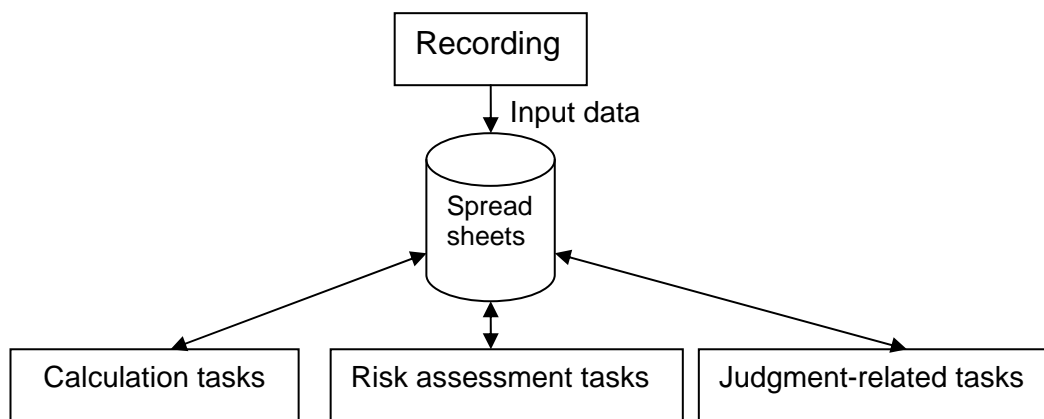


<p><b>a)</b> If your firm uses spreadsheets for calculations (eg. preliminary analytical review), does your firm electronically incorporate previously recorded data to perform calculations during the audit planning phase?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>b)</b> If your firm uses spreadsheets for [inherent] risk assessment, does your firm electronically incorporate previously recorded data and calculated figures to perform risk assessment during the audit planning phase?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>c)</b> If your firm uses spreadsheets for making judgments and suggesting further procedures, does your firm electronically incorporate previously recorded results as inputs?</p> <p>1. Yes</p> <p>2. No</p>
--	--	---

**10. Control Testing:** Please circle yes or no

**Instructions:**

1. If your answer to Question 6 (Control testing) on Page 3 is 0 or 1, please skip this page.
2. If your answer to Question 6 (Control testing) on Page 3 is 2, please answer question a) only.
3. If your answer to Question 6 (Control testing) on Page 3, please answer questions a) and b) only.
4. If your answer to Question 6 (Control testing) on Page 3 is 4, please answer questions a), b) and c).

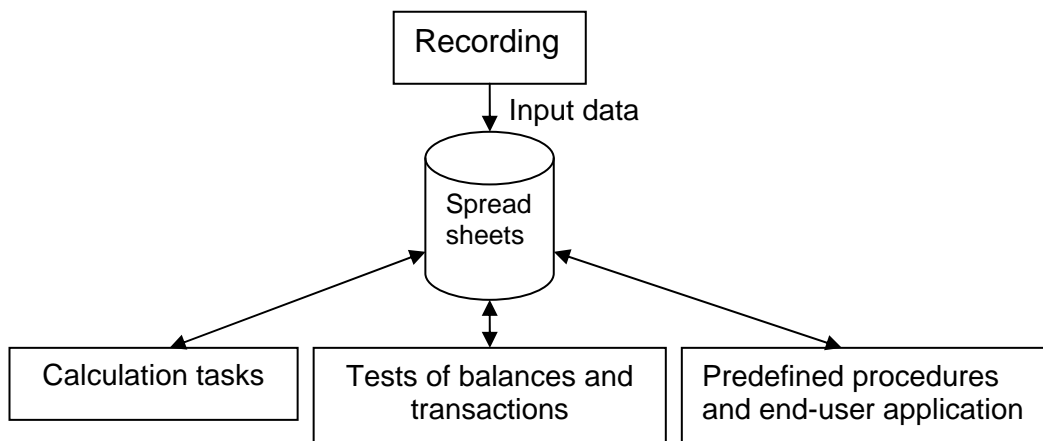


<p><b>a)</b> If you use spreadsheets for calculations, do you electronically incorporate previously recorded data to perform calculations during the control testing phase?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>b)</b> If you use spreadsheets for [control] risk assessment, do you electronically incorporate previously recorded data and calculated figures to perform risk assessment during the control testing phase?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>c)</b> If you use spreadsheets for making judgments and suggesting further procedures, do you electronically incorporate previously recorded results as inputs?</p> <p>1. Yes</p> <p>2. No</p>
--	---	--

**11. Substantive testing:** Please circle yes or no

**Instructions:**

1. If your answer to Question 7 (substantive testing) on Page 3 is 0 or 1, please skip this page.
2. If your answer to Question 7 (substantive testing) on Page 3 is 2, please answer question a) only.
3. If your answer to Question 7 (substantive testing) on Page 3, please answer questions a) and b) only.
4. If your answer to Question 7 (substantive testing) on Page 3 is 4, please answer questions a), b) and c).



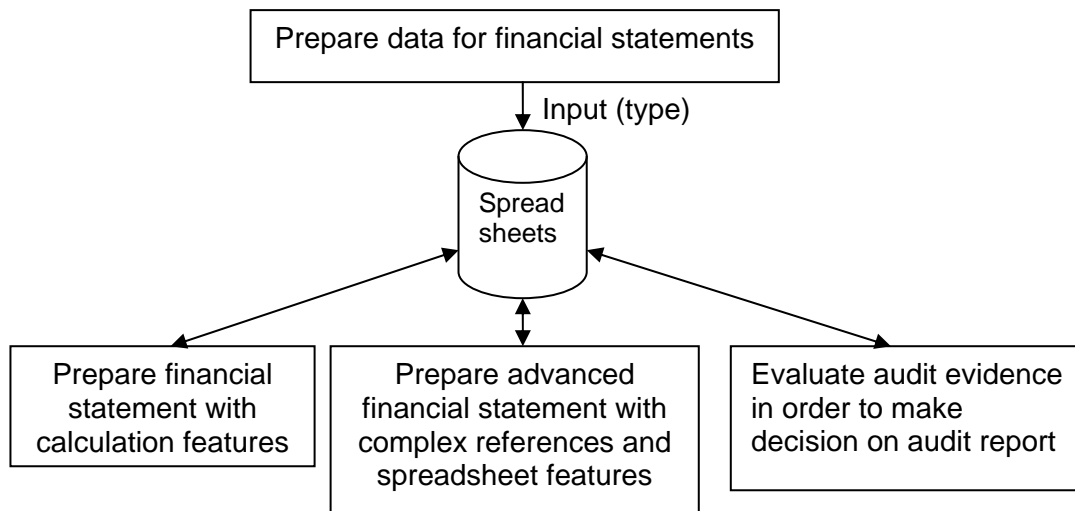
<p><b>a)</b> If your firm uses spreadsheets for calculations, does your firm electronically incorporate previously recorded data to perform calculations during the substantive testing phase?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>b)</b> If your firm uses spreadsheets for testing balance and transactions, does your firm electronically incorporate previously recorded data and calculated figures to test the balance and transactions?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>c)</b> If your firm develops spreadsheets as templates or end-user application, does your firm electronically incorporate previously recorded results as inputs?</p> <p>1. Yes</p> <p>2. No</p>
---	--	---



**12. Audit report:** Please circle yes or no

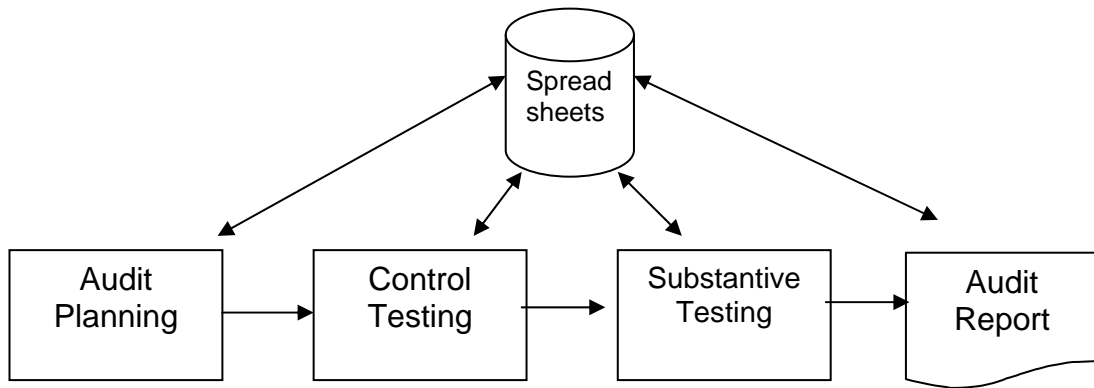
**Instructions:**

1. If your answer to Question 8 (audit report) on Page 3 is 0 or 1, please skip this page.
2. If your answer to Question 8 (audit report) on Page 3 is 2, please answer question a) only.
3. If your answer to Question 8 (audit report) on Page 3, please answer questions a) and b) only.
4. If your answer to Question 8 (audit report) on Page 3 is 4, please answer questions a), b) and c).



<p><b>a)</b> If your firm uses spreadsheets for preparing and integrates calculations into the financial statements, does your firm electronically incorporate previously recorded figures and show results in the financial statements?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>b)</b> If your firm uses spreadsheets for preparing advanced financial statement (eg. statement of cash flows, consolidation) with complex references, does your firm electronically incorporate previously recorded data and calculated figures to prepare the report?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>c)</b> If your firm uses spreadsheets to evaluate evidence and suggest an appropriate audit report, does your firm electronically incorporate previously recorded data as inputs?</p> <p>1. Yes</p> <p>2. No</p>
---	--	--

**13. Four major audit steps:** Please circle yes or no



<p><b>a)</b> Does your firm electronically incorporate data gathered during the audit planning phase to perform tests of control?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>b)</b> Does your firm electronically incorporate data gathered during the audit planning and/or the control testing phases to perform substantive tests?</p> <p>1. Yes</p> <p>2. No</p>	<p><b>c)</b> Does your firm electronically incorporate data gathered during the previous audit phases to prepare financial statements and audit report?</p> <p>1. Yes</p> <p>2. No</p>
--	---	--

**14. Please indicate any audit tasks/procedures that your firm could not have done without the use/existence of spreadsheets.**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

<b>Part IV: Please rate your firm by circling a level of the scale.</b>
---

*Strongly disagree ----- Strongly agree*

**15. Task Variety**

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | Our firm performs a variety of services (eg. statutory, special auditing, consulting).       | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm has a significant number of clients.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Our firm's clients represent many industries (eg. manufacturing, trading, retail, services). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**16. Information Technology (IT) Infrastructure Flexibility**

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | Our firm's IT infrastructure (eg. hardware) is very flexible in relation to future needs.              | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm's IT infrastructure allows staff to share data and knowledge.                                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Our firm's IT infrastructure allows staff to access data from anywhere (within-firm and from outside). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**17. Organizational IT competence**

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | Our firm has sufficient knowledge of all features, functions, and abilities of spreadsheets.        | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm has sufficient knowledge of how to use spreadsheets to perform audit tasks.                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Our firm has sufficient knowledge of how other audit firms use spreadsheets to perform audit tasks. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Please rate your firm by circling a level on the scale**

*Strongly disagree ----- Strongly agree*

**18. Social Network and External Support**

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | Our firm makes regular use of external IT consultant(s).   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm regularly participates and exchanges knowledge and opinions with other audit firms.   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Our firm regularly participates and exchanges knowledge and opinions with <u>institutes other than audit firms</u> (eg. Universities, regulators). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**19. Management Support**

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | The partner(s) actively encourages audit staff to use IT in their daily tasks.                        | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | The partner(s) provides enough IT training and/or time for staff to think of using IT in audit tasks. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | User IT satisfaction has been a major concern of the partner(s).                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**20. Routinization**

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | The use of spreadsheets has been incorporated into the firm's work procedures.          | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | The use of spreadsheets is pretty much integrated as part of normal audit work routine. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | The use of spreadsheets is a normal part of the firm's procedures.                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Please rate your firm by circling a level on the scale**

*Strongly disagree ----- Strongly agree*

**21. IT Champion**

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | In our firm, there are one or more individuals who vigorously and enthusiastically support/promote the use of spreadsheets in audit work. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | In our firm, these individuals spend significant amounts of time investigating/experimenting the use of spreadsheets in audit work.       | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | In our firm, these individuals spend significant amounts of time pushing/convincing other firm members to use spreadsheets in audit work. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**22. *The Infusion of Spreadsheets***

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | <i>Our firm</i> is using spreadsheets to their fullest potential for supporting <i>audit</i> work. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm is using all capabilities of spreadsheets in the best fashion to help us on the job.      | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | There are many better ways for our firm to use spreadsheets to support audit work.                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**23. *Extended Use***

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | Our firm is using spreadsheets in complex ways in audit work.   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | There are many more possible areas in our audit work where spreadsheets can be used.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | The use of spreadsheet software in our firm involves considerable use of pre-saved information, functions, templates or macros. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Please rate your firm by circling a level on the scale**

*Strongly disagree ----- Strongly agree*

**24. Integrative Use**

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | In our firm, audit procedures have been linked by the use of spreadsheets.   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Our firm's users establish work flow linkages with other individuals, where spreadsheets used by one individual directly precedes or follows that by another individual. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | In our firm, spreadsheets are used as common platforms for audit work.   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**25. Emergent Use**

- |    |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|
| a) | The use of spreadsheets enables our firm to perform new audit tasks that were not recognized prior to the existence of the application.   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | The use of spreadsheets enables our firm to perform work tasks that were not feasible prior to the existence of the application.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Some audit tasks could not be completed [either manually or with the use of other applications], if the spreadsheet software became unavailable. [The unavailability could result from a power failure, a system crash or maintenance being performed]. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Please rate your firm by circling a level on the scale**

*Strongly disagree ----- Strongly agree*

**26. IT Impacts**

- |    |  |   |   |   |   |   |   |   |
|----|--|---|---|---|---|---|---|---|
| a) | Spreadsheets have helped us improve audit revenue.                                   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| b) | Spreadsheets have helped us reduce audit time (cost).                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| c) | Spreadsheets have helped increase the quality of our audit services.                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| d) | Spreadsheets have helped us improve client relationships (eg. reduce response time). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| e) | Spreadsheets have helped us improve firm image.                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| f) | Spreadsheets have helped improve firm innovativeness.                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| g) | Spreadsheets have helped improve firm audit processes.                               | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| h) | Spreadsheets have helped us improve staff productivity.                              | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| i) | Overall, the use of spreadsheets has had a significant positive impact on the firm.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| k) | Overall, spreadsheets have made a strong positive contribution to firm performance.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Part V: Please give your additional answers/responses to the questions below**

27. **What has helped and/or would help your firm use spreadsheets to the fullest potential *to support audit work*?**

---

---

---

---

28. **What has prevented or hindered your firm from *achieving the higher level of use of spreadsheets*?**

---

---

---

---

29. **Please state your additional comments (if any) on the use of spreadsheets or other technology in your firm.**

---

---

---

---



## **APPENDIX C – ADDITIONAL RESULTS FROM THE OPEN-ENDED QUESTIONS OF THE SURVEY: IT INFUSION ENABLERS AND INHIBITORS**

This appendix reports additional results from the open-ended question of the survey questionnaire. This include IT infusion enablers and inhibitors. The results showed a combination of individual-level and organization-level of analysis enablers and inhibitors. The analysis of these enablers and inhibitors requires further investigation. Due to the limitation of the survey methodology, this study does not include the analysis of these results. This also leaves room for future research in the field of IT infusion.

### **INFUSION ENABLERS AND INHIBITORS**

Out of 75 responses, 50 firms responded to opened-end questions about infusion enablers and inhibitors. The most common responses are summarized, using framework from the literature, in Table C.1 below. The numbers shown represent the number of responses that claim the enablers or inhibitors

Spreadsheet Infusion Enablers	Spreadsheet Infusion Inhibitors
Relative advantage	
Ability to reduce audit time 13	
Ability to reduce errors in work 3	New form of errors 1
Ability to store and retrieve data 1	
The ability to establish process and enable knowledge transfer (Partly from staff turnover problem) 3	Lack of advanced abilities (eg. data mining) 2
The ability to reduce work procedure 2	
Total 22	Total 3
External factors	
Clients' data – significant amount complex 11	1
Clients' data – compatibility 7	Clients' data compatibility 5
Client's use of complex IT 1	
Clients cooperation 1	Clients do not cooperate 2
Total 20	Total 8
Staff – related factors	
Staff – IT competence 4	Staff IT competence 31
Staff – personal factors (creativity, interests, motivation) 1	Staff have no motivation 1
Total 5	Total 32

**Table C.1:** The survey results – spreadsheet infusion enablers and inhibitors

Spreadsheet Infusion Enablers		Spreadsheet Infusion Inhibitors	
Management support - Training			
Training	5	Lack of training	1
Total	5	Total	1
IT infrastructure			
		IT Infrastructure and investment	4
Total	0	Total	4
Social network and external support			
Academic institutes include spreadsheets in curriculum	1		
Training by academic institutes	1		
Availability of support from expert	1	No support from expert	2
Total	3	Total	2
IT champion			
		Lack of staff who can teach others plus his/her ability to teach and to learn new things	1
Total	0	Total	1
Other factors			
New audit technique has been developed	1	Electricity supply is unstable	1
Total	1	Total	1

Table C.1: The survey results – spreadsheet infusion enablers and inhibitors (continued)

### C.1 Spreadsheet infusion enablers

The most common spreadsheet infusion enablers (Figure C.1) include relative advantages of spreadsheets in reducing audit time, reducing errors, and their ability to establish work procedures. The second key enablers are client related. These factors cannot be controlled. Amount of clients' transactions and systems compatibility are major concerns.

Other important enablers include staff IT competence which is claimed that can be improved by training and availability of external support and social network.

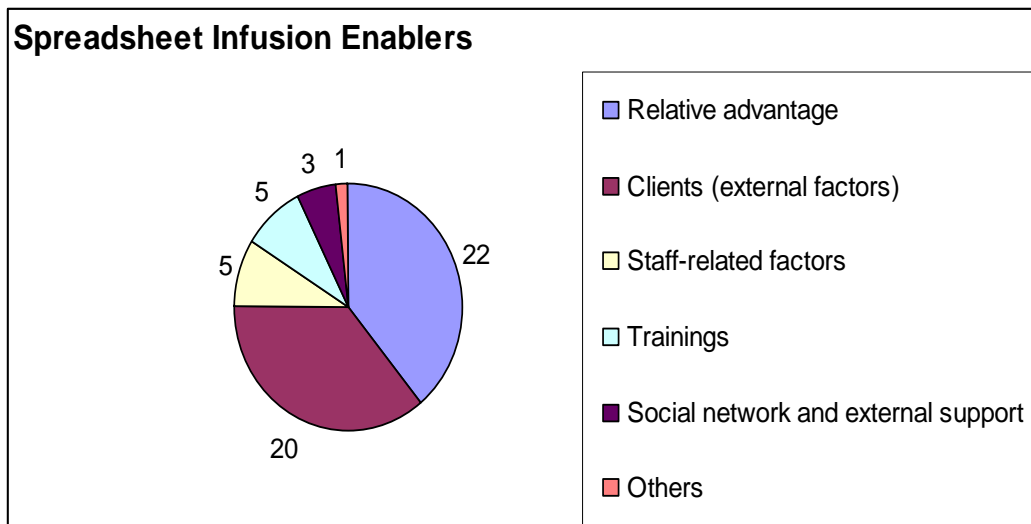


Figure C1: The survey results – Spreadsheet infusion enablers

## C.2 Spreadsheet infusion inhibitors

While relative advantages of spreadsheets are the most common enablers, staff-related factors, especially staff IT competence, are claimed to be the most common inhibitors (Figure C.2). Other important inhibitors include compatibility with clients' systems and investment in IT infrastructure. The results can be explained by the fact that small firms rarely get top graduates from leading Universities; therefore, staff quality may be a major problem. In addition, being small also discourages IT investment and the ability to pay for external support or experts.

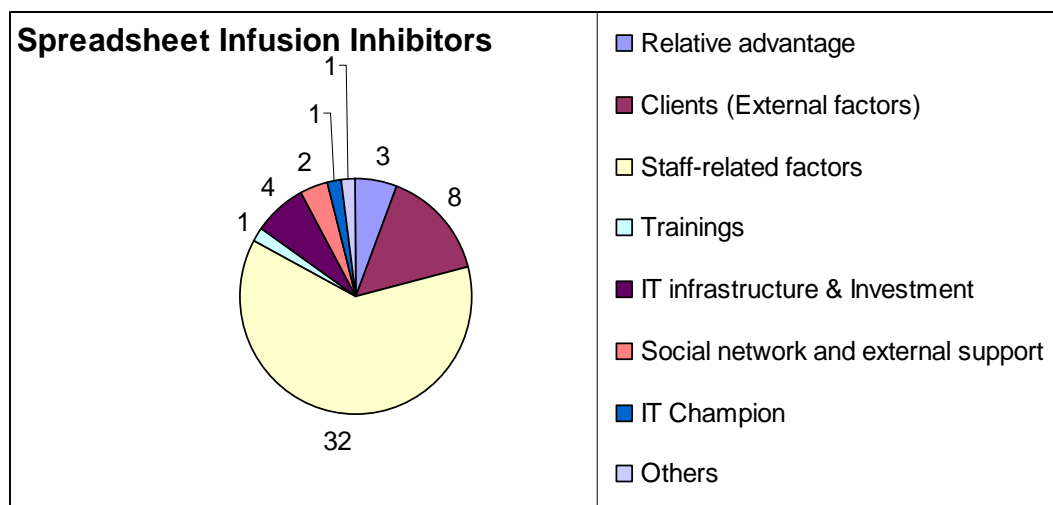


Figure C.2: The survey results – Spreadsheet infusion inhibitors

## REFERENCES

- Abdi, H. "Partial Least Square Regression," in: Encyclopedia of Measurement and Statistics, N. Salkind (ed.), Sage Publication, Thousand Oaks, CA, 2007.
- Abdolmohammadi, M., and Usoff, C. "A longitudinal study of applicable decision aids for detailed tasks in a financial audit," *International Journal of Intelligent Systems in Accounting, Finance and Management* (10:3) 2001, pp 139-154.
- Abdolmohammadi, M.J. "A Comprehensive Taxonomy of Audit Task Structure, Professional Rank and Decision Aids for Behavioral Research," *Behavioral Research in Accounting* (11) 1999, pp 51-92.
- Acs, Z.J., FitzRoy, F.R., and Smith, I. "High-technology employment and R&D in cities: Heterogeneity vs specialization," *The Annals of Regional Science* (36:3) 2002, pp 373-386.
- Ahearne, M., Jelinek, R., and Rapp, A. "Moving beyond the direct effect of SFA adoption on salesperson performance: Training and support as key moderating factors," *Industrial Marketing Management* (34) 2005, pp 379-388.
- Ahuja, M.K., and Thatcher, J.B. "Moving beyond intentions and toward the theory of trying: Effects of work environment and gender on post-adoption information technology use," *MIS Quarterly* (29:3), Sep 2005, pp 427-459.
- AICPA "Top 10 technologies - plus 5 for tomorrow," *Journal of Accountancy* (187:5), May 1999, p 16.
- AICPA "Top 10 technologies 2005," *Journal of Accountancy* (187:5), May 2005, p 16.
- Ajzen, I. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50:2), Dec 1991, pp 179-211.
- Aldrich, H.E., and Pfeffer, J. "Environments of Organizations," *Annual Review of Sociology* (2) 1976, pp 79-105.

- Alwin, D.F. "Making Errors in Surveys - Overview," *Sociological Methods & Research* (6:2) 1977, pp 131-150.
- Amoako-Gyampah, K., and Salam, A.F. "An extension of the technology acceptance model in an ERP implementation environment," *Information & Management* (41:6), Jul 2004, pp 731-745.
- Armstrong, C.P., and Sambamurthy, V. "Information technology assimilation in firms: The influence of senior leadership and IT infrastructures," *Information Systems Research* (10:4), Dec 1999, pp 304-327.
- Arnold, V., Clark, N., Collier, P.A., Leech, S.A., and Sutton, S.G. "The differential use and effect of knowledge-based system explanations in novice and expert judgment decisions," *Mis Quarterly* (30:1), Mar 2006, pp 79-97.
- Ax, C., and Bjornenak, T. "Bundling and diffusion of management accounting innovations - the case of the balanced scorecard in Sweden," *Management Accounting Research* (16:1) 2005, pp 1-20.
- Bajwa, D.S., and Lewis, L.F. "Does size matter? An investigation of collaborative information technology adoption by U.S. firms," *JITTA : Journal of Information Technology Theory and Application* (5:1) 2003, pp 29-46.
- Baldi, R.A. "Training older adults to use the computer: Issues related to the workplace, attitudes, and training," *Educational Gerontology* (23:5), Jul-Aug 1997, pp 453-465.
- Bandura, A. "Self-Efficacy - toward a Unifying Theory of Behavioral Change," *Psychological Review* (84:2) 1977, pp 191-215.
- Bandura, A. "The Explanatory and Predictive Scope of Self-Efficacy Theory," *Journal of Social and Clinical Psychology* (4:3) 1986, pp 359-373.
- Bandura, A., and Locke, E.A. "Negative self-efficacy and goal effects revisited," *Journal of Applied Psychology* (88:1) 2003, pp 87-99.
- Banji, O.-O., and Kaushalesh, L. "Learning new technologies by small and medium enterprises in developing countries," *Technovation* (26:2) 2006, pp 220-231.

- Banker, R.D., Hsihui, C., and Yi-ching, K. "Impact of Information Technology on Public Accounting Firm Productivity," *Journal of Information Systems* (16:2), Fall 2002, pp 209-222.
- Barki, H., and Hartwick, J. "Rethinking The Concept Of User Involvement," *MIS Quarterly* (13:1) 1989, pp 53-64.
- Barki, H., and Hartwick, J. "Measuring user participation, user involvement, and user attitude," *MIS Quarterly* (18:1) 1994, pp 59-82.
- BarNir, A., and Smith, K.A. "Interfirm alliances in the small business: The role of social networks," *Journal of Small Business Management* (40:3), Jul 2002, pp 219-232.
- Bassellier, G., Benbasat, I., and Reich, B.H. "The influence of business managers' IT competence on championing IT," *Information Systems Research* (14:4), Dec 2003, pp 317-336.
- Bassellier, G., Reich, B.H., and Benbasat, I. "Information technology competence of business managers: A definition and research model," *Journal of Management Information Systems* (17:4), Spr 2001, pp 159-182.
- Beath, C.M. "Supporting the Information Technology Champion," *MIS Quarterly* (15:3) 1991, pp 355-372.
- Bedard, J.C., Jackson, C., Ettredge, M.L., and Johnstone, K.M. "The effect of training on auditors' acceptance of an electronic work system," *International Journal of Accounting Information Systems* (4:4), 2003/12 2003, pp 227-250.
- Bell, T.B., and Wright, A.M. "When judgment counts," *Journal of Accountancy* (184:5) 1997, pp 73-76.
- Benbasat, I., Goldstein, D.K., and Mead, M. "The Case Research Strategy in Studies of Information-Systems," *Mis Quarterly* (11:3), Sep 1987, pp 369-386.



- Bessant, J., and Rush, H. "Building Bridges for Innovation - the Role of Consultants in Technology-Transfer," *Research Policy* (24:1), Jan 1995, pp 97-114.
- Bierstaker, J.L., Burnaby, P., and Hass, S. "Recent changes in internal auditors' use of technology," *Internal Auditing* (18:4), Jul/Aug 2003, pp 39-45.
- Bierstaker, J.L., Burnaby, P., and Thibodeau, J. "The impact of information technology on the audit process: An assessment of the state of the art and implications for the future," *Managerial Auditing Journal* (16:3) 2001, pp 159-164.
- Bjornenak, T., and Olson, O. "Unbundling management accounting innovations," *Management Accounting Research* (10:4) 1999, pp 325-338.
- Blancero, D., Boroski, J., and Dyer, L. "Key competencies for a transformed human resource organization: Results of a field study," *Human Resource Management* (35:3), Fal 1996, pp 383-403.
- Bonner, S.E. "A model of the effects of audit task complexity," *Accounting, Organizations and Society* (19:3) 1994, pp 213-234.
- Bonner, S.E. *Judgment and Decision Making in Accounting* Pearson Education, Inc., Upper Saddle River, NJ, 2008, p. 462.
- Bradley, J., and Lee, C. "ERP Training and User Satisfaction: A Case Study," *International Journal of Enterprise Information Systems* (3:4) 2007, pp 33-50.
- Bruque, S., and Moyano, J. "Organisational determinants of information technology adoption and implementation in SMEs: The case of family and cooperative firms," *Technovation* (27:5), May 2007, pp 241-253.
- Buhler, P.A., and Vidal, J.M. "Towards Adaptive Workflow Enactment Using Multiagent Systems," *Information Technology and Management* (6:1) 2005, pp 61-87.

- Burt, R.S., and Celotto, N. "The Network Structure of Management Roles in a Large Matrix Firm," *Evaluation and Program Planning* (15:3), Jul-Sep 1992, pp 303-326.
- Burton-Jones, A., and Gallivan, M.J. "Toward a Deeper Understanding of System Usage in Organizations: A Multilevel Perspective," *MIS Quarterly* (31:4) 2007, pp 657-680.
- Buswick, T. "Champions of Technology Innovation," *Training and Development Journal* (44:2) 1990, pp 48-53.
- Byrd, T.A., Lewis, B.R., and Bradley, R.V. "Is infrastructure: The influence of senior IT leadership and strategic information systems planning," *Journal of Computer Information Systems* (47:1), Fal 2006, pp 101-113.
- Calderon, T.G., Chandra, A., and Cheh, J.J. "Modeling an intelligent continuous authentication system to protect financial information resources," *International Journal of Accounting Information Systems* (7:2) 2006, pp 91-109.
- Cash, J.I.J., Bailey, A.D.J., and et al. "A Survey of Techniques for Auditing EDP-Based Accounting Information Systems," *The Accounting Review* (52:4) 1977, pp 813-832.
- Castner, G., and Ferguson, C. "The Effect of Transaction Costs on the Decision to Replace 'Off-the-shelf' Software: the Role of Software Diffusion and Infusion," *Information Systems Journal* (10) 2000, pp 65-83.
- Chang, P.-L., and Lung, S.S.C. "Organizational changes for advanced manufacturing technology infusion: An empirical study," *International Journal of Management* (19:2) 2002, pp 206-217.
- Chang, S.E., and Ho, C.B. "Organizational factors to the effectiveness of implementing information security management," *Industrial Management + Data Systems* (106:3) 2006, pp 345-361.
- Chapman, C. "Power tools 2002 audit software usage survey," *The Internal Auditor* (59:4), Aug 2002, pp 28-36.

- Cheetham, G., and Chivers, G. "Part I - How professionals learn - the theory!," *Journal of European Industrial Training* (25:5) 2001, pp 250-269.
- Chengalur-Smith, I., and Duchessi, P. "The initiation and adoption of client-server technology in organizations," *Information & Management* (35:2) 1999, pp 77-88.
- Chernick, M.R. *Bootstrap Methods: A Guide for Practitioners and Researchers* John Wiley & Sons, Inc., Hoboken, NJ, 2008, p. 369.
- Chin, W., and Marcolin, B. "The Future of Diffusion Research," *The Data Base in Advances in Information Systems* (32:3), Summer 2001, pp 8-12.
- Chin, W., and Newsted, P.R. "Structural Modeling Analysis with Small Samples Using Partial Least Squares," in: *Statistical Strategies for Small Sample Research*, R. Hoyle (ed.), Sage Publication, Thousand Oaks, CA, 1999, pp. 307-341.
- Chin, W.W. "Issues and opinion on structural equation modeling," *MIS Quarterly* (22:1) 1998, pp VII-XVI.
- Choueke, R., and Armstrong, R. "The learning organisation in small and medium-sized enterprises A destination or a journey?," *International Journal of Entrepreneurial Behaviour & Research* (4:2) 1998, pp 129-140.
- Chung, Q.B., Luo, W., and Wagner, W.P. "Strategic alliance of small firms in knowledge industries: A management consulting perspective," *Business Process Management Journal* (12:2) 2006, pp 206-233.
- Clarke, G. "My paperless auditing system," in: *PC User*, 1995, p. 138.
- Coetzer, A. "Employee learning in New Zealand small manufacturing firms," *Employee Relations* (28:4) 2006, pp 311-325.
- Cohn, S.F., and Turyn, R.M. "The Structure of the Firm and the Adoption of Process Innovations," *IEEE Transactions on Engineering Management* (27:4) 1980, pp 98-102.

- Collier, S., Weinburgh, M.H., and Rivera, M. "Infusing Technology Skills into a Teacher Education Program: Change in Students' Knowledge About and Use of Technology," *Journal of Technology and Teacher Education* (12:3) 2004, pp 447-469.
- Coltman, T., Devinney, T.M., Midgley, D.F., and Venaik, S. "Formative versus reflective measurement models: Two applications of formative measurement," *Journal of Business Research* (61:12) 2008, pp 1250-1262.
- Compeau, D.R., and Higgins, C.A. "Application of social cognitive theory to training for computer skills," *Information Systems Research* (6:2) 1995, pp 118-144.
- Compeau, D.R., Meister, D.B., and Higgins, C.A. "From Prediction to Explanation: Reconceptualizing and Extending the Perceived Characteristics of Innovating \*," *Journal of the Association for Information Systems* (8:8) 2007, pp 409-439.
- Cooper, R.B., and Zmud, R.W. "Information Technology Implementation Research: A Technological Diffusion Approach," *Management Science* (36:2) 1990, pp 123-139.
- Cornford, S.L., and Hicks, K.A. "Evaluating the residual risks of infusing new technologies into NASA missions," *Annual Reliability and Maintainability Symposium - 2000 Proceedings* 2000, pp 376-381.
- Cragg, P.B., and King, M. "Small-firm computing: Motivators and inhibitors," *MIS Quarterly* (17:1) 1993, pp 47-60.
- Cresswell, J.W. *Designing and conducting mixed method research* Sage Publications, Inc, Thousand Oaks, CA, 2003.
- Cronbach, L.J. "Coefficient Alpha and the Internal Structure of Tests," *Psychometrika* (16:3) 1951, pp 297-334.

- Curtis, M.B., and Payne, E.A. "An examination of contextual factors and individual characteristics affecting technology implementation decisions in auditing," *International Journal of Accounting Information Systems* (9:2) 2008, pp 104-121.
- Damsgaard, J., Rogaczewski, A., and Lyytinen, K. "How Information Technologies Penetrate Organizations: An Analysis of Four Alternative Models," IFIP TC8 Working Conference on Diffusion, Transfer and Implementation of Information Technology, Elsevier Science B.V., Pittsburgh, PA, USA, 1993, pp. 1-21.
- Davidson, R.A., and Hart, S.D. "Managing the adoption of new technologies: Does personality affect the acceptance of new audit technologies?," *Revue Canadienne des Sciences de l'Administration* (12:4) 1995, pp 268-276.
- Davis, F.D., Bagozzi, R.P., and Warshaw, P.R. "User Acceptance Of Computer Technology: A Comparison Of Two," *Management Science* (35:8) 1989, pp 982-1004.
- Davis, F.D., and Yi, M.Y. "Improving Computer Skill Training: Behavior Modeling, Symbolic Mental Rehearsal, and the Role of Knowledge Structures," *Journal of Applied Psychology* (89:3) 2004, pp 509-523.
- Davis, J.T., Massey, A.P., and Lovell, R.E.R.I. "Supporting a complex audit judgment task: An expert network approach," *European Journal of Operational Research* (103:2), Dec 1 1997, pp 350-373.
- DeCanio, S.J., Dibble, C., and Amir-Atefi, K. "The importance of organizational structure for the adoption of innovations," *Management Science* (46:10) 2000, pp 1285-1299.
- DeLone, W.H., and McLean, E.R. "The DeLone and McLean model of information systems success: A ten-year update," *Journal of Management Information Systems* (19:4) 2003, pp 9-30.
- Devaraj, S., and Kohli, R. "Performance impacts of information technology: Is actual usage the missing link?," *Management Science* (49:3) 2003, pp 273-289.

- Dillman, D.A. *Mail and Internet Survey: The Tailored Design Method*, (2nd ed.) John Wiley & Sons, Inc., Hoboken, NJ, 2007, p. 523.
- Dowling, C., and Leech, S. "Audit support systems and decision aids: Current practice and opportunities for future research," *International Journal of Accounting Information Systems* (8:2) 2007, pp 92-116.
- Drake, P.D., and Nigrini, M.J. "Computer assisted analytical procedures using Benford's Law," *Journal of Accounting Education* (18:2), Spring 2000, pp 127-146.
- Dube, L., and Pare, G. "Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations," *MIS Quarterly* (27:4) 2003, pp 597-635.
- Duncan, N.B. "Capturing flexibility of information technology infrastructure: A study of resource characteristics and their measure," *Journal of Management Information Systems* (12:2) 1995, pp 37-57.
- Eder, L.B., and Igbaria, M. "Determinants of Intranet diffusion and infusion," *Omega* (29:3) 2001, pp 233-242.
- Efron, B. "1977 Rietz Lecture - Bootstrap Methods - Another Look at the Jackknife," *Annals of Statistics* (7:1) 1979, pp 1-26.
- Efron, B. "Empirical Bayes Confidence-Intervals Based on Bootstrap Samples - Comment," *Journal of the American Statistical Association* (82:399), Sep 1987, pp 754-754.
- Eikebrokk, T.R., and Olsen, D.H. "An empirical investigation of competency factors affecting e-business success in European SMEs," *Information & Management* (44:4) 2007, pp 364-383.
- Eining, M.M., Jones, D.R., and Loebbecke, J.K. "Reliance on decision aids: An examination of auditors' assessment of management fraud," *Auditing* (16:2), Fall 1997, pp 1-19.
- Eisenhardt, K.M. "Building Theories from Case-Study Research," *Academy of Management Review* (14:4), Oct 1989, pp 532-550.

- Ettlie, J.E., Bridges, W.P., and O'Keefe, R.D. "Organization Strategy and Structural Differences for Radical Versus Incremental Innovation," *Management Science* (30:6) 1984, pp 682-695.
- Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., and Strahan, E.J. "Evaluating the use of exploratory factor analysis in psychological research," *Psychological Methods* (4:3), Sep 1999, pp 272-299.
- Fichman, R.G. "The role of aggregation in the measurement of IT-related organizational innovation," *MIS Quarterly* (25:4) 2001, pp 427-455.
- Fichman, R.G., and Kemerer, C.F. "The assimilation of software process innovations: An organizational learning perspective," *Management Science* (43:10) 1997, pp 1345-1363.
- Fischer, M.J. ""Real-izing" the benefits of new technologies as a source of audit evidence: An interpretive field study\*1," *Accounting, Organizations and Society* (21:2-3), 1996/0 1996, pp 219-242.
- Flyvbjerg, B. "Five Misunderstandings about Case-study Research," *Qualitative Inquiry* (12:2), Apr 2006, pp 219-245.
- Frohman, A.L. "The Performance of Innovation: Managerial Roles," *California Management Review* (20:3) 1978, pp 5-12.
- Gist, M.E. "The Influence Of Training Method On Self-Efficacy And Idea," *Personnel Psychology* (42:4) 1989, pp 787-805.
- Glover, S.M., Prawitt, D., and Romney, M.B. "The software scene," *The Internal Auditor* (57:4), Aug 2000, pp 49-57.
- Goodhue, D.L., and Thompson, R.L. "Task-technology fit and individual performance," *MIS Quarterly* (19:2) 1995, pp 213-236.
- Gordon, S.R., and Tarafdar, M. "How do a company's information technology competences influence its ability to innovate?," *Journal of Enterprise Information Management* (20:3) 2007, pp 271-290.

- Gorsuch, R.L. "Common Factor-Analysis Versus Component Analysis - Some Well and Little Known Facts," *Multivariate Behavioral Research* (25:1), Jan 1990, pp 33-39.
- Gregor, S., and Benbasat, I. "Explanations from intelligent systems: Theoretical foundations and implications for practice," *MIS Quarterly* (23:4) 1999, pp 497-530.
- Grossman, T., and Walsh, J. "Avoiding the Pitfalls of ERP System Implementation," *Information Systems Management* (21:2) 2004, pp 38-42.
- Gupta, A.K., Tesluk, P.E., and Taylor, M.S. "Innovation At and Across Multiple Levels of Analysis," *Organization Science* (18:6) 2007, pp 885-900.
- Hall, J.A. *Information Systems Auditing and Assurance* South-Western College Publishing, Cincinnati, 2000.
- Hann, J., and Weber, R. "The impact of IT Infusion and Diffusion on Some Characteristics of IS Planning: A Model and Empirical Test," *International Conference on Information System*, Amsterdam, The Netherlands, 1995.
- Hanna, V., and Walsh, K. "Small firm networks: a successful approach to innovation?," *R & D Management* (32:3), Jun 2002, pp 201-207.
- Hansen, M.T., and Birkinshaw, J. "The Innovation Value Chain," *Harvard Business Review* (85:6) 2007, pp 121-135.
- Harrison, D.A., Mykytyn, P.P., and Riemenschneider, C.K. "Executive decisions about adoption of information technology in small business: Theory and empirical tests," *Information Systems Research* (8:2), Jun 1997, pp 171-195.
- Heilmann, P. "High level competence: a tool for coping with organizational change," *Journal of European Industrial Training* (31:9) 2007, pp 727-741.
- Hidalgo, A., and Albors, J. "New innovation management paradigms in the knowledge-driven economy," *Management of Technology Innovation and Value Creation* (2) 2008, pp 3-19.



- Howell, J.M., and Higgins, C.A. "Champions of Technological Innovation," *Administrative Science Quarterly* (35:2) 1990, pp 317-341.
- Hu, J., Huhmann, B.A., and Hyman, M.R. "The Relationship between task complexity and information search: The role of self-efficacy," *Psychology & Marketing* (24:3) 2007, pp 253-270.
- IFAC, I.F.o.A. "International Standard on Auditing (ISA) 315: Understanding the Entity and Its Environment and Assessing the Risk of Material misstatements," 2005.
- Igbaria, M. "End-User Computing effectiveness: A structural equation model," *Omega* (18:6) 1990, pp 637-652.
- Igbaria, M. "User acceptance of microcomputer technology: An empirical test," *Omega* (21:1) 1993, pp 73-91.
- Igbaria, M., Pavri, F.N., and Huff, S.L. "Microcomputer Applications: An Empirical Look at Usage," *Information & Management* (16:4) 1989, pp 187-196.
- Igbaria, M., Zinatelli, N., Cragg, P., and Cavaye, A.L.M. "Personal computing acceptance factors in small firms: A structural equation model," *Mis Quarterly* (21:3), Sep 1997, pp 279-305.
- Janvrin, D., Bierstaker, J., and Lowe, D.J. "An Examination of Audit Information Technology Use and Perceived Importance," *Accounting Horizons* (22:1) 2008, pp 1-21.
- Jarvenpaa, S.L., and Ives, B. "Executive Involvement and Participation in the Management of Information Technology," *MIS Quarterly* (15:2) 1991, pp 205-227.
- Jarvis, C.B., MacKenzie, S.B., and Podsakoff, P.M. "A critical review of construct indicators and measurement model misspecification in marketing and consumer research," *Journal of Consumer Research* (30:2) 2003, pp 199-218.

- Jaspersen, J. "The impact of social structures on information technology infusion: Investigation of alternative individual appropriation moves," The Florida State University, United States -- Florida, 1999.
- Jaspersen, J., Carter, P.E., and Zmud, R.W. "A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated with Information Technology Enabled Work Systmes," *MIS Quarterly* (29:3) 2005, pp 525-558.
- Jick, T.D. "Mixing Qualitative and Quantitative Methods - Triangulation in Action," *Administrative Science Quarterly* (24:4) 1979, pp 602-611.
- Johnston, D.A., and Linton, J.D. "Social networks and the implementation of environmental technology," *IEEE Transactions on Engineering Management* (47:4), Nov 2000, pp 465-477.
- Johnston, R. "Technology is for Client Service," *CPA Technology Advisor* (19:1) 2009, pp 42-43.
- Johnston, R.P., Spencer, R.H., and Mendlowitz, E. "Time to Go Paperless," *Journal of Accountancy* (199:6) 2005, pp 44-50.
- Jones, E., Sundaram, S., and Chin, W. "Factors Leading to Sales Force Automation Use: A Longitudinal Analysis," *Journal of Personal Selling & Sales Management* (22:3), Summer 2002, pp 145-156.
- Jones, G.R. *Organizational theory, design, and change: Text and Cases*, (4th ed.) Prentice Hall, Inc., Upper Saddler River, NJ, 2004, p. 591.
- Kahan, S. "Reengineered auditing," *The Practical Accountant* (34:1), Jan 2001, pp 49-50.
- Kaplan, R.S., and Norton, D.P. *The Strategy-focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment* Harvard Business School Press, Boston, MA, 2001, p. 400.
- Kishore, A., and McLean, E.R. "Reconceptualizing Innovation Compatibility as Organizational Alignment in Secondary IT Adoption Contexts: An Investigation of Software Reuse Infusion," *IEEE Transactions on Engineering Management* (54:4) 2007, p 756.

- Kishore, R., and McLean, E.R. "Diffusion and Infusion: Two Dimensions of "Success of Adoption" of IS Innovations," Fourth Americas Conference of the Association on Information Systems (AMCIS 1998), Baltimore, Maryland, 1998, pp. 731-733.
- Ko, D.G., and Dennis, A.R. "Sales force automation and sales performance: Do experience and expertise matter?," *Journal of Personal Selling & Sales Management*:24), Fall 2004, pp 311-322.
- Konrath, L.F. *Auditing: A Risk Analysis Approach* South-Western, Cincinnati, OH, 2002.
- Kraemer, K.L. "Survey research methods," in: *The Information Systems Research Challenge: Survey Research Methods*, Harvard Business School, Boston, MA, 1991.
- Kraiger, K., Ford, J.K., and Salas, E. "Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation," *Journal of Applied Psychology* (78:2) 1993, p 311.
- Kwon, T.H., and Zmud, R.W. "Unifying the fragmented models of information systems implementation," in: *Critical Issues in Information Systems Research*, J. R. J. Boland and R.J. Hirschheim (eds.), John Wiley and Sons, Inc., New York, 1987.
- Laforet, S., and Tann, J. "Innovative characteristics of small manufacturing firms," *Journal of Small Business and Enterprise Development* (13:3) 2006, p 363.
- Lassila, K.S., and Brancheau, J.C. "Adoption and utilization of commercial software packages: Exploring utilization equilibria, transitions, triggers, and tracks," *Journal of Management Information Systems* (16:2), Fal 1999, pp 63-90.
- Laudon, J.P., and Laudon, K.C. *Management Information Systems: Managing the Digital Firm*, (10th ed.) Prentice Hall, Inc., Upper Saddle River, NJ, 2007, p. 736.

- Lee, J., and Runge, J. "Adoption of information technology in small business: Testing drivers of adoption for entrepreneurs," *The Journal of Computer Information Systems* (42:1) 2001, p 44.
- Lefebvre, L.A., Harvey, J., and Lefebvre, E. "Technological Experience and the Technology Adoption Decisions in Small Manufacturing Firms," *R & D Management* (21:3), Jul 1991, pp 241-249.
- Leiponen, A. "Skills and innovation," *International Journal of Industrial Organization* (23:5-6), Jun 2005, pp 303-323.
- Lertwongsatien, C., and Wongpinunwatana, N. "E-commerce adoption in Thailand: An empirical study of Small and Medium Enterprises (SMEs)," *Journal of Global Information Technology Management* (6:3) 2003, p 67.
- Lewis, B.R., Templeton, G.F., and Byrd, T.A. "A methodology for construct development in MIS research," *European Journal of Information Systems* (14:4), Dec 2005, pp 388-400.
- Liang, H., Saraf, N., Hu, Q., and Xue, Y. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management," *MIS Quarterly* (31:1) 2007, p 59.
- Libby, R., and Tan, H.T. "Modeling the Determinants of Audit Expertise," *Accounting Organizations and Society* (19:8), Nov 1994, pp 701-716.
- Lievens, F., Van Hove, G., and Schreurs, B. "Examining the relationship between employer knowledge dimensions and organizational attractiveness: An application in a military context," *Journal of Occupational and Organizational Psychology* (78), Dec 2005, pp 553-572.
- Lin, H.-F. "Knowledge sharing and firm innovation capability: an empirical study," *International Journal of Manpower* (28:3/4) 2007, p 315.
- Loecher, U. "Small and medium-sized enterprises - delimitation and the European definition in the area of industrial business," *European Business Review* (12:5) 2000, p 261.

- Lombardo, C. "Catherine Parente: Paperless mastermind," *Accounting Technology* (18:11), Dec 2002, p 56.
- Loof, H., and Brostrom, A. "Does knowledge diffusion between university and industry increase innovativeness?," *Journal of Technology Transfer* (33:1) 2008, p 73.
- Loraas, T., and Wolfe, C.J. "Why Wait? Modeling Factors that Influence the Decision of When to Learn a New Use of Technology," *Journal of Information Systems* (20:2) 2006, p 1.
- Lord, F.M., and Novick, M.R. *Statistical theories of mental test scores* Addison-Wesley, Reading, MA, 1968, p. 568.
- MacCallum, R.C., and Browne, M.W. "The use of causal indicators in covariance structure models: Some practical issues," *Psychological Bulletin* (114:3) 1993, p 533.
- Magklaras, G.B., and Furnell, S.M. "A preliminary model of end user sophistication for insider threat prediction in IT systems," *Computers & Security* (24:5), Aug 2005, pp 371-380.
- Mahoney, J., and Goertz, G. "The possibility principle: Choosing negative cases in comparative research," *American Political Science Review* (98:4), Nov 2004, pp 653-669.
- Manson, S., McCartney, S., and Sherer, M. "Audit Automation: The Use Of Information Technology in the Planning, Controlling and Recording of Audit Work," *Institute of Chartered Accountants of Scotland*, Edinburgh.
- Manson, S., McCartney, S., and Sherer, M. "Audit automation as control within audit firms," *Accounting, Auditing & Accountability Journal* (14:1) 2001, p 109.
- Markus, M.L., and Benjamin, R.I. "Change agency - the next IS frontier," *Mis Quarterly* (20:4), Dec 1996, pp 385-407.

- Massa, S., and Testa, S. "Innovation or imitation? Benchmarking: a knowledge-management process to innovate services," *Benchmarking* (11:6) 2004, p 610.
- Masseti, B., and Zmud, R.W. "Measuring the extent of EDI usage in complex organizations: Strategies and illustrative examples," *MIS Quarterly* (20:3) 1996, p 331.
- Medcof, J.W. "The Effect of Extent of Use of Information Technology and Job of the User upon Task Characteristics," *Human Relations* (42:1) 1989, p 23.
- Melville, Nigel, Kenneth Kraemer, and Vijay Gurbaxani (2004), "Review: Information Technology and Organizational Performance: An Integrative Model of IT Businss Value," *MIS Quarterly*, 28 (2), pp 283-322.
- Miller, N.J., Besser, T., and Malshe, A. "Strategic networking among small businesses in small US communities," *International Small Business Journal* (25:6), Dec 2007, pp 631-665.
- Mitra, J. "Making connections: Innovation and collective learning in small businesses," *Education & Training* (42:4/5) 2000, p 228.
- Moore, J.B., II "Information technology infusion: A motivation approach," The Florida State University, United States -- Florida, 2002.
- Murthy, U.S., and Kerr, D.S. "Comparing Audit Team Effectiveness via Alternative Modes of Computer-Mediated Communication," *Auditing* (23:1) 2004, p 8.
- Namwoon, K., and K., S.R. "Managing intraorganizational diffusion of technological innovations," *Industrial Marketing Management* (27:3) 1998, pp 229-246.
- Nelson, R.R., and Cheney, P.H. "TRAINING END USERS AN EXPLORATORY STUDY," *MIS Quarterly* (11:4) 1987, pp 547-559.
- Neuman., L. *Social research methods : qualitative and quantitative approaches*, (6th ed.) Pearson, Boston, MA, 2006, p. 592.

- Nunnally, J.C. *Psychometric Theory*, (2nd ed.) McGraw-Hill, New York, NY, 1978, p. 701.
- O'Brien, J.A. *Introduction to information systems*, (12th ed.) McGraw-Hill Companies, Inc., New York, 2005, p. 452.
- Oyelaran-Oyeyinka, B., and Lal, K. "Learning new technologies by small and medium enterprises in developing countries," *Technovation* (26:2) 2006, pp 220-231.
- Palvia, P.C., and Palvia, S.C. "An examination of the IT satisfaction of small-business users," *Information & Management* (35:3) 1999, pp 127-137.
- Pentland, B.T. "Sequential variety in work processes," *Organization Science* (14:5) 2003, pp 528-540.
- Petter, S., Straub, D., and Rai, A. "Specifying formative constructs in information systems research," *Mis Quarterly* (31:4), Dec 2007, pp 623-656.
- Pflughoeft, K.A., Ramamurthy, K., Soofi, E.S., Yasai-Ardekani, M., and Zahedi, F.M. "Multiple conceptualizations of small business web use and benefit," *Decision Sciences* (34:3), Sum 2003, pp 467-512.
- Phelan, S.E. "A paperless success story," *Journal of Accountancy* (196:4), Oct 2003, pp 59-65.
- Picot, A., Neuburger, R., and Niggl, J. "Management perspectives of electronic data interchange systems," *International Journal of Information Management* (13:4) 1993, pp 243-248.
- Pijpers, G.G.M., and Montfort, K.v. "An Investigation of Factors that Influence Senior Executives to Accept Innovations in Information Technology," *International Journal of Management* (22:4) 2005, pp 542-555.
- Pitt, L., Merwe, R.v.d., Berthon, P., Salehi-Sangari, E., and Barnes, B.R. "Swedish BioTech SMEs: The veiled values in online networks," *Technovation* (26:5,6) 2006, pp 553-560.

- Pollard, C. "Exploring Continued and Discontinued Use of IT: A Case Study of OptionFinder, a Group Support System," *Group Decision and Negotiation* (12:3) 2003, pp 171-193.
- Premkumar, G. "A Meta-Analysis of Research on Information Technology Implementation in Small Business," *Journal of Organizational Computing and Electronic Commerce* (13:2) 2003, pp 91-121.
- Premkumar, G., and Margaret, R. "Adoption of new information technologies in rural small businesses," *Omega* (27:4) 1999, pp 467-484.
- Quaddus, M., and Hofmeyer, G. "An investigation into the factors influencing the adoption of B2B trading exchanges in small businesses," *European Journal of Information Systems* (16:3) 2007, pp 202-215.
- Ramamurthy, K., Sen, A., and Sinha, A.R. "Data warehousing infusion and organizational effectiveness," *IEEE Transactions on Systems Man and Cybernetics Part a-Systems and Humans* (38:4), Jul 2008, pp 976-994.
- Ray, C.M., Harris, T.M., and Dye, J.L. "Small business attitudes toward computers," *Journal of End User Computing* (6:1) 1994, pp 16-25.
- Raymond, L. "Organizational Characteristics and Mis Success in the Context of Small Business," *Mis Quarterly* (9:1) 1985, pp 37-52.
- Raymond, L. "The Impact of Computer Training on the Attitudes and Usage Behavior of Small Business Managers," *Journal of Small Business Management* (26:3) 1988, pp 8-13.
- Raymond, L., Bergeron, F., and Rivard, S. "Determinants of business process reengineering success in small and large enterprises: An empirical study in the Canadian context," *Journal of Small Business Management* (36:1), Jan 1998, pp 72-85.
- Rezaee, Z., Elam, R., and Sharbatoghlie, A. "Continuous auditing: The audit of the future," *Managerial Auditing Journal* (16:3) 2001, pp 150-158.
- Rogers, E.M. *Diffusion of innovations* Free Press, New York, 2003, p. 551.



- Rouse, A.C., and Corbitt, B. "There's SEM and "SEM": A Critique of the Use of PLS Regression in Information Systems Research," 19th Australasian Conference on Information Systems, Christchurch, New Zealand, 2008.
- Rowley, J., Dysard, G., and Arnold, J. "Developing a New Technology Infusion Program for Preparing Tomorrow's Teachers," *Journal of Technology and Teacher Education* (13:1) 2005, pp 105-123.
- Rubin, H.J., and Rubin, I. *Qualitative interviewing : the art of hearing data*, (2nd ed.) Sage Publications, Thousand Oaks, CA, 2005, p. 291.
- Sadler-Smith, E., Sargeant, A., and Dawson, A. "Higher level skills training and SMEs," *International Small Business Journal* (16:2) 1998, pp 84-94.
- Saga, V.L. "The Nature and Determinants of Information Technology Infusion: An Organizational Level of Analysis," The Florida State University, United States -- Florida, 1994.
- Saga, V.L., and Zmud, R.W. "The Nature and Determinants of IT Acceptance, Routinization, and Infusion," The IFIP TC8 Working Conference on Diffusion, Transfer and Implementation of Information Technology, Elsevier Science, Pittsburgh, PA, USA, 1994, pp. 67-86.
- Sankar, Y. "Organizational Culture And New Technologies," *Journal of Systems Management* (39:4) 1988, pp 10-17.
- Sayana, S.A. "Using CAATs to support IS audit," *Information Systems Control Journal* (1) 2003, pp 21-23.
- Scheepers, R. "Key roles in intranet implementation: the conquest and the aftermath," *Journal of Information Technology* (18:2) 2003, pp 103-119.
- Scott, P., Jones, B., Bramley, A., and Bolton, B. "Enhancing technology and skills in small- and medium-sized manufacturing firms: Problems and prospects," *International Small Business Journal* (14:3) 1996, pp 85-99.
- Shachak, A., and Fine, S. "The Effect of training on biologists acceptance of bioinformatics tools: A field experiment," *Journal of the American Society for Information Science and Technology* (59:5) 2008, pp 719-730.

- Shanthi, G., and Fariborz, D. "The impact of organizational context on innovation adoption in commercial banks," *IEEE Transactions on Engineering Management* (47:1) 2000, pp 14-25.
- Sharma, S., and Rai, A. "An assessment of the relationship between ISD leadership characteristics and IS innovation adoption in organizations," *Information & Management* (40:5) 2003, pp 391-401.
- Shaughnessy, J.J., Zechmeister, E.B., Cull, W.L., and Hart, H.M. "The Expanse of the Expanding Test Series Effect," *Bulletin of the Psychonomic Society* (29:6), Nov 1991, pp 493-493.
- Simon, S.J., and Werner, J.M. "Computer training through behavior modeling, self-paced, and instructional approaches: A field experiment," *Journal of Applied Psychology* (81:6) 1996, pp 648-659.
- Soh, C.P.P., Yap, C.S., and Raman, K.S. "Impact of Consultants on Computerization Success in Small Businesses," *Information & Management* (22:5), May 1992, pp 309-319.
- Spanos, Y.E., Prastacos, G.P., and Poulymenakou, A. "The relationship between information and communication technologies adoption and management," *Information & Management* (39:8) 2002, pp 659-675.
- Stevens, M.G. "The changing audit," *The Practical Accountant* (33:2), Feb 2000, pp 18-21.
- Stevens, M.G. "Paperless audits weigh in," *The Practical Accountant* (36:2), Feb 2003, pp 32-35.
- Sullivan, C.H. "Systems planning in the information age," *Sloan Management Review* (pre-1986) (26:2) 1985, pp 3-12.
- Sundaram, S., Schwarz, A., Jones, E., and Chin, W.W. "Technology use on the front line: how information technology enhances individual performance," *Academy of Marketing Science. Journal* (35:1) 2007, pp 101-112.

- Suraweera, T. "IT management sophistication in small business : its definition, measurement and relationship with IT impact " in: AFIS, University of Canterbury, Christchurch, 2004, p. 293.
- Swan, J., Newell, S., Scarbrough, H., and Hislop, D. "Knowledge management and innovation: networks and networking," *Journal of Knowledge Management* (3:4) 1999, p 262.
- Terziovski, M. "The relationship between networking practices and business excellence: A study of small to medium enterprises (SMEs)," *Measuring Business Excellence* (7:2) 2003, pp 78-92.
- Thong, J.Y.L. "An integrated model of information systems adoption in small businesses.," *Journal of Management Information Systems* (15:4) 1999, pp 187-214.
- Thong, J.Y.L., Yap, C.-S., and Raman, K.S. "Top management support, external expertise and information systems implementation in small businesses.," *Information Systems Research* (7:2) 1996, pp 248-267.
- Ungan, M.C. "Manufacturing best practices: implementation success factors and performance," *Journal of Manufacturing Technology Management* (18:3) 2007, pp 333-348.
- Venkatesh, V. "Creation of favorable user perceptions: Exploring the role of intrinsic motivation," *MIS Quarterly* (23:2) 1999, pp 239-260.
- Venkatesh, V., Brown, S.A., Maruping, L.M., and Bala, H. "Predicting different conceptualizations of system use: the competing roles of behavioral intention, facilitating conditions, and behavioral expectation," *MIS Quarterly* (32:3) 2008, pp 483-502.
- Venkatesh, V., and Davis, F.D. "A model of the antecedents of perceived ease of use: Development and test," *Decision Sciences* (27:3) 1996, pp 451-481.
- Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. "User acceptance of information technology: Toward a unified view1," *MIS Quarterly* (27:3) 2003, pp 425-478.

- Vera-Munoz, S.C., Ho, J.L., and Chow, C.W. "Enhancing Knowledge Sharing in Public Accounting Firms," *Accounting Horizons* (20:2) 2006, pp 133-155.
- Walker, E., and Brown, A. "What Success Factors are Important to Small Business Owners?," *International Small Business Journal* (22:6) 2004, pp 577-594.
- Wan, D., Ong, C.H., and Lee, F. "Determinants of firm innovation in Singapore," *Technovation* (25:3), Mar 2005, pp 261-268.
- Weber, R. *Information Systems Control and Audit* Prentice-Hall, Inc., Upper Saddle River, NJ, 1999.
- Williams, L.J., Edwards, J.R., and Vandenberg, R.J. "Recent Advances in Causal Modeling Methods for Organizational and Management Research," *Journal of Management* (29:6) 2003, pp 903-936.
- Winston, E.R., and Dologite, D. "How does Attitude Impact IT Implementation: A Study of Small Business Owners," *Journal of End User Computing* (14:2) 2000, pp 16-29.
- Winston, E.R., and Dologite, D.G. "Achieving IT Infusion: A Conceptual Model for Small Businesses," *Information Resources Management Journal* (12:1) 1999, pp 26-38.
- Withey, M., Daft, R.L., and Cooper, W.H. "Measures of Perrow Work Unit Technology - an Empirical-Assessment and a New Scale," *Academy of Management Journal* (26:1) 1983, pp 45-63.
- Wood, R., and Bandura, A. "Social Cognitive Theory of Organizational Management," *Academy of Management Review* (14:3), Jul 1989, pp 361-384.
- Wood, R.E. "Task Complexity - Definition of the Construct," *Organizational Behavior and Human Decision Processes* (37:1), Feb 1986, pp 60-82.
- Yeow, A., and Sia, S.K. "Negotiating "best practices" in package software implementation," *Information and Organization* (18:1) 2008, pp 1-28.
- Yin, R.K. *Case Study Research Design and Methods*, (3rd ed.) Sage Publication, Inc., Thousand Oaks, CA, 2003, p. 179.

- Yoon, Y.H., Guimaraes, T., and Oneal, Q. "Exploring the Factors Associated with Expert-Systems Success," *Mis Quarterly* (19:1), Mar 1995, pp 83-106.
- Zaltman, G., Duncan, R., and Holbek, J. *Innovations and organizations* John Wiley & Sons, Inc., New York, 1973.
- Zinatelli, N., Cragg, P.B., and Cavaye, A.L.M. "End user computing sophistication and success in small firms," *European Journal of Information Systems* (5:3), Sep 1996, pp 172-181.
- Zmud, R.W., and Apple, L.E. "Measuring Technology Incorporation/Infusion," *The Journal of Product Innovation Management* (9:2) 1992, pp 148-155.
- Zmud, R.W., and Boynton, A.C. "Survey Measures and Instruments in MIS: Inventory and Appraisal," in: *The Information Systems Research Challenge: Survey Research Methods*, K.L. Kraemer (ed.), Harvard Business School, Boston, MA, 1991, p. 395.