Investigating Measurement Richness Effect on the Relationship between Information Technology Use and Individual Performance

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ABSTRACT

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Whether Information Technology (IT) use leads to better individual performance has always been an intriguing topic in IS field. However, not many studies examined the Information Technology use/individual performance relationship given the significance of the topic. Researchers and practitioners simply assumed that more IT use lead to better individual performance. A review of the literature presented a different, rather conflicting, picture than the conventional wisdom. The current study thus aims at investigating IT use/individual performance relationship by focusing on the measurement issue i.e. how different richness level measurement of IT use and individual performance affects the use/individual performance relationship. A questionnaire was used to collect data to test the hypotheses. A total number of 261 account managers from two Canadian banks completed the survey regarding their use of new system at the bank. Our results show that, for the most part, use is significantly and positively related to individual performance. However, depending on the measures used, IT use is sometimes significantly but negatively related to individual performance, or there is no significant relationship between the two. Our results are presented in a matrix putting IT use and individual performance in relationship based on different richness level of use and performance measures. Our results helps validate and integrate previous research by providing a comprehensive map in terms of measurement issue. This research helps interpret and compare prior research on use/performance relationship. Results are also of great use to practitioners to assess and examine the benefits of implementing new IT.

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INTRODUCTION

Information Technology (IT) use has long been studied at two levels, individual level and organizational level. Most studies at individual level terminate at the "acceptance" of the technology rather than performance outcome (Dasgupta et al. 2002). The lack of study between IT use and its impact on individual performance could be attributed to the conventional wisdom that more use leads to better performance. However, this statement is based on two assumptions. First, IT will not contribute to better performance unless it is used; an alternative assumption is that users assess the cost and benefit of the system, and will use the system if the benefit of using it outweighs the cost (Gelderman, 1998). Both assumptions imply more use will lead to improved performance. However, this is not necessarily the case. There are empirical studies presenting contradictory results—non-significant or even inverse relationship between the two variables (Aldag & Power, 1986; Lucas, 1975; Pentland, 1989; Udo, 1992; Szajna, 1993; Lucas & Spliter, 1999; Dasgupta et al. 2002; Staples & Seddon, 2004). Thus, recently researchers turned their attention to the measurement issue and started to seek for the contingent factors that lead to the conflicting results (Bernard, 2004; Burton-Jones & Straub, 2006). Thereby, the goal of the current study is to examine the relationship between IT use and individual performance given different richness level of use and performance measurement.

A questionnaire was used to collect data. A total number of 261 account managers from two Canadian banks were surveyed regarding their use of a new system and their individual performance. Our results mapped out a matrix, demonstrated different measurements' effect on the use/performance relationship. For the most part, use is positively related to individual performance with different R square and beta value given different richness level

of measures. Meanwhile, there are occasions where use is negatively related to individual performance, or where there is no significant relationship between the two. The current study helps validate and integrate previous research by providing a comprehensive map by focusing on measurement issue. This research also helps researchers to interpret and compare prior research on the use/performance relationship. Results are also of great use for practitioners to assess the benefits of new IT usage by organizational members.

The current thesis is organized as follows: first, an exhaustive literature review of the definition and measurement for both IT use and individual performance, and relationship between the two from previous studies are presented in chapter 1. At the end of chapter 1, our research question is proposed. In chapter 2, we build our research model based on the literature review. Also, research hypotheses are specified. Chapter 3 presents the research setting, measurements, data collection and analyses that we used to test our hypotheses. Detailed results of data analysis are demonstrated in chapter 4. In the last chapter, we discuss our findings, the contribution of our study to both academic and practice. We also point out the research limitations and identify avenues for future research.

CHAPTER 1: LITERATURE REVIEW

This chapter reviews previous literature that is relevant to the current research. Specifically, main constructs are discussed, including IT use, individual performance, and most importantly, the relationship between IT use and individual performance. Based on the review, the research question is devised at the end of this chapter.

1.1 IT USE

IT use has been one of the main dependent variables in IS (Information System) research and has been studied extensively. The "system–to-value chain" introduced by Doll & Torkzadeh (1998) provides a clear overview of IT use's position among other variables in the IS domain. In the system-to-value chain, upstream studies are concerned with how causal factors, for example, beliefs and attitude, affect IT use while downstream studies investigate impacts of IT use. Thus, IT use mediates upstream and downstream studies. However, most IS research focused on upstream research with IT use as dependent variable and studied the factors that predict IT use. Meanwhile, less research effort was given to the IT use's role as an independent variable that predicts the downstream impact of IT (Doll & Torkzadeh, 1998). Among those downstream studies, IT use has been elusively, if not poorly, defined. A large percentage of the downstream papers did not give specific or clear definition of IT use(e.g. Almutairi & Subramanian, 2005; Dasgupta, Granger, & McGarry, 2002; Lucas, 1975; McGill, Hobbs, & Klobas, 2003; Millman & Hartwick, 1987; Pentland, 1989; Staples & Seddon, 2004; Yoon & Guimaraes, 1995).

1.1.1 IT Use Definition

IT use, as the name implies, is rather self-explanatory and thus the definition should be very straightforward. As a result, among all the studies, very few papers have clearly defined IT use, which can be seen in Table 1. Among the studies that did define IT use, unfortunately, the researchers have not reached consensus on the definition.

Table 1 IT use DefinitionIT use Definition

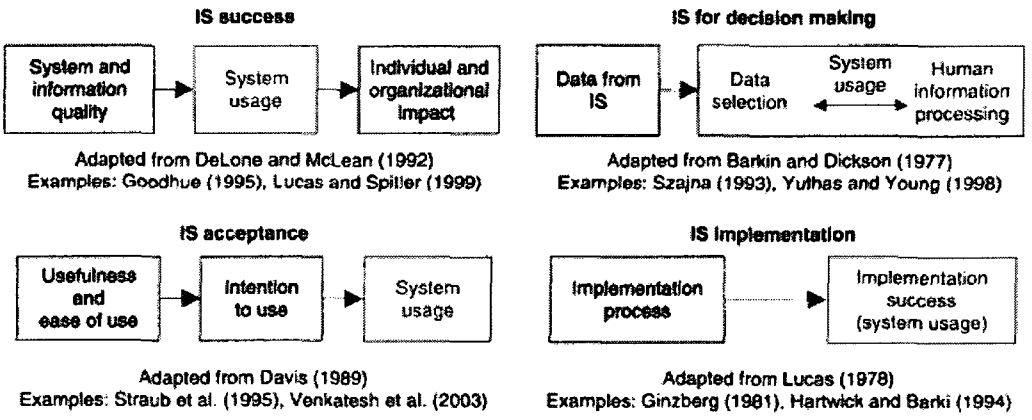
Author	IT use definition
DeLone & McLean (1992)	"Information use" was defined as "recipient consumption of the output of an information system". This paper defined and used the term "information use" rather than "IT use". However, the paper examined the actual use of an information system, not the use of information.
Straub et al. (1995)	Utilization of information technology by individuals, groups, or organizations.
Goodhue & Thompson (1995)	The behavior of employing the technology in completing tasks.
Pinsonneault & Rivard (1998)	Interaction with the computer
Lucas & Spitler (1999)	Use of market, office, and mainframe subsystems.
D'Ambra & Rice (2001)	IT use is the behaviour employed in completing tasks (finding information, entertainment, extrinsic or intrinsic)
Boffo & Barki (2003)	IT use as task accomplishment: user's direct or indirect interaction with an IS in the accomplishment of their organizational tasks; IT use as adaptation: user behaviours directed at changing or modifying an IS, or how it will be deployed and used in an organization; IT use as learning: users interact with each other and exchange information in order to adapt to new ways of performing their tasks.
D'Ambra & Wilson (2004)	The behaviour employed in completing tasks.
Bokhari (2005)	Either the amount of effort expended interacting with an information system, or less frequently, as the number of reports or other information products generated by the information system per time (Trice & Treacy, 1988)
Barki, Titah, & Boffo (2007)	Interaction with IT in accomplishing tasks, and activities that adapt, change, or modify any element of task-technology-individual context.

Several reasons can be identified to explain the difficulty for researchers to reach consensus on the definition of IT use. First of all, IT use is "process-dependent" i.e. IT use is defined differently depending on the process which is examined (Trice & Treacy, 1988). Also, the definition depends on the type of IT examined and the context under which IT was being implemented and adopted. Reviewing previous research, Trice & Treacy (1988) claim that IT use was defined as "either the amount of effort expanded interacting with an information system, or, less frequently, as the number of reports or other information products generated

by the information system per unit time". Based on Manson (1978)'s expansion of the effectiveness or influence level, DeLone & McLean (1992) define "information use" as "recipient consumption of the output of an information system". It is worth mentioning that although DeLone & McLean (1992) defined IT use in terms of the information generated from IS, however, their literature review includes papers which examined IT use in terms of both the use of information system and the use of information generated by information system. Common definitions for IT use are "the behaviour of employing the technology in completing tasks"(Goodhue & Thompson, 1995) or simply "utilization of information technology by individual, groups or organizations" (Straub et al., 1995) or the "interaction with the computer" (Pinsonneault & Rivard, 1998). Relying on a comprehensive set of direct and indirect IT use and use-oriented activities, Boffo & Barki (2003) conceptualize IT use into three categories—IT use as task accomplishment, IT use as adaptation, and IT use as learning. The first category epitomizes past behavioural conceptualization of IT use in the IS field—IT use as task accomplishment. Burton-Jones & Straub (2006) differentiated IT use definitions across four research domains: IS success, IS acceptance, IS implementation, and IS for decision making (see Figure 1). Just as Doll & Torkzadeh (1998)'s system-to-value chain, the IS success stream of research depicts IT use as an independent variable or mediating variable leading to downstream social impact on both individuals and organizations. Such a definition of IT use can be found in DeLone & McLean (1992), Goodhue & Thompson (1995), and Lucas & Spitler (1999). In IS acceptance research, IT use was considered as a dependent variable which is the behavioural consequence of social and cognitive variables. In this domain, IT use was simply operationalized as the decision to use, or as the actual use behaviour. Examples can be found in Davis (1989) and Straub et al. (1995). The other two research areas—decision making and implementation—are not the

focus of current study. However, the definitions in these two areas are similar to the ones in the first two areas.

Figure 1 Past Conceptualization of IT Use Construct (Burton-Jones & Straub (2006)



1.1.2 IT Use Operationalization and Measurement

Undoubtedly, the lack of consistent conceptualization of use leads directly to incongruent operationalization for this variable in research. As shown in Table 2, miscellaneous ways to operationalize and measure IT use can be identified from the literature. However, there are a few papers that did a good job at generalizing and categorizing previous measures (Bernard, 2004; Burton-Jones & Straub, 2006; DeLone & McLean, 1992). Next, we present them in order to give a gist of the diversity of IT use measurements in past studies.

In the IS success model suggested by DeLone & McLean (1992), IT use was posited as one of the important indicator of IS success. Reviewing previous works, DeLone & McLean (1992) clearly summarize prior measures for IT use. Constructs measuring IT use can be roughly categorized by binary measure (use/non-use), absolute (number of minutes, number of functions used, hours per week etc.) relative measure (percentage of time the system is used, frequency of use, regularity of use etc.), voluntariness of the use (mandatory or

voluntary), directness of use (direct or indirect use), subjectivity of use measurement (subjective or objective measure), and level of use (general "routinely" use or specific "personalized initiated request" for additional functions that reflect a higher level of ability to utilize the system). It is worth noting that only one paper, Zmud et al. (1987), among DeLone & McLean (1992)'s literature review, takes into account the tasks that IT was used to complete, that is, whether IT was used in support of cost reduction, in supporting management, or for strategy planning and competitive thrust.

Table 2 IT use Operationalization and Measurement

Author	IT use operationalization	IT use measurement
Lucas (1975)	N/A	Working with customers; Detailed analysis of buying entity/account; Overall progress; Summary this year versus last year; Planning; Cancellation.
Snitkin & King (1986)	Duration of use	Estimated hours of use per week
Millman & Hartwick (1987)	Decision to use; Frequency of use.	Which sub system were used; How often the system was used.
Pentland (1989)	Decision to use; Variety of use; Extent of use; Duration of use.	First two analysis: which features were actually used; For the third analysis: number of audit tasks automated, the number of AES features used, the hours of use per week.
Yoon & Guimaraes (1995)	Frequency of use	Agreement or disagreement with the statement "the ES is used all the time"
Straub et al. (1995)	Proportion of use; Extent of use.	Percentage of number of messages sent/received on an average day; Heavy/light/moderate/non user; Features of system used.
Goodhue & Thompson (1995)	Degree of dependence of use.	Respondents were asked to rate how dependent they were on a list of systems available in their organizations.
Igbaria & Tan (1997)	Extent of use; Variety of use.	Number of computerized application used; Number of business tasks for which the system is used (Eight tasks and sixteen different types of software applications were listed)
Pinsonneault & Rivard (1998)	Extent of use; Duration of use; Variety of use.	The respondents were asked to indicate which application was used, for how many minutes and for what purpose each was used.
Gelderman (1998)	Duration of use; Frequency of use.	How many hours per week, and how many times a week the system was used.

Lucas & Spitler (1999)	Extent of use;	Heavy/light use; Which subsystems were used; Which functions were used
D'Ambra & Rice (2001)	Hours of use; General use.	Hours per week; Years using PC; Computing expertise.
Dasgupta et al. (2002)	Extent of use; Duration of use.	Actual usage data from system log files
McGill et al.(2003)	Frequency of use.	Use all the time/often/not often etc.
Staples & Seddon (2004)	Duration of use; Frequency of use.	Number of hours used in the past and expected to use in the future; Light/heavy user; Frequent/infrequent user.
D'Ambra & Wilson (2004)	Decision to use; Variety of use.	Use/non-use; Use for what tasks;
Sundarraj & Vuong (2004)	Duration of use.	Weekly number of conversion completed by a respondent by two-bucket categorization
Livari (2005)	Duration of use; Frequency of use.	Hours spent daily; Frequency of use (numeric).
Bokhari (2005)	Duration of use; Frequency of use.	"Two common measures of system usage—time spent in terms of hour and frequency of use"(page 214)
Almutairi & Subramanian (2005)	Decision to use; Extent of use; Variety of use.	Time spent daily; Frequency of use (numeric); Use on what tasks; Which package was used.
Jelinek et al.(2006)	Frequency of use; Extent of use; Variety of use.	Frequent user (semantic); Fully use the capabilities; Integrate into sales process; Use different automation tools; Use only for task required.
Guimaraes et al. (2007)	Duration of use; Frequency of use.	Hours spent daily; Frequency of use (numeric).

Bernard (2004) suggests that IT use measurements vary along five attributes: dimensionality, overt/covert behavior, subjectiveness, relativeness, and voluntariness. Dimensionality refers to how many dimensions of IT use are evaluated, including decision to use, frequency, duration, extent of use, dependence of use, or multi-dimensioned. IT use as overt behaviour refers to the tangible and observable use behaviour while IT use as covert behaviour refers to cognitive process, which is harder to measure. Subjectiveness relates to the self-report measurement as opposed to computer-logged record. Relativeness refers to whether IT use was measured as a proportion or absolute amount. Lastly, voluntariness indicates the extent to which the use environment is voluntary or mandatory. Bernard's study shows that, except subjectiveness, the other four attributes of IT use measurements do affect the IT use-individual performance relationship along three dimensions of individual performance—productivity, quality or multi-dimension.

Burton-Jones & Straub (2006) reviewed diverse measurements for IT use in previous research from 1977-2005 and classified them into two broad dimension—IT use measured as the use of information generated from an information system or IT use as the use of an information system. Both were further broken down into sub-dimensions reflecting diversified aspects of IT use (see Figure 2). The sub-dimensions include, among others, extent of use, duration of use, frequency of use, and decision to use (for more refer to Figure 2), resembling the dimensions proposed by DeLone & McLean (1992) and Bernard (2004). Apart from the dimensions stated in Bernard (2004), Burton-Jones & Straub (2006) added new dimensions, such as method of use (direct or indirect use), variety of use, and specificity of use (general or specific use).

Figure 2 Diverse Measurements for IT use in previous studies (Burton-Jones & Straub (2006)

Broad dimension	Individual measures	Used as IV	Used as DV
System usage measured as the use of information from an IS			
Extent of use	Number of reports or searches requested	✓	✓
Nature of use	Types of reports requested, general versus specific use	✓	
Frequency of use	Frequency of report requests, number of times discuss information		✓
System usage measured as the use of an IS			
Method of use	Direct versus indirect		✓
Extent of use	Number of systems, sessions, displays, functions, or messages; user's report of whether they are a light/medium/heavy user	✓	✓
Proportion of use	Percentage of times use the IS to perform a task		✓
Duration of use	Connect time, hours per week	✓	✓
Frequency of use	Number of times use system (periods are: daily, weekly, etc.)	✓	✓
Decision to use	Binary variable (use or not use)		✓
Voluntariness of use	Binary variable (voluntary or mandatory)		✓
Variety of use	Number of business tasks supported by the IS	✓	✓
Specificity of use	Specific versus general use		✓
Appropriateness of use	Appropriate versus inappropriate use	✓	✓
Dependence on use	Degree of dependence on use	✓	✓

[1]Developed from a sampling of 48 articles in major IS journals in the period 1977–2005 (Burton-Jones 2005).

These three papers covered all essential dimensions of IT use measurement in past studies. They resemble and complement one another. DeLone & McLean (1992) is a classic literature review for IS success indicators, while Bernard (2004) and Burton-Jones & Straub (2006) both attempted to clarify the IT use measurement issue with different approaches. Bernard's study indicates that IT use measurements do affect the IT use-individual performance relationship. Burton-Jones & Straub (2006) further proposed a two-staged approach to devise IT use measurement to improve its accuracy and integrity.

1.1.3 Deficiencies with Current IT Use Measurement

Two essential insufficiencies with the IT use measures currently used in the literature are: first, the IT use measurement tends to be uni-dimensional, more often than not, lean dimensioned; second, IT use measurement is diversified from study to study. Different measurement was selected for different studies, as can be seen in Table 2.

1. **Uni-dimensionality issue.** Measurements for IT use in the literature tend to be uni-dimensional and thus fail to examine how IT was actually used in organizations (Doll &

Torkzadeh, 1998). Boffo & Barki (2003) reviewed papers that assessed IT use in MISQ and ISR during 1992-2002 period, and pointed out that IS use is typically conceptualized as an amount. Therefore, IT use was, often, merely operationalized as frequency, duration, or variety of functions used (Barki et al., 2007). The traditional measures such as decision to use (use or non-use) represent limited practical value when IT use is mandatory (DeLone & McLean, 1992) or when the actual specific behaviour is meant to improve productivity in the workplace (Chin & Marcolin, 2001). In a social setting, IT is viewed as being used by individuals in a work context to perform certain organizationally relevant functions (Doll & Torkzadeh, 1998). Hence, inevitably, there are other variables coming in the way when considering IT use as an intervening variable linking information technology to performance (Trice & Treacy, 1988). The extensive scale of IT use in modern-day organizations determined its delicate nature thus it is unlikely that one or two dimension is sufficient to effectively measure the IT use construct (Doll & Torkzadeh, 1998). Take "variety of use" for example. "Variety of use" is normally measured by asking respondents "what and how many applications of the information system were used". In real workplace, for example, bank account managers can efficiently switch between different applications to better serve their customers or they can be merely goofing off at work, or they can be bewildered and overwhelmed by multiple applications. As a result, the simple measurement "the number of application" used at work demonstrates little, if any, practical value to researchers and practitioners.

2. **Diversity measurement issue.** Naturally, different systems require different level of use as sufficient. *Level of use* refers to the extent of sufficient use level (Szajna, 1993). For example, to improve individual performance, a word processing system might need to be used on regular basis while an expert system is only used when it comes to make a specific

decision. It would be arbitrary to claim which level of use is sufficient for all different systems. Furthermore, level of use is also related to the job description in question. As a result, different IT measurements were selected by researchers in various system contexts. However, this distinction in the construct operationalization impedes the collective efforts of IS researchers to compare across studies. To sum up, the aforementioned issues existing in current IT use literature call for a more solid understanding of the IT use construct and the development of a more comprehensive IT use measurement.

1.1.4 Efforts to Improve IT Use Construct

The fact that there is no accepted definition of IT use is directly responsible for the incongruent operationalization for this construct in academics (Burton-Jones & Straub, 2006). In order to better accommodate IT use as an independent variable in different implementation settings and to compare studies in this area, a standardized approach to define IT use and select its measurement is imperative (Burton-Jones & Straub, 2006; Trice & Treacy, 1988). A few researchers attempted to re-conceptualize and operationalize IT use in a more comprehensive and accurate fashion (Barki et al., 2007; Burton-Jones & Straub, 2006; Doll & Torkzadeh, 1998; Trice & Treacy, 1988).

Trice & Treacy (1988) suggested that in order to better evaluate IT use in organization, great emphasis should be accentuated on the actual IT use phenomena, which shares a tighter link with individual performance. Accordingly, they suggested two ways to operationalize IT use as an independent variable. The first one is to identify dimensions of individual performance which are of interest to practitioners, and then measure the corresponding aspects of IT use. For example, if a bank is interested in how well IT was used to improve its account management capability, then researchers should focus on the account management related

features of the information system, rather than other features, for example, online group discussion function of the information system. A second way to better operationalize IT use is to scrutinize the "theoretical factors" that were shown to affect performance from past theory of performance and operationalize IT use accordingly (Trice & Treacy, 1988).

Aware of the wide gap between the potential of IT use and the actual IT use in organization settings, Doll and Torkzadeh (1998) proposed an agenda to measure IT use in organizations. Reviewing previous IT use measurement, they argued that the previous measurements merely captured overt data of IT use, such as frequency of use, hours of use, and number of application used. These measures lack a deeper insight into IT use, that is, how the technology is used by individuals to perform certain tasks in real organization. For example, IT can be used to assist in problem-solving, to serve customers or to coordinate work activity vertically or horizontally in organization. Grounding their research on studies in technology's impact on nature of work domain, Doll and Torkzadeh (1998) presented Hirschhorn & Farduhar (1985)'s five components of IT use: problem solving, decision rationalization, horizontal integration, vertical integration and customer service. Doll and Torkzadeh (1998) further argued that the common operationalization, such as frequency of use, or number of features used, is rather an indicator of skill than performance-related behaviour. They reviewed the social science literature to show how IT use affects task performance at the individual level in post-implementation context. Specifically, IT use was found to support individual decision-making by providing useful data and models. Horizontal work integration was enabled by establishing communication between individual users. Through vertical integration, managers are able to supervise and direct the subordinates. Also, IT use was found to create value for both internal and external

customers. To support their statement, Doll and Torkzadeh (1998) empirically examined the reliability of 62 items used in past studies to measure the five dimension of IT use. They argued that the approach they suggested to operationalize IT use will help better facilitate downstream information system research.

Burton-Jones & Straub (2006) distinguished between three essential elements of IT use: user, system, and task. They proposed a two-staged approach to define IT use and to select IT use measures. They created a continuum for the richness of IT use measurement, which ranges from "very lean" to "very rich". The six levels of richness were determined by which of the three elements are involved in the evaluation. For example, the binary measure "use/non-use" is a "very lean" measure; duration and extent of use are examples of a "lean" measure; one richness level up of "lean" measure is "somewhat rich". It refers to the inclusion of one of the three essential elements, system, i.e. of which features the system was used; "rich" measure involves two elements: system and user, or system and task; finally, the "very rich" measure includes all the three elements. The author suggested that researchers select relevant elements of IT use according to the context in which the study will be conducted.

In the same vein, Barki et al. (2007) reviewed papers published in MIS and ISR between 1992 and 2007 and suggested the concept of ISURA (Individual-level IS Use-Related Activity) which refers to what individuals do to perform tasks and for which they employ IT. This idea, again, encompasses the three major components: task, technology, and individual as accentuated in Burton-Jones & Straub (2006).

1.2 INDIVIDUAL PERFORMANCE

Individual performance plays a great role in organizational life and other human affairs in general. There are many kinds of performance given different situations. For example, in classroom setting, students are normally evaluated based on their participation, assignments, or capability to cooperate. In an organizational context, workers' individual performance may be evaluated in terms of their productivity, quality of their output, commitment to the job, communication skills, or integrity. Due to the variety of contexts, individual performance was vaguely defined and measures are drastically different. In this section, we will review individual performance definitions, operationalizations, and measurements that are relevant to current study. Most of these are shared and mentioned repeatedly in the IS literature.

1.2.1 Individual Performance Definition

The discussion about individual performance abounds in psychology literature, human resource research, and general management literature. However, in IS literature, researchers seem to assume that individual performance is rather self-explanatory, which would explain why we lack a clear definition. In addition, putting together the research that studied individual performance in IS literature, we can see that the contexts, the constructs measured, or the theories based upon are not consistent.

As demonstrated in the Table 3, most studies developed their definitions of "individual performance" based on the "individual impact" definition from DeLone & McLean (1992). According to DeLone & McLean (1992), IT use leads to three types of outcomes: user satisfaction, individual impact, and organizational impact. *Individual impact* was defined as "the effect of information on the behaviour of the recipient". Compared to *individual*

performance, the term *individual impact* was used loosely. It transcends mere *individual performance* and includes all other outcomes under different contexts, for example, change in decision-making productivity, change in user activity, and user's perception of the importance of the system (DeLone & McLean, 1992).

Table 3 Individual Performance in IS studies

Author	Individual Performance Definition	Measure	Based on
Lucas (1975)	None	Sales performance	Pounds (1969)
Aldag & Power (1986)	None	Decision reports	n/a
Snitkin & King (1986)	None	Perceived effectiveness	n/a
Cats-Baril & Huber (1987)	None	Quality of user's performance; User's productivity of ideas	n/a
Millman & Hartwick (1987)	Perceived change in jobs and work	Performance	Work design literature
Pentland (1989)	Productivity in any given task depends on whether the computer is used, the fit between the task and the technology, and the skill level of the user	Productivity	Lucas (1975)
Kuaut, Dumais, & Koch (1989)	None	Productivity; Quality	n/a
Udo (1992)	None	DSS benefits	n/a
Szajna (1993)	None	Perceived decision performance	n/a
Goodhue & Thompson (1995)	Performance impact in the paper's context relates to the accomplishment of a portfolio of tasks by an individual. Higher performance implies some mix of improved efficiency, effectiveness and/or higher quality.	Performance impact	DeLone & McLean (1992)
Yoon & Guimaraes (1995)	Expert system are thought to have significant impact on users' job by providing problem-solving expertise on specific problem areas thus improving user productivity	ES impact on users' jobs	DeLone & McLean (1992); Expert System literature
Etezadi-Amoli & Farhoomand (1996)	The impact of the primary application software on the user's work environment	User performance	n/a
Igbaria & Tan (1997)	Individual impact refers to the influence of IT on the perceived performance of the individual on the quality of his/her decision making.	Individual impact	Millman & Hartwick (1987); Attewell & Rule (1984)

Lucas & Spitler (1999)	None	Performance and prior performance	Davis (1989); DeLone & McLean (1992)
D'Ambra & Rice (2001)	Performance impact involves accomplishing a portfolio of tasks by an individual. High performance implies a high level of TTF, and satisfaction with the IS.	Performance impact	DeLone & McLean (1992); Goodhue & Thompson (1995)
Dasgupta, Granger et al. (2002)	None	Academic performance	Lucas & Spitler (1999)
Cascant, Ecuador, Plaisent et al. (2002)	Performance is identified as a specific outcome	Decision making performance	Decision support system literature; Goodhue & Thompson (1995)
McGill & Hobbs (2003)	Individual impact is the effect of the IS on the behavior of the user.	Individual impact	DeLone & McLean (1992)
Sundarraj & Vuong (2004)	None	Perceived performance of employees	Torkzadeh & Doll (1999)
Staples & Seddon (2004)	Overall net benefit of the system	Perceived performance impact	Goodhue & Thompson (1995)
D'Ambra & Wilson (2004)	Performance impact is the accomplishment of a portfolio of tasks by an individual. Higher performance implies a high level of task-technology fit, and satisfaction with the Web.	Performance impact	Goodhue & Thompson (1995)
Almutairi & Subramanian (2005)	Individual impact examines the effect of IS on the user's performance.	Individual impact	DeLone & McLean (1992)
Livari (2005)	DeLone & McLean (1992) characterize individual impact as "an indication that an information system has given a user a better understanding of the decision context, has improved his/her decision making productivity, has produced a change in user activity, or has changed the decision maker's perception of the importance or usefulness of the information system". Individual impact was interpreted as a unit of analysis rather than the beneficiary of the impact and was defined as the effect of an information system on the work performance of individual users as measured by perceived usefulness.	Individual impact	DeLone & McLean (1992)
Jelinek et al. (2006)	Presents literature review that shows automation system enhance communication, personal effectiveness, decision making, productivity, and improved services.	Sales performance	n/a
Guimaraes et al. (2007)	None	Job impact	Millman & Hartwick (1987)

In the 70s and the 80s, most research used performance, productivity, or quality without defining it. After DeLone & McLean (1992)'s paper, some research used their definition of *individual impact* and examine the effect of IT use in its general sense (Almutairi & Subramanian, 2005; Livari, 2005; Lucas & Spitler, 1999; McGill et al., 2003; Yoon & Guimaraes, 1995). For instance, McGill & Hobbs (2003) defined individual impact as "the effect of the IS on the behavior of the user". Almutairi & Subramanian (2005) stated that individual impact examines "the effect of IS on the user's performance". Meanwhile, Goodhue & Thompson (1995) developed their definition of "performance impact". In their paper, *performance impact* relates to "the accomplishment of a portfolio of tasks by an individual". Higher performance implies some mix of improved efficiency, effectiveness, and/or higher quality. Several studies adopted Goodhue & Thompson (1995)'s definition (Cascant, Ecuador, & Plaisent, 2002; D'Ambra & Rice, 2001; D'Ambra & Wilson, 2004; Staples & Seddon, 2004).

There are several other papers that develop their constructs of individual performance from the work design literature (Guimaraes, Staples, & Mckeen, 2007; Millman & Hartwick, 1987) or the decision sciences literature (Aldag & Power, 1986; Cats-Baril & Huber, 1987; Snitkin & King, 1986; Szajna, 1993; Udo, 1992), which we will discuss in section 1.2.2.

As a matter of fact, the review above did not clarify the definition of individual performance. We believe it would be necessary and informative to trace back to management literature for more rudimentary explanation. Different than IS literature, in Campbell et al. (1993), it was clarified and accentuated that performance is the action itself; it is not the consequence or result of action. "Performance is defined as a synonym of behavior. It includes those actions

or behaviors that are relevant to the organization's goals and that can be scaled in terms of each individual's proficiency". The authors also warned that there is a distinction between performance, effectiveness, and productivity. *Effectiveness* refers to "the evaluation of the results of performance". In this perspective, most of the studies we reviewed in IS field fall into this category. What most researchers measured was the effect of IT use action or behaviors. In the same vein, the common definition of *productivity* is the ratio of output to the input or "the ratio of effectiveness to the cost of achieving that level of effectiveness".

Campbell et al. (1993) pointed out eight factors constitute the major parts of performance. They are job-specific task proficiency, non-job-specific task proficiency, written and oral communications task proficiency, demonstrating effort, maintaining personal discipline, facilitating peer and team performance, supervision/leadership and management/administration. In practice, not all factors are required in all jobs. However, three components are essential to every job: core task proficiency, demonstrated effort, and maintenance of personal discipline. Most IS literature focused on the component "core task proficiency" and examined IT use's effect on the core task proficiency (e.g. Lucas & Spitler, 1999; Boffo & Barki, 2003).

Also, Campbell et al. (1993) argue that, aside from the effect of personal traits, individual performance difference is determined by three factors: declarative knowledge, procedural knowledge and skill, and motivation. *Declarative knowledge* refers to the knowledge about facts i.e. understanding what to do for a give task. *Procedural knowledge and skill* is the combination of knowing what to do for a given task and how to do it. *Motivation* stems from three factors: the choice to make efforts, the level of effort made, and the perseverance of that specific

level of effort. According to Campbell et al. (1993), these three factors are the direct determinants, others factors being indirect antecedents. That is, all other differences in organizations, such as management support, training, and innovative technology, affect individual performance through these three factors. For example, a new bank account management system will most likely change the way account manager works i.e. the tasks required and how to do the tasks will be changed. For example, different types of customer information might be needed in order for the new system to calculate, work used to be done on paper, now needs to be entered to the system in standard electronic format. Therefore, the implementation of this new information system induced change in the three direct determinants of individual performance. The change of the three direct determinants further leads to the change of account manager's performance.

1.2.2 Individual Performance Operationalization and Measurement

In IS field, individual performance was operationalized and measured differently under specific contexts. As demonstrated in Table 4, there are roughly five major approaches that researchers take to operationalize and measure individual performance: objective numeric indicators, decision support system related measurement, job impact, generic performance measurement, and multi-dimensional measurement.

Table 4 Individual Performance Operationalization and Measurement

Author	Individual Performance Operationalization	Based on	Individual Performance Measurement
Lucas (1975)	Sales performance	n/a	Gross total booking for 1972 selling season obtained from sales information system files.
Aldag & Power (1986)	Four factors were evaluated: system orientation, quality, problem statement and adequacy, and general negative effect.	n/a	n/a
Snitkin & King (1986)	n/a	n/a	The respondents were asked to describe the effectiveness of their system ranging from "very effective" to "not very effective" in "solving business problems"
Cats-Baril & Huber (1987)	The subjects' occupational preference profile, the list of career objectives, the list of strategies for achieving those objectives and prioritized list of those alternatives	n/a	Productivity was measured directly using 3 measures: the number of objectives generated by the subject, the number of alternatives, and the number of alternative strategies the subject decided to prioritize.
Millman & Hartwick (1987)	How office automation had influenced users personally	Hackman & Lawler (1976); Hackman & Oldham (1976); Hackman & Oldham (1980); Job satisfaction literature	Respondents were asked to indicate whether automation had increased, decreased or had no effect on 15 different aspects of their job and work including: 1. importance of job 2. amount of work required on job 3. accuracy demanded by job 4. skills needed on job 5. interesting work 6. knowledge of performance on job 7. responsibility for results of work 8. freedom in how to do the job 9. supervision received on the job 10. opportunity for advancement 11. job security 12. relationship with fellow employees 13. personal effectiveness 14. department's effectiveness 15. organization's effectiveness

Pentland (1989)	Productivity was operationalized in terms of both efficiency and effectiveness; Efficiency represents quality, or how quickly a given task is done; Effectiveness represents the difference in quality of work done using computer, or how well a given task is done.	n/a	Efficiency measured as the difference in the time required completing a case by using the laptop; the objective actual hours charged to each case was also included. Effectiveness was measured subjectively in terms of whether the laptop 1. Improve the quality of work 2. Enhances my ability to contribute to my job 3. Enhances my pride in my work 4. Allows to do more Effectiveness was also measured in objective measure "the dollars assessed per hour of time on case".
Kuaut, Dumais, & Koch (1989)	User's reports of the frequency with which they performed important job-related tasks (e.g. finding a customer record, adjusting an account or making a sales attempt) and the ease of accomplish these tasks	n/a	n/a
Udo (1992)	Decision quality, competitive edge, improved communication, production cost reduction, increased productivity, time savings, overall cost-effectiveness.	n/a	n/a
Szajna (1993)	Decision performance was measured using the formula: $\text{profit} = \frac{\text{subjective allocation profit- zero allocation profit}}{\text{optimal allocation profit- zero allocation profit}}$		
Goodhue & Thompson (1995)	Perceived performance	n/a	Users were asked to self-report on the perceived impact of computer systems and services on their effectiveness, productivity and performance in job
Yoon & Guimaraes (1995)	Eleven variables 1. Importance of the user's job; 2. amount of work required on job; 3. accuracy demanded on job 4. skills needed to do the job 5. job appeal 6. feedback on job performance 7. freedom in how to do the job 8. opportunity for advancement	Expert System literature	n/a

	9. job security 10. relationship with fellow employees 11. job satisfaction		
Etezadi-Amoli & Farhoomand,(1996)	n/a	n/a	Four variables 1. improving user's quality of work 2. making the end user's job easier 3. saving time 4. helping fulfill the needs and requirements
Igbaria & Tan (1997)	1. Decision making quality 2. Performance 3. Productivity 4. Effectiveness of the job	n/a	n/a
Lucas & Spitler (1999)	Bank record of performance data for individual brokers	n/a	Log of 1994 and 1995 average monthly commission revenue; an implied performance is calculated for each sales assistant by averaging the commissions of the brokers with whom they works
Torkzadeh & Doll (1999)	Task productivity Task innovation Customer satisfaction Management control	n/a	Please refers to appendix A on page 336 in Torkzadeh & Doll (1999)
D'Ambra & Rice (2001)	Performance impact	n/a	1. Positive impact on my ability to get things done; 2. Quality of work done; better decision; 3. Accomplish things more quickly; 4. Increased knowledge about topics or interests; 5. Better informed.
Dasgupta, Granger et al. (2002)	Performance is operationalized as the academic success attained by a student in class.	n/a	Performance was calculated as a weighted average of scores in assignments, exams, and projects.
Cascant, Ecuador, Plaisent et al. (2002)	Decision making performance		The decision making performance was determined by the closeness of the solutions to the correct solutions.
McGill & Hobbs (2003)		Goodhue & Thompson (1995)	Whether system use improves 1. Perceived effectiveness 2. Productivity 3. Performance

Sundarraj & Vuong, (2004)	Productivity Innovation Customer satisfaction	Torkzadeh & Doll (1999)	11-item on page 13 in Sundarraj & Vuong (2004)
Staples & Seddon (2004)	1. Efficiency and effectiveness issue 2. Overall advantage 3. Cost-effectiveness 4. Overall satisfaction.	Goodhue and Thompson (1995); Seddon and Kiew (1996); Moore and Benbasat (1991)	Seven self-reported questions: 1. The system is a cost-effective solution to my needs 2. The advantage of using the system outweigh the disadvantage 3. The system is efficient 4. The system is effective 5. Overall I am satisfied with the system 6. The system is worthwhile 7. I would have no difficulty telling others about the results of my use of the system
D'Ambra & Wilson (2004)	Performance impact	n/a	1. Positive impact on the ability to make travel arrangement; 2. Quality of travel has improved; 3. make better travel decision; 4. Accomplish travel arrangement more quickly; 5. Increased knowledge about travel; 6. Better informed about the travel in general.
Almutairi & Subramanian (2005)	Productivity, Innovation, Customer satisfaction Management control.	Torkzadeh & Doll (1999)	Measurement was given in Appendix 2 section V on page 122 in Almutairi & Subramarian (2005)
Livari (2005)	Individual impact was operationalized as the impact on the user's work performance. Perceived usefulness was considered covering all aspects of individual impact.	Adaptation of the 6-item instrument for perceived usefulness by Davis (1989)	1. Enable the user to accomplish tasks more quickly; 2. Improves user's job performance; 3. Increase user's productivity; 4. Enhances user's effectiveness in the job; 5. Makes user's job easier; 6. The system is useful in user's job.
Jelinek et al. (2006)	Sale's achievement of sales objectives.	Shortened version of Behrman & Perreault (1982)'s scale	1. Generating high levels of dollar sales; 2. Exceeding sales targets and objectives; 3. Selling high profit margin products
Guimaraes et al. (2007)	Perceived impact of the system was evaluated in terms of performance, productivity, and effectiveness in respondent's job.	Adapted from Millman & Hartwick (1987)	Importance of job; Amount of work required on job; Accuracy demanded from the job; Skills needed to do the job; Job appeal; Feedback on job performance; Freedom in how to do the job; Opportunity for advancement; Job security; Relations with fellow employees; Job satisfaction.

Objective numeric indicators is the most straightforward one and normally can be simply obtained from information system recorded data. Lucas (1975) used gross total booking obtained from a sales information system files to measure the individual performance of sales representatives and accounting executives. In the same vein, Lucas & Spitler (1999) withdrew the average monthly commission revenue from the bank information system log to evaluate brokers' individual performance. In classroom setting, grade is, without question, considered as appropriate measure for students' individual performance (Dasgupta et al., 2002). Szajna (1993) used a formula to calculate profit as individual decision making performance.

In *decision making* area, the measures are somewhat different, pertaining more closely to the decision support system context. With DSS (decision support system), IT has become an essential tool to help individual make better decisions in order to accomplish their daily tasks. By providing specific problem-solving tactic, expertise and strategy, decision support system was believed to improve user's productivity. For example, Igbaria & Tan (1997) clearly defined *individual impact* as the influence of IT on the perceived performance of individual decision making quality. Therefore, a large number of studies have focused on decision making process. The measures often used are, for instance, time to arrive at a decision (Udo, 1992), quality of decision making (Udo, 1992), change in decision behavior, and value in decision making. DeLone & McLean's review identified a few measures used in previous studies. For instance, "understanding of information" measure includes interpretation accuracy, ability to identify strategic opportunities or problems, user understanding of inventory problem; "application of the information to a specific problem" measure includes number of alternatives considered (Cats-Baril & Huber, 1987), time to

reach a decision; "change in decision making behavior" measure includes decision quality, change in decision behavior. In addition, there are other studies which examined overall efficiency and effectiveness as outcomes of the decision making process e.g. time taken to complete task, task performance, personal effectiveness (Snitkin & King, 1986), and productivity improvement (Udo, 1992).

Some researchers evaluate individual performance in light of IT use *impact* on the users' jobs. Early scholars saw IT as a big leap for automating and deskilling work in the sense that the machine could take the place of labour as in the industrial revolution (Attewell & Rule, 1984; Braverman, 1974). Subsequent scholars argue that IT requires highly intellectual skill to make full use of the new technology thus in a way enrich the work (Doll & Torkzadeh, 1998). Specifically, studies of IT impact on job quality showed that IT had a very substantial positive impact along five job dimensions: skill variety, task identity, task significance, autonomy, and job feedback (Long, 1993; Millman & Hartwick, 1987). Evidently, the effect varies across managerial hierarchy, with first line supervisor benefiting the least and middle management benefiting the most. The clerical and secretary jobs have increased the most in quality since computer eliminates most of the routines and repetitive tasks for them (Long, 1993). Along the same five dimensions, an office automation system was found to positively affect middle manager's job: they claimed that they have more job security and promotional opportunity, and that their work became more interesting, and most importantly their own personal effectiveness and productivity has improved (Millman & Hartwick, 1987). Despite the two opposing opinions, some other researchers argue that both deskilling and upgrading are happening in the industry (Attewell & Rule, 1984; Pinsonneault & Rivard, 1998). Computerization and other new information technology indeed deteriorate the polarization

of skill distribution at work: the lower level unskilled clerical workers are victimized when their job, the mere manipulation of data, is replaced by computer. Meanwhile, information technology, when introduced in highly-routinized work situation, helped to decrease the drudge job from the information processing (Attewell & Rule, 1984). Millman & Hartwick (1987) presented a comprehensive list of the changes that IT use brings to user's job: importance of job; amount of work required on job; accuracy demanded by job; skills needed on job; job appeal; feedback of performance on job; responsibility for the results of work; freedom in how to do the job; supervision received on the job; opportunity for advancement; job security; and relationship with fellow employees. Yoon & Guimaraes (1995) and Guimaraes et al. (2007) developed their measures based on Millman & Hartwick (1987). It is worth noting that both Yoon & Guimaraes (1995) and Guimaraes et al. (2007) added job satisfaction as one of the dimensions. User satisfaction was originally identified as one of the influence of IT use by DeLone & McLean (1992). It is defined as "the recipient response to the use of the output of an information system" (DeLone & McLean, 1992) or more specifically, "the extent to which users are convinced an information system satisfies their information needs" (Bokhari, 2005) and "to the extent to which users believe the information system available to them meets their information requirements"(Gelderman, 1998). Gelderman (1998) developed alternative measures to evaluate individual performance—user information satisfaction in work situation when IT use comes to mandatory. He argued that users' impression reflects the actual effectiveness of the system.

Generic performance measurement has also been used in several studies (Goodhue & Thompson, 1995; Igbaria & Tan, 1997; McGill et al., 2003; Pentland, 1989; Staples & Seddon, 2004). Performance was identified explicitly as one specific outcome of IT use (Cascant et al.,

2002). The most common performance measures are productivity, effectiveness, efficiency, and quality (Igbaria & Tan, 1997; McGill et al., 2003; Staples & Seddon, 2004). For example, Pentland (1989) claimed that productivity can be operationalized in both efficiency and effectiveness. *Efficiency* refers to quantity i.e. how fast a certain task is done while *effectiveness* represents quality i.e. how well the task is done. In the same vein, Goodhue & Thompson (1995) suggest that higher performance implies improved efficiency, effectiveness, and higher quality. Etezadi-Amoli & Farhoomand (1996) measure the IT use impact with four items: quality of work, ease of job, time-saving, and whether the system fulfills the needs of the job.

As they did with regard to the uni-dimensionality of IT use measures, Torkzadeh & Doll (1999) criticized the use of productivity as a uni-dimensional measure of individual performance. They indicate the significant role of technology in serving customers in contemporary organization context. They reviewed previous literature on technology impact of all aspects of work life and identified multiple impacts of technology based on a broader concept. Four types of constructs were suggested to assess the technology's impacts on work, namely, task productivity, task innovation, customer satisfaction, and management control. Additionally, they suggest that different part of this instrument might be used to assess different types of applications. Recently, more researchers started to apply their measure of individual performance (e.g. Sundarraj & Vuong, 2004; Almutairi & Subramanian, 2005).

1.3 RELATIONSHIP BETWEEN IT USE AND INDIVIDUAL PERFORMANCE

The relationship between IT use and individual performance has not been well addressed (Sundarraj & Vuong, 2004). The conventional wisdom is that more use will lead to better

performance. This can be traced back to DeLone & McLean's work. In their study, use was defined as surrogate measure of system effectiveness and success. After that, several studies based their model on this study, and overlooked testing the link between IT use and individual performance (Almutairi & Subramanian, 2005; Livari, 2005; McGill et al., 2003). Among those who did, however, research generated conflicting results (Cascant et al., 2002; D'Ambra & Rice, 2001; D'Ambra & Wilson, 2004; Goodhue & Thompson, 1995; Lucas, 1975; Lucas & Spitler, 1999; Sundarraj & Vuong, 2004). Therefore, researchers came to realize that greater use does not necessarily imply better performance (Goodhue, Klein, & March, 2000). Use must precede impacts but it does not necessarily cause them (Rai, Lang, & Welker, 2002; Seddon, 1997). Gelderman (1998) interprets the myth by exhibiting the underlying assumptions. He argued that this statement only holds true on two conditions: first, the users know perfectly how to assess the system and how to effectively use the system at work; second, the users must share goals congruent with those of the organization. However, IT use might be made mandatory by management or forced by social desirability. Thus the mere IT use behavior, in itself, is not sufficient to represent improved individual performance under all circumstances.

Researchers have made much effort to understand the relationship between IT use and the consequential individual performance but prior research failed to reach consensus on the nature, nor the strength of this very relationship. Only conflicting results were presented from previous studies, which will be discussed next.

1.3.1 More IT Use Improves Individual Performance

The conventional wisdom, IT use leads to better individual performance, is the most common result from previous study. A reasonable body of studies support this point of view. A summary of studies with positive relationship results is shown in Table 5.

Table 5 Research with positive relationship results

Article	Measurement		Results
	IT use	Indl. Perf.	
Lucas (1975)	Use of system for working with customers in store; Use of system for detailed analysis of buying entity; Use of system for overall progress; Use of system for summary this year versus last year; Use of system for planning; Use of system for cancellations	Total dollar bookings (sales data)	Use of system for working with customers in store → performance
Snitkin & King (1986)	Hours of use each week	Perceived effectiveness	Hours of use each week→ Perceived effectiveness
Millman & Hartwick (1987)	Indicate which of the systems were currently being used in the company: main frame; personal computer; word processing; email; and teleconferencing; How often each system was used in the department	Perceived personal effectiveness	The mere presence of system → perceived personal effectiveness; Personal use → perceived personal effectiveness
Cats-Baril & Huber (1987)	The presence or absence of decision-aid heuristics; The degree of interaction between users and system; Whether or not the system was computerized	Quality of user's performance; User's productivity of ideas	Productivity of ideas: no heuristic < heuristic, non-interactive < interactive, Computer = paper/pencil. Quality of performance: no heuristic < heuristic , non-interactive < interactive Computer = paper/pencil.
Pentland (1989)	Software used: Word processing, spreadsheet; Database; Micro RAR; Work center and field use.	Efficiency; Effectiveness	Subjectively ✓ Use of database → efficiency ✓ Use of all software → effectiveness Objectively ✓ Use of word process, and Micro RAR →effectiveness
Szajna (1993)	Number of reports used; Time spent on using the reports for historical and functional data	Decision performance	✓ Time spent on functional data → decision performance ✓ Percentage of time spent on the functional data → decision performance: significant positive
Goodhue & Thompson (1995)	Dependence on system use	Effectiveness and productivity; Performance	✓ Use → effectiveness, productivity and performance ✓ TTF → effectiveness, productivity and performance: positive (alone explain 14%)
Yoon & Guimaraes (1995)	Frequency of use	Eleven items dealing with changes in job importance, amount of work, accuracy requirements, skills needed, job appeal, feedback about	Use → desirable ES impact on user's job

		performance, freedom in how to do the job, opportunity for advancement, job security, relation with peers, and job satisfaction.	
Igbaria & Tan (1997)	Number of computerized applications used; Number of business tasks for which the system is used	Decision making quality; Performance; Productivity; Effectiveness of the job	Use → positive individual impact
Lucas & Spitler (1999)	Use of market, office and mainframe subsystem	Average monthly commission revenue from log data of 1994 and 1995	Performance in 1994 → performance in 1995
Torkzadeh & Doll (1999)	Perceived use pattern	Task productivity; Task innovation; Customer satisfaction; Management control	Use → Task productivity; Use → Task innovation; Use → Customer satisfaction; Use → Management control
Dasgupta, Granger et al. (2002)	Total use of system; Use of file exchange capabilities.	Actual performance from class grade rosters	Use of file exchange function of the system→performance
Cascant, Ecuador, Plaisent et al. (2002)	Use/non-use	The closeness of the solutions generated by the subjects to the correct solutions	Use → performance
Sundarraj & Vuong, (2004)	Weekly number of conversions completed; Frequent-user and non frequent users	Task productivity; Task innovation; Customer service	Use → productivity Use → customer services Use → innovation
D'Ambra & Wilson (2004)	Use/non-use; Information obtained from use	Efficiency; Quality; Effectiveness	Use → perceived performance ($R^2 = 0.25$).
Almutairi & Subramanian (2005)	Daily time spent on computer; Frequency of use; The extent to which computer helps in one's work; The number of packages used	Task productivity; Task innovation; Customer satisfaction; Management control	Use → individual impact
Jelinek et al. (2006)	Frequency of use; Extent of use; Variety of use	Sale people's achievement of sales objectives	Actual use→ improvements in sales performance
Guimaraes et al. (2007)	Duration of use; Frequency of use	Productivity; Performance; Effectiveness	Actual use→ positive job impact

Most of the studies above assessed IT use in organizational settings. Lucas (1975) examined both account executives and sales representatives using the same sales information system. The results show that IT use for working in store with customers predicts positive performance merely in division C. Division C is in a newly developed volatile market, facing the most uncertain and challenging situation. The rationale behind this scenario is that the sales system, which helped locate new business opportunity, fitted in the competitive environment and thus significantly improved the performance. Millman & Hartwick (1987) examined the impact of automated office systems on middle managers work and found that the mere presence of automation system did positively affect middle managers' perception of their personal effectiveness and that personal use of main frame and personal computer bring about increased personal effectiveness. Pentland (1989) examined both subjective and objective data sources for individual performance. The results from subjective data show that the Automated Examination System had a substantial positive impact on efficiency. Contrastingly, the objective data showed limited relationship between use and efficiency or effectiveness. Both Millman & Hartwick (1987) and Pentland (1989) demonstrate that, sometimes, IT use can be symbolic rather than instrumental, that is, users are confident and satisfied with the system, even though it might not be helping to improve the actual performance. However, due to the difficulty to gain objective data or unbiased subjective data, the research in IS is still mixed with both subjective and objective data sources. The subjectiveness of data sources constitutes a measurement issue that we will elaborate on in section 1.4.2. Igbaria & Tan (1997) examined some common IT use in office, such as email, and electronic scheduling and found a positive impact of IT use on individual performance, productivity, and effectiveness. Torkzadeh & Doll (1999) tested the use-individual performance relationship with their newly developed measures for individual performance

and found positive relationships between use and the four dimensions[1] of individual performance. Using the same four dimensions to measure individual performance as in Torkzadeh & Doll (1999), other studies further confirmed their findings (Almutairi & Subramanian, 2005; Sundarraj & Vuong, 2004). Greater IT use was found to render employee stronger perception of improvement in their productivity and in their ability to provide better customer service (Sundarraj & Vuong, 2004). Almutairi & Subramanian (2005) found that there is a significant relationship between IT use and individual performance, along all four dimensions—task productivity, task innovation, customer satisfaction and management control.

Studies out of workplace also show positive relationship between IT use and individual performance. It was found that there is a strong positive relationship between the use of world wide web and perceived performance in the travel information domain (D'Ambra & Rice, 2001; D'Ambra & Wilson, 2004). The result of this study also shows that performance is influenced directly by use regardless of technology-task fit, which means merely using the system improved performance (D'Ambra & Rice, 2001; Goodhue & Thompson, 1995). An e-collaboration technology to assist in students' study was found helpful to improve their performance (Dasgupta et al., 2002). The results however show that only more access of file exchange function of the software improved performance of grade while the total use of the system did not significantly relate to student performance.

Some of the studies presented in Table 1.5 are from the decision making area e.g.(Cascant et al., 2002; Cats-Baril & Huber, 1987; Snitkin & King, 1986; Szajna, 1993; Yoon & Guimaraes,

1 Four dimensions are task productivity, task innovation, customer satisfaction and management control.

1995). Even though IT use and individual decision making performance is not the focus of the current study, we present some examples of this stream to demonstrate the extent of IT use and its influential positive effect. Most of these studies confirmed the link between IT use and better individual decision making performance or job performance in general. Use is found to be associated with greater perceived effectiveness of decision making (Snitkin & King, 1986). Yoon & Guimaraes's assessment of an expert system shows that ES does induce positive impact on user's job. In a lab setting, the use of Expert Decision Support System, as a training tool for novice employees, was found to improve user's performance (Cascant et al., 2002).

1.3.2 More IT Use Leads to Less Individual Performance

There are a few studies whose results indicate that more IT use leads to less individual performance. They are shown in Table 6 as follows.

Table 6 Research with negative relationship results

Article	Measurement		Results
	IT use	Individual Performance	
Lucas (1975)	Use of system for working with customers in store; Use of system for detailed analysis of buying entity; Use of system for overall progress; Use of system for summary this year versus last year; Use of system for planning; Use of system for cancellations	Total dollar bookings (sales data)	Use → performance: $\beta = -.32$ ** (accounting executives)
Pentland (1989)	Software used: Word processing, spreadsheet; Database; Micro RAR; Work center and field use.	Efficiency; Effectiveness	Use of work center → subjective efficiency: $\beta = -.070$*
Udo (1992)	Frequency of use	DSS effectiveness	Frequency of use→ Perceived DSS effectiveness: $\beta = -.2352$
Szajna (1993)	Number of reports used; Time spent on reports; Time spent on using the reports for historical and functional data; Percentage of time spent on using historical and functional data	Perceived decision performance	Time spent on reports → perceived decision performance: $\beta = -.16$** Time spent on functional data → perceived decision performance: $\beta = -.15$**
Lucas & Spitler (1999)	Use of market, office and mainframe subsystem	Average monthly commission revenue from log data of 1994 and 1995	Performance →intended use: $\beta = -.21$**

* $p < .1$
** $p < .05$

Lucas (1975) examined both account executives and sales representatives using the same sales information system. Since the product line information provided by sales information systems is generally irrelevant to the work of account executives, the results show that the less account executives used the system, the better their performance were. Pentland (1989) found that there is a small negative association between IT use and perceived efficiency for the use of work centre. He attributed this inverse relationship to a task-technology misfit and insufficient user skills and training. Revenue agents were performing similar mix of tasks which require the use of certain hardware and software tools but it relies on users' discretion to correctly and efficiently choose the tool suitable for the task in order to achieve individual performance gain. Szajna (1993) also found that time spent on reports or the time spent on functional data did not improve user's perceived decision performance, while in the same study, it was found that time spent using functional data or the percentage of time spent on functional data did improve objective decision performance. This further supports the significant role of task-technology fit. We will discuss task-technology fit in section 1.4.1.

1.3.3 Non-Significant Relationship Between IT Use and Individual Performance

There are studies that did not find any significant relationship between IT use and individual performance. They are listed in Table 7 below.

Table 7 Research with non-significant relationship results

Article	Measurement		Results
	IT use	Individual Performance	
Aldag & Power (1986)	Use/non-use	Evaluation of decision reports.	Use → Evaluation of the decision making performance
Cats-Baril & Huber (1987)	The presence or absence of decision-aid heuristics; The degree of interaction between users and system; Whether or not the system was computerized	Quality of user's performance; User's productivity of ideas	Productivity of ideas: ✓ Computer=paper/pencil. Quality of performance: ✓ Computer=paper/pencil.
Udo (1992)	Frequency of use	DSS effectiveness	Frequency of use → DSS effectiveness: β = .0991 (non-Sig.)
Lucas & Spitler (1999)	Use of market, office and mainframe subsystem	Average monthly commission revenue from log data of 1994 and 1995	Use→performance: β = .03 (non-Sig.) intended use →performance: β = .07 (non-Sig.)
Dasgupta, Granger et al. (2002)	Total use of system; Use of file exchange capabilities	Actual performance from class grade rosters.	Total system usage →performance: β = .0225 (non-Sig.)
McGill & Hobbs (2003)	Intended frequency of use	Effectiveness and productivity	Intended use → perceived individual impact:: β = −.19 (non-Sig.)
Staples & Seddon (2004)	Hours per week; Frequent or infrequent use; Light or heavy use	Performance impact including Effectiveness, efficiency	Mandatory utilization → performance impacts: β = −.029 (non-Sig.) Voluntary utilization → performance impacts: β = .181 (non-Sig.)
Livari (2005)	Daily use; Frequency of use	Perceived efficiency; Perceived productivity; Perceived effectiveness	Actual use→ Perceived job performance (might be due to the mandatory environment): β = .15 (non-Sig.)

Udo (1992) and McGill & Hobbs (2003) both measured IT use with frequency of use and measured individual performance with effectiveness. Their results showed no significant relationship between IT use and individual performance with low beta values. Lucas & Spitler (1999) and Dasgupta et al. (2002) both use the binary IT use measure (use/non-use) and objective individual performance measures. Their results showed no significant relationship between IT use and individual performance. The beta values are even lower than the ones presented in Udo (1992) and McGill & Hobbs (2003). Staples & Seddon (2004) measured IT use with frequency and total time spent on system in both mandatory and voluntary implementation settings. Neither setting showed significant relationship. However, in mandatory setting, the beta value was negative while in voluntary setting, it was positive.

1.3.4 Individual Performance Predicts IT Use

Very few studies, as presented in Table 8, investigated the reverse relationship between IT use and individual performance. The reverse relationship is not the focus of current study, but it is worth noting the two studies that looked into it. Lucas (1975) found a weak negative relationship between performance and the intended IT use. Twenty years later, Lucas & Spitler (1999) examined this reverse relationship again and found that high level of use and/or intended use were predicted by lower prior performance. They reasoned that poor performers most likely consider using the system as a way to improve their performance. Ironically, in the same study, use was found not significantly related to the subsequent performance at the next phase. A plausible explanation for this scenario is that the system had not been used long enough to have had an impact on performance or the use context was much more complex than usual thus rendering the relationship more complicated.

Table 8 Research with reverse relationship between IT use and individual Performance

Article	Measurement		Results
	IT use	Indl. Perf.	
Lucas (1975)	Use of system for working with customers in store; Use of system for detailed analysis of buying entity; Use of system for overall progress; Use of system for summary this year versus last year; Use of system for planning; Use of system for cancellations	Total dollar bookings (sales data)	Performance→ intended usage : negative (weak strength)
Lucas & Spitler (1999)	Use of market, office and mainframe subsystem	Average monthly commission revenue from log data of 1994 and 1995	✓ Performance →intended use: negative (the strongest negative relationship is for the word processing package) ✓ Performance in 1994 → performance in 1995: positive

1.4 EFFORTS TO EXPLAIN THE CONFLICTING RESULTS

In general, two different points of view dominated in previous studies regarding the consequence of technology, deterministic view and in-deterministic view. Determinist claims that technology will inevitably lead to either negative or positive consequence, on the other hand, in-determinist takes a less assertive position, suggesting that neither result is inevitable, and that a variety of factors participate affecting the outcomes depending on the specific contexts (Long, 1993). With the accumulating conflicting results on the IT use-performance relationship from the prior studies, researchers are keen to find out the explanation to the seemingly contradictory results. A number of factors could possibly affect the relationship between IT use and individual performance. For example, Yoon & Guimaraes (1995) examined the use of an Expert System. The results show that nine out of the ten major expert system related factors, problem importance, problem difficulty, domain expert quality, user characteristics, user satisfaction, shell quality, user involvement, management support and system use are all directly related to desirable impact on users' jobs. Use alone is only a moderate factor for this outcome. Therefore, it was suggested that other factors might take part and affect the strength of the relationship between IT use and performance. In this section, we will present some important factors that are found from previous research and introduce our research question.

1.4.1 TTF

One of the most renowned factors that influence the IT use-performance relationship is technology-task fit (Goodhue & Thompson, 1995). In Pentland (1989)'s paper, it was proposed that performance is determined by the match between "a certain set of system tool", "a certain level of user skill and the task", and "how and where the user applies the system to help the work". The improvement of performance is only induced when the users

coordinate these three elements to match one another. To put it more simply, more use does not necessarily ameliorate performance; this is only true when technology is applied by a skilled worker to the right task. Following the same logic, Goodhue & Thompson (1995) proposed TTF (technology-task fit) as a critical factor that affects performance. *TTF* refers to "the degree to which a technology assists an individual in performing his/her portfolio of tasks", or, more specifically, "the correspondence between task requirements, individual abilities, and the functionality of the technology". Task-technology fit is not a new concept. As we mentioned in section 1.3.2, both Lucas (1975) and Pentland (1989) attributed the negative relationship they found between IT use and individual performance to either the dysfunctional match between the system and task or the inability of users to apply the matching software to certain tasks. Goodhue & Thompson (1995) empirically examined the significant role of TTF and found that both TTF and use lead to better individual performance but TTF accounted for more variance of the individual performance improvement as opposed to the construct "use" alone did. Though not significantly, Staples & Seddon (2004) found that there is a weaker path from TTF to individual performance with a stronger path from use to individual performance under voluntary setting than it is under mandatory setting. This finding further is in line with Goodhue & Thompson's suggestion that "to the extent that utilization is not voluntary, performance impacts will depend increasingly upon TTF rather than utilization".

1.4.2 Measurement

Among the studies attempting to reconcile the conflicting result by examining other contingent factors involved in the relationship, an alternative approach is the "measurement relevance" issue first mentioned by Trice & Treacy (1988). They underpinned the importance of taking careful consideration of the research goal when it comes to

operationalization and deciding measurement for research. They claimed that variables in empirical studies are usually rationalized by the researchers, but the researchers rarely make efforts to justify or to show the relevance of the particular measurements they used to the study. Bernard (2004) proposed that four types of measurement issue of IT use were found to affect the relationship between use and individual performance: multidimensionality, subjectivity, relativeness, and voluntariness. As we mentioned in section 1.3.1, both Millman & Hartwick (1987) and Pentland (1989) suggested that subjective data sources and objective data source could generate different results. Pentland (1989) examined IT use and individual performance with both subjective and objective data source. The results show that with objective measurement, fewer software packages were found significantly related to better individual performance and that some of software package use even had no significant effect on individual performance. More importantly, the uni-dimensionality has been considered to threaten the content validity of IT use measurement since it is highly doubtful that uni-dimensional measure can comprehensively assess each dimension of the IT use in real organizational settings (Burton-Jones & Straub, 2006). A lab setting experiment confirmed this speculation: the strength of the relationship between use and individual performance varies under different richness level of use measurement. The richer the "use" measurement, the more explanatory variance explained by "use" (Burton-Jones & Straub, 2006).

1.5 CONCLUSION/RESEARCH QUESTION

In this chapter, we reviewed two major constructs of this research, "IT use" and "individual performance", and presented previous literature that focused on the relationship between IT use and individual performance. Compared to other topics in IS field, e.g. IT acceptance, there is not much research done on the relationship between IT use and individual

performance. As can be seen from section 1.1, even among those papers, IT use is ill-defined due to its process-dependent character. As a result, the operationalization and measurement vary along studies, hindering the generalization and comparison between studies. Meanwhile, in section 1.3, we presented the conflicting results from previous studies on the relationship between IT use and individual performance. Researchers have been making effort to make sense out of these results, which we elaborated in section 1.4 (Burton-Jones & Straub, 2006; Goodhue & Thompson, 1995). Given the situation that IT use is ill-defined and operationalized differently from study to study, it is understandable and reasonable for researchers to link the measurement issue to the seemingly contradictory findings about IT use-performance relationship (Bernard, 2004; Burton-Jones & Straub, 2006).

Nonetheless, there is still room and need for further improvement. Burton-Jones & Straub (2006) tested the richness of IT use measurement's effect on the strength of the IT use-performance relationship and demonstrated quite intriguing results. However, compared to how they categorized "IT use" measures, the "individual performance" measure was "lean" in their study. To be specific, in their experiment, "individual performance" was simply evaluated by asking independent coders to rate student's immediate performance on solving an asset purchase spreadsheet using MS EXCEL. But we should know that, as equally important as IT use measurement, the measurements for individual performance can possibly affect the IT use-performance relationship as well (Bernard, 2004). Another aspect that needs to be improved with Burton-Jones & Straub's study is that they proposed a good theory but tested in a lab experiment, which bears little external validity. Therefore, it would complement and add value to both academic and practice, if we can test what Burton-Jones

& Straub (2006) proposed in an organizational setting and with enriched multi-dimensional measurements for individual performance. In terms of the multi-dimensional measurements for individual performance, Bernard (2004) compared multidimensionality (productivity, quality or multidimensional) and subjectivity as differentiators affecting the IT use-performance relationship. Apart from what they considered, some other traditional dimensions of "individual performance" can be identified from literature, for instance, quality and efficiency (Pentland, 1989); task productivity, task innovation, customer satisfaction and management control (Torkzadeh & Doll, 1999).

Here, an interesting research question can be conceived based originally on Burton-Jones & Straub (2006) coupled with other aforementioned literature:

How do different richness levels of information technology use measures and individual performance measures affect the use/individual performance relationship in organization setting?

The current study, therefore, is the development and test of the measurement issue in real organizational setting and will bring value to academic by using multi-dimensional measurements for both IT use and individual performance. To be specific, we will borrow the definition and the measurement of IT use from Burton-Jones & Straub (2006). Furthermore, we will develop an equivalent measurement for individual performance construct. The development of individual performance measurement, the research model and hypotheses will be presented in chapter 2.

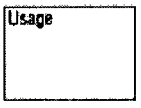
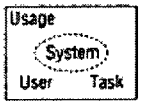
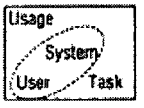
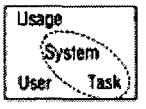
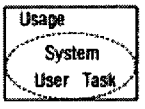
CHAPTER 2 RESEARCH MODEL AND HYPOTHESES

This chapter presents the development of the measurement instrument for the individual performance construct and elaborates the rationale and the process of the research model building. The literature used to build the research model is presented. The hypotheses to be tested in this research follow.

2.1 RESEARCH MODEL

We build our research model based mainly on Burton-Jones & Straub (2006), Bernard (2004) and Torkzadeh & Doll (1999). Burton-Jones & Straub (2006) distinguished between the three elements of IT use activity: user, system, and task and created a continuum for the richness of measures ranging from very lean, to very rich, as shown in Figure 3.

Figure 3 Rich and Lean Measures of System Usage (Burton-Jones & Straub, 2006)

Richness of measures	1. Very lean	2. Lean	3. Somewhat rich (IS)	4. Rich (IS, User)	5. Rich (IS, Task)	6. Very rich (IS, User, Task)
Type	Presence of use	Extent of use (omnibus)	Extent to which the system is used	Extent to which the user employs the system	Extent to which the system is used to carry out the task	Extent to which the user employs the system to carry out the task
Domain of content measured*						
Example	Use/nonuse	Duration; extent of use	Breadth of use (number of features)	Cognitive absorption	Variety of use (number of subtasks)	None to date (difficult to capture via a reflective construct)
Reference	Alavi and Henderson (1981)	Venkatesh and Davis (2000)	Saga and Zmud (1994)	Agarwal and Karahanna (2000)	Igbaria et al. (1997)	

*Lean measures reflect usage alone; rich measures reflect its nature, involving the system, user, and/or task.

The six levels of richness for IT use are determined according to which of the three elements are involved in the evaluation. *Very lean* use measure refers to the binary measure "use/non-use". Duration and extent of use are *lean* use measure. *Somewhat rich* use measure refers to the inclusion of system. *Somewhat rich* use measure should demonstrate how much the system is used, application-wise. *Rich* use measures involve two elements, system and task. *Rich* use measures evaluate how much the system is used to help complete different tasks. Thus, it is more task-wise compared to *somewhat rich* use measures. We are going to categorize the IT

use measurements from previous research into these four classes to help construct our hypotheses.

Burton-Jones & Straub (2006) examined the IT use/individual performance relationship under different richness level of IT use measurement. Their results show that the richer the "use" measurement, the more variance of individual performance that can be explained by "use". Meanwhile, Bernard (2004) proposed that not only does IT use measurement affect the relationship, individual performance measurement also affects the relationship. In terms of individual performance, he took into account multidimensionality (productivity, quality or multidimensional) and subjectivity as differentiators affecting the results. His results show that the relationship between IT use and individual performance varies with different dimensionality (uni-dimensional or multi-dimensional) of individual performance measurement. To be specific, even though use/individual performance relationship are all significantly positive when individual performance was measured by productivity, quality and multi-dimensional by combing the two, the strength of the relationship is different. In terms of subjectivity of individual performance measurement, however, given the limited studies on the relationship between IT use and individual performance, his meta-analysis shows that there is no significant difference of the use/individual performance relationship between objective and subjective individual performance measurements.

Besides the individual performance measurement that Bernard (2004) used (productivity and quality), other dimensions of "individual performance" can be identified from our literature review, for instance, quality and efficiency (Pentland, 1989); task innovation, customer satisfaction and management control (Torkzadeh & Doll, 1999).

Following Bernard (2004), we categorize individual performance measurement in terms of its dimensionality and subjectivity. Although Bernard (2004) suggests that subjectivity does not affect the use/individual performance relationship, our literature review indicates that objective measures are considered as more impartial and more accurate than subjective ones. Therefore, given the same number of dimension measured, objective measurement would be considered as richer than subjective measurement. Table 9 presents individual performance measures from the IS literature and classifies them according to the 6 levels of richness: very lean, lean, somewhat rich subjective, somewhat rich objective, rich and very rich.

Table 9 Individual Performance Richness Level

Individual Performance Richness Level		Author	Use Measurement	Individual Performance Dimension/Measurement	Results
Very Lean	1 dimension 1 item	Lucas (1975)	Working with customers; Detailed analysis of buying entity/account; Overall progress; Summary this year versus last year; Planning; Cancellation	Gross total booking for sales personnel	Sale personnel $R^2 = 0.3$; $\beta = 0.27$* Accounting department: $R^2 = 0.46$; $\beta = -0.32$ **
		Snitkin & King (1986)	Estimated hours of use per week	Effectiveness	Chi-square test shows positive result sig. at 0.05 level
		Millman & Hartwick (1987)	Which subsystem was used; How often the system was used	Personal effectiveness	1.4% decreased 23% no change 75.7% increase
		Lucas & Spitler (1999)	Heavy/light use; Which subsystems were used; Which functions were used	Monthly commission revenue	Use→Perf.: non-sig. Intended use→ Perf.: $\beta = 0.09$*
		Dasgupta et al. (2002)	Actual usage data from system log files	Students' grades	Total use→ performance: $\beta = 0.0225$ non-sig. $R^2 = 0.2255$, Use file→ Performance: $\beta = 0.0316$* $R^2 = 0.2429$
		Szajna (1993)	Number of reports; Time spent on reports; Historical data time; Functional data time; % Historical data; % Functional data	Decision performance was measured by a formula with objective profits data	Number of reports: $\beta = 0.16$** Time spent on report: $\beta = 0.32$**** Historical data time: $\beta = 0.00$ Functional data time: $\beta = 0.47$**** % Historical data: $\beta = -0.23$*** % Functional data: $\beta = 0.23$***
Lean	1 dimension Multiple items	Aldag & Power (1986)	Use/non-use	4 items to measure decision report quality	non-sig.

		Pentland (1989)	First two analysis: which features were actually used; For the third analysis: number of audit tasks automated, the number of AES features used, the hours of use per week.	Efficiency: objective measure i.e. time difference to complete task with laptops Efficiency: 4 items as subjective measure; dollars assessed per hour of time on case as objective measure	Depends on the application and whether effectiveness or efficiency was measured: e.g. the use of workcenter to efficiency: β=.093*** but the use of workcenter to effectiveness: β=-.070*; word process to efficiency: non-sig but to effectiveness: β=.125****
		Szajna (1993)	Number of reports; Time spent on reports; Historical data time; Functional data time; % Historical data; % Functional data	5 items to evaluate perceived decision performance	Number of reports: Non.sig. Time spent on report: Non.sig. Historical data time: Non.sig. Functional data time: β=-0.15** % Historical data: Non.sig. % Functional data: Non.sig.
		Cascant et al. (2002)	Use/non-use of EDSS	10 items to evaluate the closeness between users' solution to the correct solution	T test shows significant difference between EDSS user group and non-EDSS user group
		Jelinek et al. (2006) ,	Frequent user (semantic); Fully use the capabilities; Integrate into sales process; Use different automation tools; Use only for task required	3 factors to evaluate the achievement of sales objectives	β=0.21*** R^2=0.11
Somewhat rich subjective	2 dimensions Subjective	Staples & Seddon (2004)	Number of hours used in the past and expected to use in the future; Light/heavy user; Frequent/infrequent user.	Efficiency and effectiveness; Cost-effectiveness	Mandatory use: β=-0.029 non-sig.; Voluntary use: β=0.181 non sig.
Somewhat rich Objective	2 dimensions Objective	Cats-Baril & Hubert (1987)	The degree of interaction between users and system; Whether or not the system was computerized	Productivity Quality	non-sig.

Rich	Multi-dimensions (3 or more) Subjective	Udo (1992)	Frequency of use	Decision quality: 2 items; Increased productivity: 2 items; Overall cost-effectiveness: 2 items	Decision quality: β=0.3055*; Increased productivity: β=0.1139 non.sig.; Overall cost-effectiveness: β=0.0991 non.sig.
		Goodhue & Thompson (1995)	Respondents were asked to rate how dependent they were on a list of systems available in their organizations	Effectiveness; Productivity; Performance on job	Use alone: β=0.13**** Use and TTF: β=0.11****
		Igbaria & Tan (1997)	Number of computerized application used; Number of business tasks for which the system is used (Eight tasks and sixteen different types of software applications were listed)	Decision making quality; Performance; Productivity; Effectiveness of the job	β=0.23*** R^2=0.28
		Torkzadeh & Doll (1999)	Perceived use pattern	Task productivity Task innovation Customer satisfaction Management control	The correlations between use and four dimensions are: Overall: β=0.70** Task Productivity: β=0.52** Task innovation: β=0.64** Customer satisfaction: β=0.46** Management control: β=0.49**
		McGill et al. (2003)	Use all the time/often/not often	Whether system use improves 4. Perceived effectiveness 5. Productivity 6. Performance	β=-0.19 non-sig. R^2=0.577
		Sundarraj & Vuong (2004)	Weekly number of conversion completed by a respondent by two-bucket categorization	Productivity; Innovation; Customer satisfaction	Productivity and customer satisfaction are significantly different for heavy user/fair uses, but not innovation
		D'Ambra & Wilson (2004)	Use/non-use; Use for what tasks; Time spent per week	7. Positive impact on the ability to make travel arrangement; 8. Quality of travel has improved; 9. make better travel decision;	Web use→perf. R^2=0.25 Weekly use hour→ Perf.: β=0.22***

				10. Accomplish travel arrangement more quickly; 11. Increased knowledge about travel; 12. Better informed about the travel in general.	
		Almutairi & Subramanian (2005)	Time spent daily; Frequency of use (numeric); Use on what tasks; Which package was used	Productivity; Innovation; Customer satisfaction; Management control	β=0.32*** R^2=0.10
		Livari (2005)	Hours spent daily; Frequency of use (numeric)	7. Enable the user to accomplish tasks more quickly; 8. Improves user's job performance; 9. Increase user's productivity; 10. Enhances user's effectiveness in the job; 11. Makes user's job easier; 12. The system is useful in user's job	β=0.15 non-sig. R^2=0.35
		Guimaraes et al. (2007)	Hours spent daily; Frequency of use (numeric)	Performance; Productivity; Effectiveness	R^2=54.3% β=0.328***
Very Rich	Multi-dimensions (3 or more) Objective	None	None	None	None

* p<0.10 ** p<0.05 ***p<0.01 ****p<0.001

We differentiate very lean and lean individual performance measurements not by subjectivity but by the number of items used. Very lean individual performance measurement implies that only one dimension of individual performance was measured with only one item. For example, Lucas (1975) obtained total booking of sales personnel to evaluate their performance, Snitkin & King (1986) and Millman & Hartwick (1987) both used only one item to assess perceived effectiveness, Lucas & Spliter (1999) accessed log data for brokers' average monthly commission revenues to evaluate their performance. In a classroom setting, Dasgupta et al. (2002) used final grade as students' performance. Similarly, lean individual performance measure evaluates only 1 dimension, but with more than one item, for example, Aldag & Power (1986) hired business doctoral and master degree students to serve as raters to evaluate the quality of decision report using 4 items. Pentland (1989) assessed efficiency and effectiveness separately, efficiency was evaluated by obtaining the actual time spent on each case, and effectiveness by monetary value produced and four other subjective items. Jelinek et al. (2006) used three items to assess sale's achievement of sales objective. Somewhat rich subjective refers to subjective measure of 2 dimensions of individual performance. For example, Staples & Seddon (2004) evaluated two dimensions—efficiency and effectiveness. Somewhat rich objective uses 2 dimensions with objective measurements. Cats-Baril & Hubert (1987) assessed productivity and quality with four professional career counselors. This method is considered as objective measurement in current study since they brought objective third-party into evaluation process. Rich measurement refers to studies that measured 3 or more dimensions subjectively. Different studies measured various aspects of individual performance. For example, most researchers examined widely-used dimensions of individual performance, such as, quality, productivity, efficiency, effectiveness or general performance (e.g. D'Ambra & Wilson, 2004; Goodhue & Thompson, 1995; Guimaraes,

Staples, & Mckeen, 2007; Igbaria & Tan, 1997; Livari, 2005; McGill, Hobbs, & Klobas, 2003; Udo, 1992). Adapted from Torkzadeh & Doll (1999), other researchers examined individual performance along dimensions of task productivity, task innovation, customer satisfaction, and management control (e.g. Almutairi & Subramanian, 2005; Sundarraj & Vuong, 2004). Very rich individual performance measurement refers to three or more dimensions assessed with objective measures. However, we found that no study used such very rich measures in our literature review.

With both IT use and individual performance measurements classified along the richness level, we re-positioned the results from previous literature. The results are presented in Table 10, which will be used to develop our hypotheses.

Table 10 Use and Individual Performance Matrix

		Individual Performance			
		Very lean	Lean	Somewhat rich	Rich
Use	Very lean	N/A	**Cascant et al. (2002):** T test show sig. difference between EDSS users and non-users	N/A	N/A
	Lean	**Snitkin & King (1986):** Chi-square test shows that more usage has better perceive effectiveness (sig.**)	N/A	**Staples & Seddon (2004):** Mandatory use: β=-0.029 non-sig.; Voluntary use: β=0.181 non sig.	**Udo (1992):** Decision quality: β=0.3055*; Increased productivity: β=0.1139 non.sig.; Overall cost-effectiveness: β=0.0991 non.sig. **McGill et al. (2003):** -0.19 non-sig. **D'Ambra & Wilson (2004):** β=0.22*** **Sundarraj & Vuong (2004):** Productivity and customer satisfaction are sig. different for two groups, but not innovation **Livari (2005):** β=0.15 non-sig. **Guimaraes et al. (2007):** β=0.328***, R^2=0.543
	Some what rich	**Millman & Hartwick (1987):** Effectiveness for use/non-use is significant **Szajna (1993):** Number of reports: β=0.16**; Time spent on report: β=0.32****; Historical data time: β=0.00; Functional data time: β=0.47****; % Historical data: β=-0.23***; % Functional data: β=0.23*** **Lucas & Spitler (1999):** use: non-sig./intended use: β=0.09* **Dasgupta et al. (2002):** total use Non-sig. /use of file ' exchange: β=0.0316*	**Szajna (1993):** Number of reports: non.sig. Time spent on report: non.sig. Historical data time: non.sig. Functional data time: β=-0.15** % Historical data: non.sig. % Functional data: non.sig. **Pentland (1989):** The use/performance relationship depends on the application and whether effectiveness or efficiency was measured: e.g. the use of workcenter to efficiency: β=.093*** but the use of workcenter to effectiveness: β=-.070*; word process to efficiency: non-sig but to effectiveness: β=.125****	N/A	N/A
	Rich	**Lucas (1975):** Sales: β=0.27*; Accounting: β=-0.32*	**Jetlinek et al. (2006):** β=0.21*** R^2=0.11	N/A	**Goodhue & Thompson (1995):** β=0.13**** **Igbaria & Tan (1997):** β=0.23***, R^2=0.28 **Torkzadeh & Doll (1999):** Overall: β=0.70** Task Productivity: β=0.52** Task innovation: β=0.64** Customer satisfaction: β=0.46** Management control: β=0.49** **Almutairi & Subramanian (2005):** β=0.32***, R^2=0.10

*p<10 **p<05 *** p<01 ****p<001 (N/A= No study found in literature)

After mapping the previous studies in Table 10, some simple observation can be made. First of all, as our literature review implied, there are not as many studies on this topic as expected. Seven out of 16 cells in our matrix are empty. For example, very lean/lean use and very lean/lean individual performance; very lean use and somewhat rich/rich individual performance; somewhat rich/rich use and somewhat rich/rich individual performance have not been investigated to our knowledge. On the other hand, 9 out of 16 cells in our matrix were filled in by 21 studies with 5 cells reporting only 1 study each. As can be seen in Table 10, ten studies relied on rich measures for individual performance but only 4 out of the ten also relied on rich measures for IT use (i.e. Goodhue & Thompson, 1995; Igbaria & Tan, 1997; Torkzadeh & Doll, 1999; Almutairi & Subramanian, 2005). On the other hand, two studies relied on rich IT use measures but on very lean/lean individual performance measures (i.e. Lucas, 1975; Jetlinek et al. 2006). Thirdly, we can observe that earlier studies tend to use leaner measures, while recent studies use richer measures for either use or individual performance or both. In the next section, we present our research hypotheses.

2.2 RESEARCH HYPOTHESES

We developed our hypotheses on the basis of the observations from the mapping of the literature according to the richness of measurement as presented in Table 10. When there are mixed results from literature, we consider the majority results. Also, we take into account the strength of the relationships that are shown in the literature. The following hypotheses are not presented in orderly manner since there are empty cells in Table 10. We will present the hypotheses that we had literatures in Table 10 first, and then follow by the hypotheses that we did not have literature hence that we had to infer from the cells next to them.

Cascant et al. (2002) relied on a very lean dichotomous measurement to evaluate IT use. Individual performance was assessed using a lean measure consisting of 10 items on 1 dimension, decision making performance. T tests show significant differences between two groups, the DSS user group performed better than the group who simply used EXCEL. Thus, the following hypothesis was made:

H2a: IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is lean.

Snitkin & King (1986) relied on a lean measure for IT use i.e. estimated hours per week, and individual performance was measured by asking respondents to assess how effectively the system helped the users to solve business problem. Their results show a significant positive relationship. Thus, we hypothesize:

H1b: IT use will be significantly and positively related to individual performance when the measure for IT use is lean and the measure for individual performance is very lean.

Staples & Seddon (2004) used subjective measure for IT use (frequency and the duration). Efficiency and effectiveness of individual performance were evaluated. They found no significant relationship between IT use and individual performance. Thus, it is hypothesized that:

H3b: IT use will not be significantly related to individual performance when the measure for IT use is lean and the measure for individual performance is somewhat rich.

Results of the studies that have tested the IT use/individual performance relationship with lean IT use measures and rich individual performance measures are mixed. McGill et al. (2003) and Livari (2005) did not find significant relationship between IT use and individual

performance. Both of them used frequency as the IT use measure. McGill et al. (2003) measured the subjective effectiveness, productivity, and performance of user-developed application; Livari (2005) measured the perceived efficiency, productivity, and effectiveness of a financial accounting system. Udo (1992) and Sundarraj & Vuong (2004) found mixed results. Udo (1992) relied on subjective measures for frequency of use and effectiveness, quality and productivity, and found that use was significantly and positively related to decision quality (with $p<0.10$), but use was not significantly related to productivity or effectiveness. Sundarraj & Vuong (2004) measured weekly amount of use and frequency of use subjectively. The results show that productivity and customer satisfaction were significantly and positively related to greater use, but no improvement was observed on innovation dimension. Finally, only two studies, D'Ambra & Wilson (2004) and Guimaraes et al. (2007), found significant positive relationship between IT use and individual performance using the same kind of measures. D'Ambra & Wilson (2004) used subjective measure for duration and frequency of IT use and efficiency, quality and effectiveness of internet use. Guimaraes et al. (2007) measured duration and frequency of IT use subjectively, and productivity, performance and effectiveness of multiple applications developed by IS professionals. The beta values in these two studies are not high though, i.e. $\beta=0.22$ (D'Ambra & Wilson, 2004), and $\beta=0.328$ (Guimaraes et al., 2007). Given these results, we would hypothesize:

H4b: IT use will not be significantly related to individual performance when the measure for IT use is lean and the measure for individual performance is rich.

Millman & Hartwick (1987) asked managers which system feature they used and their perceived personal effectiveness. Their results demonstrate significant difference between

use group and non-use groups. The group who used the system more extensively had perception of better performance. Szajna (1993) measured IT use with total time spent, and the percentage of use for historical data and functional data of a decision support system. The performance was measured by objective profit data. Szajna's results show that number of reports, total time spent on report, time spent on functional data and the percentages use of functional data are all significantly and positively related to individual performance on 1-item objective measure, profit. Lucas & Spitler (1999) asked respondents to self report their current use and intended use of major functions of the system, with performance measured as the average revenue obtained from log data. Their results show that there is no significant relationship between IT use and individual performance but a significant positive relationship between intended use and individual performance. Dasgupta et al. (2002) found that the use of certain features of the system, in their case, is the use of file exchange significantly leads to better academic performance for students, but the total use of the system was not found to be significantly related to individual performance. Thus, the following hypothesis is made:

H1c: IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is very lean.

In the same study, Szajna (2003) also measured users' perception of their performance with 5 items. The results show that time spent on functional data is significantly but negatively related to individual performance, other use measurements do not have significant relationship with individual performance. Pentland (1989) examined the use of multiple applications both subjectively and objectively and its effect on efficiency and effectiveness.

Efficiency and effectiveness were measured by how quickly the tasks were done and the quality of completed tasks. His results suggested mixed relationship. For example, work center program was found to have negative relationship with efficiency of a beta value -.070 and a positive relationship with effectiveness of a beta value .093. In either case, the beta value was not sufficiently strong. Also, no significant relationship was found between use of word processor and efficiency. Thus, it is hypothesized:

H2c: IT use will not be significantly related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is lean.

Lucas (1975) measured IT use with rich measurement i.e. what specific purpose, and to what extent the system was used. The individual performance measure used was very lean i.e. total dollar booking from sales data. The results indicate that the sale personnel's use of system is significantly and positively related to total dollar booking, while accounting personnel's use of system significantly negative related to their performance total dollar booking. He argued that the system was intended for sales personnel's use, thus negative relationship was found between accounting personnel's use of system and their individual performance. In our study, at both banks, the systems were designed and intended to assist bank managers' work. Therefore, it is hypothesized:

H1d: IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is very lean.

Jelinek et al. (2006) measured IT use with rich measurement, for example, variety of use, extent of use, frequency of use, but only used sale people's achievement as a lean individual performance measure. However, a significant positive relationship was found between the two constructs, thus it is hypothesized:

H2d: IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is lean.

The studies on the IT use/individual performance relationship with rich IT use measurement and rich individual performance measurement all show significant positive relationship between the two constructs (e.g. Goodhue & Thompson, 1995; Igbaria & Tan, 1997; Torkzadeh & Doll, 1999; Almutairi & Subramanian, 2005). Goodhue & Thompson (1995) measured the dependence on system use, and effectiveness, productivity, and performance of 25 different technologies. Igbaria & Tan (1997) measured the number of computer applications used and the number of business tasks for which the corresponding system was used, and decision quality, performance, productivity, and effectiveness of the job. Torkzadeh & Doll (1999) measured for what purpose the system were used, and task productivity, task innovation, customer satisfaction, and management control. Almutairi & Subramanian (2005) measured daily use, frequency of use, and to what extent the system helped the user's work, and the same individual performance dimensions as in Torkzadeh & Doll (1999). They all found significant positive relationship between IT use and individual performance. Thus, we hypothesize:

H4d: IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is rich.

The hypotheses above have literature in Table 10. As we mentioned at the beginning, next we will present the hypotheses that did not have literature that we had to infer from the literature that we have on hand.

Literature suggests that IT use is significantly and positively related to individual performance when the measure for IT use is lean and the measure for individual

performance is very lean, or when the measure for IT use is very lean and the measure for individual performance is lean. Also notice that, when measures for both constructs are rich, the IT use/individual performance relationship is significantly positive. Thus, we hypothesize that IT use will be significantly and positively related to individual performance when the richness of both IT use and individual performance measures are at the same level (the combination can be very lean/very lean, or lean/lean). Therefore, we have the following two hypotheses:

H1a: IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is very lean.

H2b: IT use will be significantly and positively related to individual performance when the measure for IT use is lean and the measure for individual performance is lean.

Furthermore, even though we do not have literature for very lean IT use with somewhat rich individual performance or rich individual performance. We have literature showing a significant positive relationship between very lean IT use and lean individual performance (Cascant et al., 2002). We can interpret this as such: individual performance is measured on more than one dimension, while IT use was measured uni-dimensionally. Since IT use can possibly improves individual performance on different aspects. With more dimensions of individual performance examined, better chances that certain dimensions of individual performance that are measured were caused by the use of the system in question. Thus, we hypothesize that IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is either somewhat rich or rich. Therefore, we have the following two hypotheses:

H3a: IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is somewhat rich.

H4a: IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is rich.

We also noticed that, with richer IT use measurement i.e. somewhat rich and rich, the relationship becomes contingent upon the application examined or the system feature examined, or the users examined. In other words, the result is contingent upon whether the application or the system feature that were used fit well with tasks, i.e. if the task and the technology fit, more IT use leads to better individual performance; on the other hand, if the task and technology do not fit well, either there is no significant relationship between the two constructs (Dasgupta et al. 2002) or more IT use leads to worse individual performance (Lucas, 1975). In Goodhue & Thompson (1995), they used rich measures for both IT use and individual performance and they ran three regressions for (1) use only (2) TTF only (3) use and TTF together. Their result shows that use alone explained 4% of the variance in individual performance; TTF explained a significant 14%. TTF and use together explained 16%. In our case, the applications implemented in banks are specifically designed fro account managers, thus, a significant positive relationship is likely to be found. Hence, we hypothesize that IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is either somewhat rich or rich. The following two hypotheses can be made:

H3c: IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is somewhat rich.

H4c: IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is rich.

As suggested from previous literature in Table 10, rich use was found to be positively related to very lean/lean/rich individual performance. If rich use is positively related to very lean and lean individual performance, it is very likely that rich use is also positively related to somewhat rich individual performance since somewhat rich individual performance includes more dimensions of performance than very lean and lean ones.

H3d: IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is somewhat rich.

As we mentioned, in Burton-Jones and Straub (2006), they proposed a more sensible approach to develop IT use measurement. The results of their study showed that, given the same richness of individual performance measurement, (in their case, two independent coders was asked to assess to what extent the output generated by participants met the task requirements), IT use explained more variance of IT use/individual performance relationship with richer IT use measure. Thus, the following hypothesis is made:

H5: Given the same richness level of individual performance (along the same column in our case), richer IT use measurement explained more variance in IT use/individual performance relationship. All hypotheses except H5 are summarized in the Table 11:

Table 11 Hypotheses Matrix

		Individual Performance			
		Very Lean	Lean	Somewhat Rich	Rich
Use	Very Lean	H1a	H2a	H3a	H4a
		+	+	+	+
	Lean	H1b	H2b	H3b	H4b
		+	+	not sig.	not sig.
	Somewhat Rich	H1c	H2c	H3c	H4c
		+	not sig.	+	+
	Rich	H1d	H2d	H3d	H4d
		+	+	+	+

In the next chapter, we will present our research setting, operationalization and measures of the constructs, and the process of our data collection.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter presents the research setting, the operationalization and measures for our constructs and the data collection procedure of our study.

3.1 RESEARCH SETTINGS

This study relies on empirical data that was collected as part of a large study aiming at investigating users' reactions, IT use and individual performance following a new IT implementation. Data was collected through a paper-based questionnaire to survey bank account managers from two Canadian banks regarding their use of a new account management system and their individual performance. Bank A is targeted at business banking customers. Bank B is for personal banking customers. The systems at Bank A and Bank B were different but were both intended to assist account managers in their work. Client databases (Coded as DB) were used in both Bank A and Bank B. The applications at Bank A are Winfast (Coded as WFAST), a financial analysis tool, and MEI, a profit simulation tool. Applications at Bank B are Simulateur (Coded as SIMUL), PPP, Emili, and ASAP. Simulateur is a profit simulation tool. PPP is an investment decision support system. Emili is a mortgage management tool. ASAP is a personal services administration tool. Account managers use it to open/close bank account or apply for credit lines. After system implementation, Bank B strongly recommended that account managers use the new IT but still accepted paper work in operation; while in Bank A, paper work was not accepted any more. Account managers had to use the new information system.

3.2 CONSTRUCT OPERATIONALIZATION AND MEASURES

3.2.1 Very Lean Measure

IT use

We used a three-bucket level of frequency as very lean measure for IT use. In the questionnaire, we did not have a question asking user's frequency of use. However, we asked for total number of minutes spent on system use daily. We calculated 25% and 75% percentiles for total number of minutes spent using the system and classified them into three buckets: 0-25% is light users (coded 0), 25%-75% is fair users (coded 1), and over 75% is heavy users (coded 2). However, given that Bank A and B have different applications and customer, total number of minutes spent on system might be different. Thus, we did T-test after combing the samples from Bank A and Bank B. The results are as follows in Table 12:

Table 12 Independent Sample Test

	Levene's test for equality of variance		T test for equality of means		
	F	Sig.	T	df	Sig.(2-tailed)
Total minutes of system use	3.939	.048	10.276[2] 10.769[3]	259 237.215	.000 .000

In order to conduct independent sample T test, the sample should meet the assumption that two groups have approximately equal variance on the dependent variable. If the Levene's test for equality of variance is not significant, it means the sample meet the above assumption. As seen in Table 12, total minutes of system use is not significant for Levene's test for equality of variance, which means, two groups have approximately equal variance on the dependent variable. Meeting the assumption, we can further refer to T-test result. T-test result is significant, showing that there is significant difference between two groups in terms of the number of minutes spent on system. Therefore, we need to calculate 25% and 75% percentiles separately for each bank. For Bank A, 0-150 is light user, 150-240 is fair user,

[2] Equal variance assumed
[3] Equal variance not assumed

over 240 is heavy users. For Bank B, 0-270 is light user, 270-390 is fair user, and over 390 is heavy user.

Individual Performance

Very lean individual performance measure assesses only 1 dimension with 1 item. For example, Lucas & Spitler (1999) measured individual performance by profitability with one item—average monthly commission revenue. In our questionnaire, we did not have one general question inquiring respondents' perception of whether they felt their individual performance, in general, was improved or decreased. However, we do have sales data for both Bank A and Bank B except that the sales data for Bank A was very limited. Thus, the difference of sales before and after the implementation of the system at Bank B was used as indicator for individual performance as very lean measure (Please refer to Appendix A for detailed items).

3.2.2 Lean Measure

IT use

As lean IT use measure, number of minutes spent on system was used. In our questionnaire, we have 6 items asking the respondents to indicate the number of minutes of system use to carry out 6 basic tasks per day at work (Please refer to Appendix A for detailed for the 6 items). We added up the time spent on each task as the total time spent on system and use it as lean use measure since it stands for the total time of system use. It is richer than very lean IT use measure in the sense that the exact number of minutes spent on system use was used rather than three buckets, which only approximately represents how much the system was used.

Individual performance

Lean individual performance measure implies that only 1 dimension is assessed but with multiple items, which is richer than very lean measure. Our literature review indicated that productivity, profitability, and quality were the dimensions most often used measure of individual performance. We used one dimension at a time as a lean measure of individual performance. In our questionnaire, we have 3 items for productivity, 4 items for profitability and 4 items for quality (Please refer to Appendix A for detailed items). Respondents were asked to rate how well they agree the system use has improved their individual performance on each dimension on 7-point Likert scales, ranging from "strongly disagree" to "strongly agree".

3.2.3 Somewhat rich measure

IT use

Somewhat rich measure for IT use was assessed by the total number of minutes spent on all different applications in each bank. Since there are 5 applications in Bank B and 3 applications in Bank A, in our questionnaire, we have 5 items for Bank B and 3 items for Bank A asking the respondents to indicate how much time they spent per day on each application (Please refer to Appendix A for detailed items). It is richer than lean measure in the sense that these applications are the core applications that help account managers to complete their job responsibility. As opposed to time spent on general system use, somewhat rich IT use measure serves as a better representation of how well the account managers have integrated the core system functions into their jobs.

Individual performance

A somewhat rich measure of individual performance covers two dimensions of individual performance, such as productivity, profitability, and quality. Productivity, profitability and quality will be combined to create three different somewhat rich measures: productivity and

profitability, or productivity and quality, or profitability and quality (Please refer to Appendix A for detailed items).

3.2.4 Rich Measure

IT use

Following Burton Jones & Straus (2007), a rich measure for IT use should tap into all three factors: user, system and tasks. We used a 30 items measure developed based on Mintzberg's managerial-role model (Please refer to Appendix A for detailed items). They were used as rich use measurement because they are task-oriented. The respondents were asked to rate their frequency of the system use to complete tasks in order to fulfill their managerial role on 7-Likert scale, from "never" to "several time a day".

Individual performance

Rich individual performance measure was assessed on six dimensions, namely, productivity, innovation, customer satisfaction, management control, profitability and quality of work. Productivity was measured with 3 items, Innovation was measured with 3 items, customer satisfaction was measured with 4 items, management control was measured with 4 items, profitability was measured with 4 items, and quality was measured with 4 items. In total, in the questionnaire, individual performance was measured with 22 items asking respondents to rate how well they agree the system use has improved their individual performance on the 6 dimensions on 7-point Likert scales, ranging from "strongly disagree" to "strongly agree" (Please refer to Appendix A for detailed items).

3.2.5 Demographics

In addition to information evaluating the two constructs, other demographic information was also collected, including the hiring date at job, the length of service in the company, education level, age, computer experience.

3.3 SURVEY DESIGN

The questionnaires for two banks were the same, except for the name of the system and applications. At both banks, users and management were consulted to comment on the format, the clarity, and the exhaustiveness of the questionnaires.

3.4 DATA COLLECTION

I did not collect data set for current study. The data that current study used was originally collected as part of another larger study. Thus, I'm using secondary data in order to test my hypotheses. The responses rates listed in the original study are: at bank A, 99 completed questionnaires out of 161 total questionnaires were returned representing a response rate of 61.5%. At Bank A, 162 completed questionnaires out of 365 total questionnaires were returned representing a response rate of 44.4%.

CHAPTER 4 DATA ANALYSIS

The current chapter first presents descriptive statistics. Reliability and validity analyses are presented next, followed by the tests of the research hypotheses.

4.1 DEMOGRAPHICS

We calculated minimum, maximum, and average age for account managers at both banks. The minimum and maximum ages are 25 and 56 in Bank A, and 24 and 62 in Bank B. The average age is similar in both banks with 41.91 in Bank A and 40.89 in Bank B. As for education, we calculated the frequency of degrees at each Bank. As shown in Table 13, at Bank A, most managers have bachelor degree, followed by certificate and master degree. Master, bachelor and certificate take up more than 80 percent of total respondents. At Bank B, most managers have secondary degree, followed by college and certificate. Secondary, college and certificate account for more than 75% of the total respondents. Thus, on average, managers at Bank A have higher education than those in Bank B.

Table 13 A Comparison of Education

	Bank A		Bank B	
	Frequency	Percent	Frequency	Percent
Secondary	10	10.2	48	29.8
College	8	8.2	46	28.6
Certificate	26	26.5	36	22.4
Bachelor	30	30.6	29	18.0
Master	24	24.5	2	1.2

In addition, we asked managers to rate their perception of voluntariness of the system use on a 7-Likert scale where 1 indicates completely free to choose and 7 indicates completely obligated to use the new system. As shown in Table 14, most managers in Bank A believed

the system was completely obligated (62.4%), while in Bank B, managers feel more voluntary to use the new system, with the most percent of managers at level 5 (25.2%).

Table 14 A Comparison of Voluntariness of use

Voluntariness	Bank A		Bank B	
	Frequency	Percent	Frequency	Percent
1	4	4.3	23	14.8
2	0	0	3	1.9
3	1	1.1	7	4.5
4	2	2.2	21	13.5
5	2	2.2	39	25.2
6	26	28.0	30	19.4
7	58	62.4	32	20.6

Next, we used T-test to see if there is significant difference between the two banks in terms of education, age, and voluntariness. The results are presented in Table 15 as follows:

Table 15 Independent Sample Test for Education, Age and Voluntariness

	Levene's test for equality of variance		T test for equality of means		
	F	Sig.	T	df	Sig.(2-tailed)
Education	1.001	.318	-6.879[4] -6.686[5]	226 165.776	.000 .000
Age	2.065	.152	-1.443 -1.421	226 173.127	.150 .157
Voluntariness	19.387	.000	-6.183 -6.704	226 222.192	.000 .000

In order to conduct independent sample T test, the sample should meet the assumption that two groups have approximately equal variance on the dependent variable. If the Levene's

[4] Equal variance assumed
[5] Equal variance not assumed

test for equality of variance is not significant, it means the sample meet the above assumption. In our case, education and age are not significant for Levene's test for equality of variance, which means, two groups have approximately equal variance on the dependent variable. Meeting the assumption, we can further conduct t-test for these two variables. T-test results show that there is significant difference between two groups in terms of education, but there is no significant difference between the two groups in terms of age. Next, we are presenting the validity and reliability analyses that we conducted to test the hypotheses.

4.2 CONSTRUCT VALIDITY

Construct validity was assessed through factor analysis. Factor analysis is used to simplify a large number of inter-correlated items to a few representative constructs or factors. It is based on the assumption that variables sharing similar underlying dimensions will be highly correlated, and those variables who measuring not-so-similar dimensions will demonstrate low correlations. As a result, items that highly correlated with each other will be clustered as one factor. The items under one factor are significantly different from other items under other factors (Basilevsky, 1994).

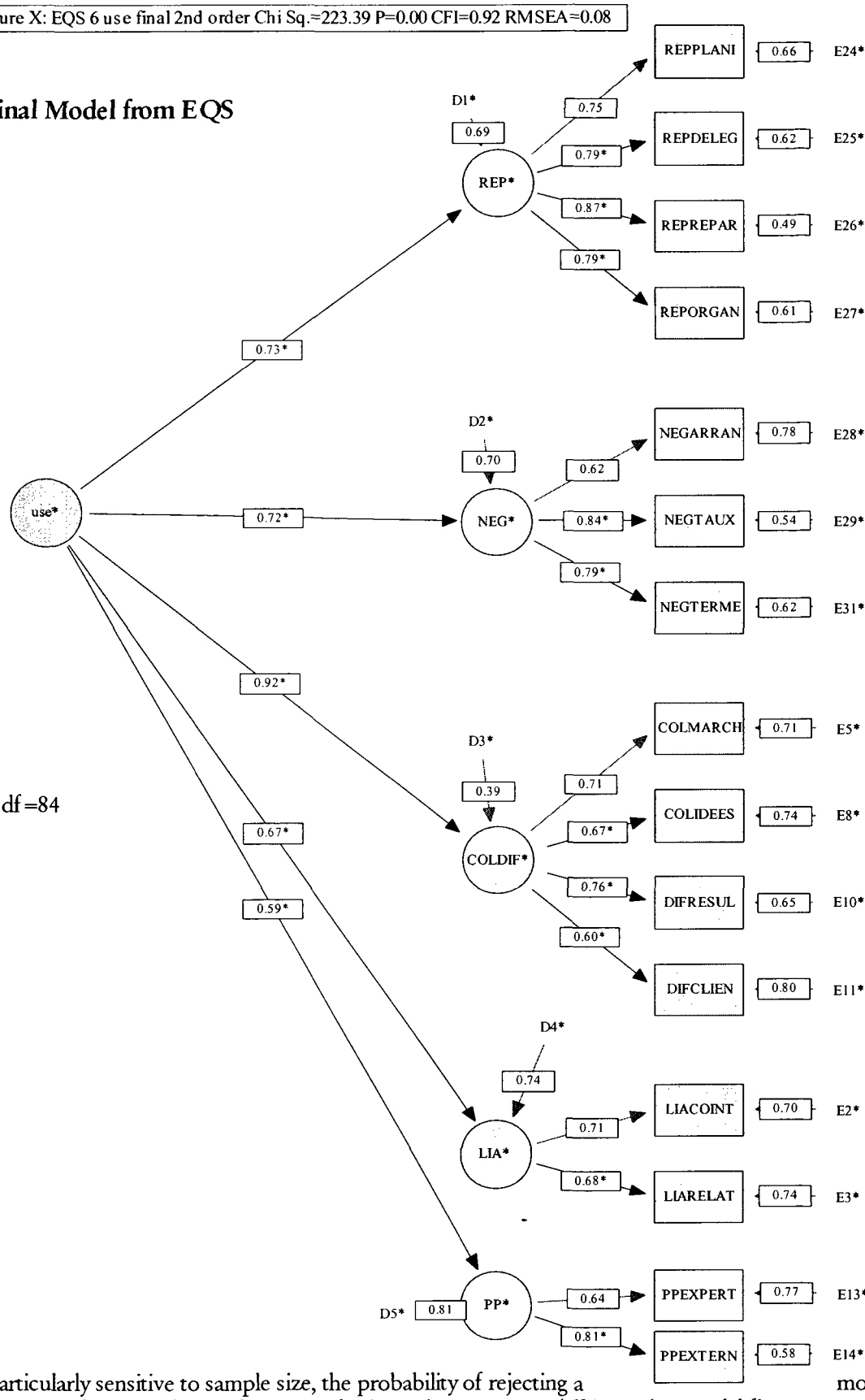
4.2.1 Factor Analysis for IT Use

Initially, we had 30 items to measure IT use. We deleted 8 items from factor analysis with SPSS on the account that these items were either loaded low on all factors or there was cross loading on multiple factors, i.e. the items might be measuring different factors at the same time. We used EQS to test the fitness of the model and further removed 7 items on the account that the items caused largest standardised residuals. Thus, the final measurement for

IT use has 5 factors, and 15 items. The final model is shown in Figure 4 (Code and the according items are identified in Appendix B).

Figure X: EQS 6 use final 2nd order Chi Sq.=223.39 P=0.00 CFI=0.92 RMSEA=0.08

Figure 4 IT Use Final Model from EQS



Chi-Square = 223.389 df =84
χ^2/df = 2.6594

Fit Indices:

NFI = .872
NNFI = .894
CFI = .915
GFI = .894
AGFI = .848
RMR = .054
RMSEA = .080

*Chi-square test are particularly sensitive to sample size, the probability of rejecting a model increases with increasing sample sizes. Thus, in large sample size as in our case, χ^2/df is used as model fit measure. The ratio should not exceed 3, which shows a good model fit. Fit indices NFI, NNFI, CFI, and LISREL GFI greater than .90 and LISREL AGFI greater than .80 are considered as good model fit. A standardized RMR not exceeding .05, and an RMSEA not exceeding .08 are indicative of good fit.

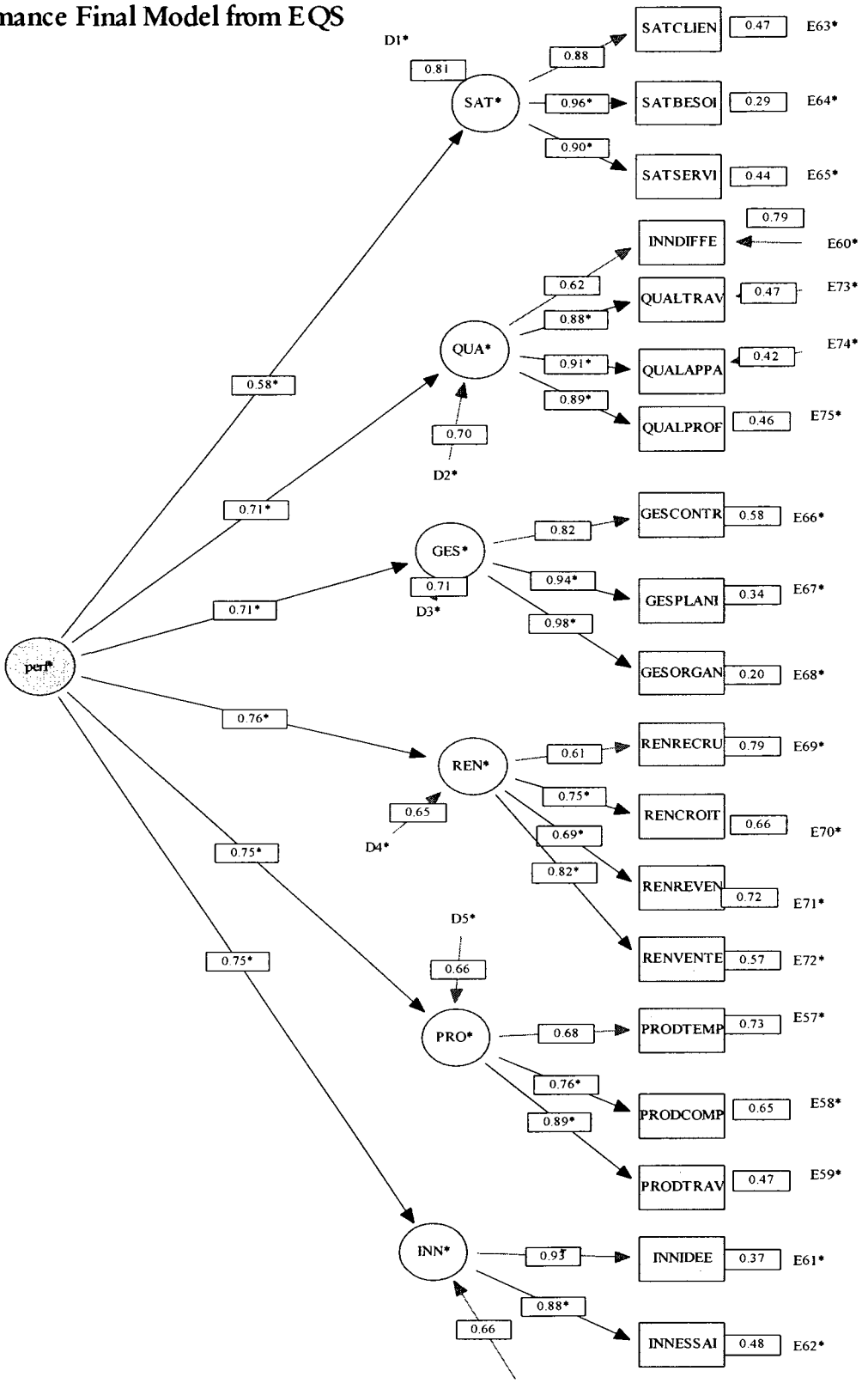
According to the threshold, our model demonstrates an adequate level of fit. As shown in Figure 4, NFI, NNFI, and LISREL GFI are quite close to .90, with AGFI passed the threshold .80. However, note that items for rich IT use are newly developed.

4.2.2 Factor Analysis for Individual Performance

We had 22 items for individual performance. We did factor analysis with SPSS and removed 3 items on the account that items were loaded low on all factors or was cross loading on multiple factors. Next, we used EQS to test the fitness of the model. The final measure for individual performance has 6 factors, 19 items. The results from EQS are shown in Figure 5 (Code and the according items are identified in Appendix B).

Figure X: EQS 6 indl perf 2nd order Chi Sq.=439.45 P=0.00 CFI=0.92 RMSEA=0.09

Figure 5 Individual Performance Final Model from EQS



Chi-Square = 439.445
df = 145 $\chi 2/df = 3.03$

Fit Indices:

NFI = .889
NNFI = .908
CFI = .922
GFI = .848
AGFI = .801
RMR = .078
RMSEA = .088

* χ^2/df is used as model fit measure. The ratio should not exceed 3, which shows a good model fit. Fit indices NFI, NNFI, CFI and LISREL GFI greater than .90 and LISREL AGFI greater than .80 are considered as good model fit. A standardized RMR not exceeding .05, and an RMSEA not exceeding .08 are indicative of good fit.

As shown in Figure 5, our model demonstrates a good fit. NNFI and CFI exceed the .90 threshold. NFI and LISREL GFI are close to .90 with AGFI passed the threshold of .80.

4.3 RELIABLITIES AND CORRELATION ANALYSIS

The validity of the measures is further assessed in terms of convergent validity. We used Cronbach's alphas to test the internal consistency reliability for multiple item scales. A Cronbach's alpha of 0.70 is considered as threshold in social sciences. If the cronbach's alpha is 0.70 or higher, it suggests that all of the items are reliable and the entire set is internally consistent. If the alpha is low, then at least one of the items is unreliable (Fornell, 1982). Lastly, we conduct correlation analysis. Correlation analysis is to test whether a relationship exists between the factors and determining its magnitude and direction. The results for IT use factors are shown in Table 16.

Table 16 Measurement Characteristics, Internal Consistency and Correlation Analysis for IT Use Factors

	# of items	mean	Std. deviation	Cronbach's alpha stad.	Inter-item Correlations				
					REP	NEG	COLD IF	LIA	PP
REP	4	6.9076	4.5405	.883	1				
NEG	3	7.7888	4.2885	.792	.511** .000	1			
COL DIF	4	6.8659	3.9187	.788	.502** .000	.519** .000	1		
LIA	2	3.1840	2.0275	.650	.387** .000	.335** .000	.461** .000	1	
PP	2	3.1516	2.1270	.684	.332** .000	.294** .000	.407** .000	.295** .000	1

**: *Correlation is significant at the 0.01 level (2-tailed)*

From table 16, notice that all factors for IT use are moderately related but not too significantly to the point that they are measuring the same factor. In terms of Cronbach's alphas, two factors, LIA and PP have lower than .70 alphas, but they were closer to the threshold. These items are newly developed, thus, we would keep them for the time being. Next, we present the internal consistency analysis and correlation analysis results for individual performance factors. The results are shown in Table 17.

Table 17 Measurement Characteristics, Internal Consistency and Correlation Analysis for Individual Performance Factors

	# of items	mean	Std. deviation	Cronbach's alpha stad.	QUA	Mgmt Control	SAT	PRO	PRO	INN
Quality	4	21.43	5.203	.893	1					
Management Control	3	10.12	4.925	.935	.491** .000	1				
Satisfaction	3	14.22	4.925	.937	.497** .000	.337** .000	1			
Profitability	4	13.89	5.705	.807	.539** .000	.484** .000	.358** .000	1		
Productivity	3	11.06	4.683	.813	.498** .000	.506** .000	.437** .000	.468** .000	1	
Innovation	2	7.22	3.332	.901	.504** .000	.574** .000	.327** .000	.513** .000	.472** .000	1

**. Correlation is significant at the 0.01 level (2-tailed)

From Table 17, we can see all factors for individual performance are moderately related but not too significantly to the point that they are measuring the same factor. Also, the Cronbach's alpha all passed the threshold of .70, representing good internal consistency reliability.

4.4 STRUCTURAL EQUATION MODELING WITH EQS

In the final measure model, we have 6 factors, 19 items for rich individual performance measure; and 5 factors, 15 items for rich use measure. We then tested all 11 factors, and 34 items on EQS. In the final model, χ^2/df is 2.08, not exceeding 3. CFI is .909, slightly greater than .90. RMSEA is .065, did not exceed .08. All other indices are close to the thresholds e.g. NFI=.841, NNFI=.892, GFI=.819, AGFI=.772. Thus, the model demonstrates a moderate fit. Next, we will use the items we obtained to test our hypotheses.

4.5 HYPOTHESES TESTING

Hypothesis 2a stated that IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is lean. We have three buckets for very lean IT use measure and 1 dimension individual performance as its lean measure. One-way ANOVA was used to analyse the difference. The results are shown in Table 18 as follows:

Table 18 Multiple Comparisons for Hypothesis 2a

Dependent Variable		(I) bucket	(J) bucket	Mean Difference (I-J)	Sig.
				Lower Bound	Lower Bound
PRODUCTIVITY	Tukey HSD	.00	1.00	-.84256	.416
			2.00	-2.40448(*)	.010
		1.00	.00	.84256	.416
			2.00	-1.56192	.088
		2.00	.00	2.40448(*)	.010
			1.00	1.56192	.088
PROFITABILITY	Tukey HSD	.00	1.00	-1.43534	.179
			2.00	-3.05777(*)	.007
		1.00	.00	1.43534	.179
			2.00	-1.62243	.167
		2.00	.00	3.05777(*)	.007
			1.00	1.62243	.167
QUALITY	Tukey HSD	.00	1.00	-.64294	.665
			2.00	-2.04703	.069
		1.00	.00	.64294	.665
			2.00	-1.40409	.208
		2.00	.00	2.04703	.069
			1.00	1.40409	.208

* The mean difference is significant at the .05 level.

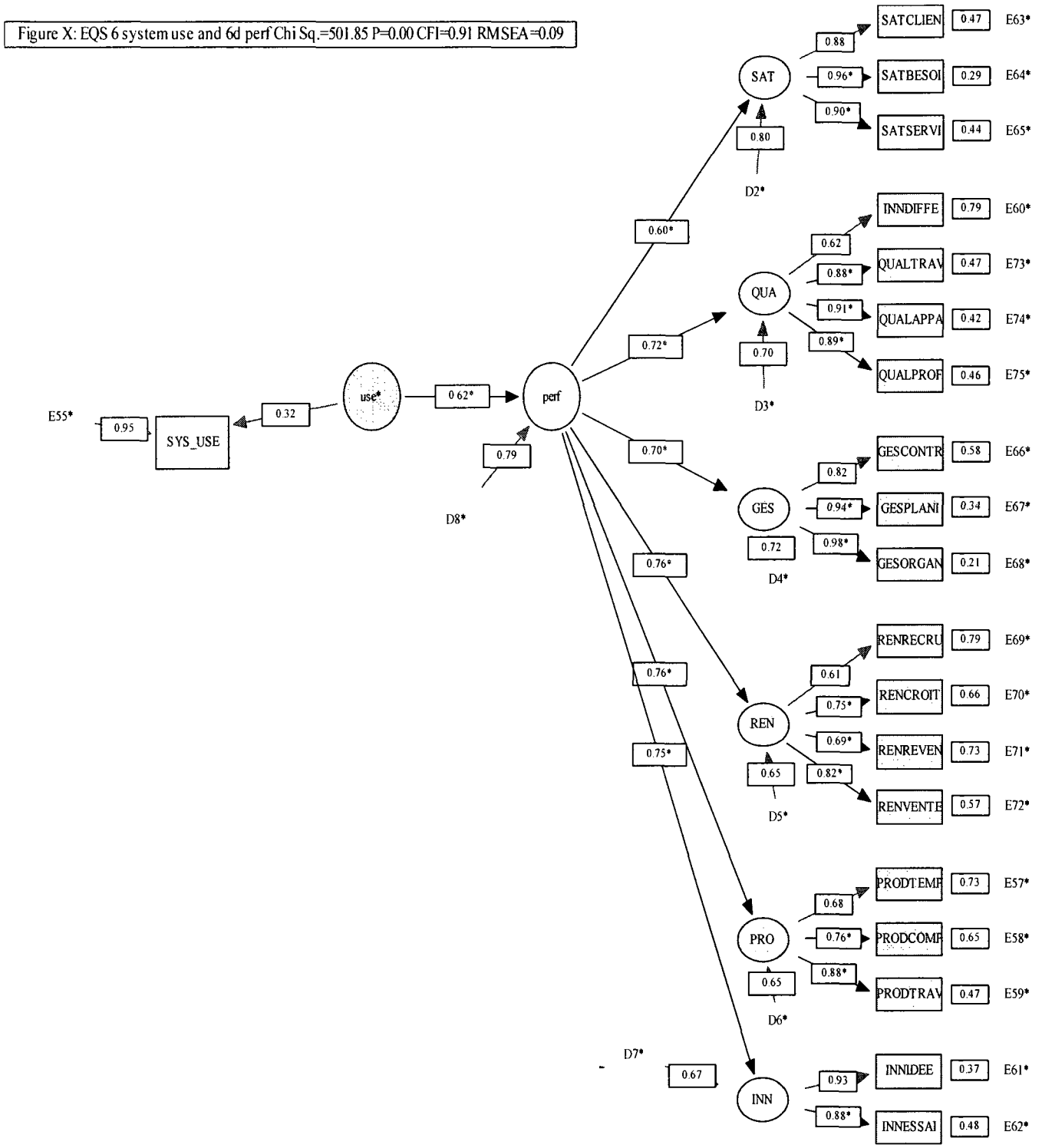
As shown in Table 18: in terms of productivity, there is a significant mean difference between bucket 0 and bucket 2, bucket 2 with higher mean. In terms of profitability, bucket 2 has significantly higher mean than bucket 0. There is no significant difference between the three buckets in terms of quality. Thus, heavy users have significantly better productivity than light users ($p=.01$) and have significantly better profitability than light users ($p<01$). However, in terms of quality, heavy users have higher quality mean than light users, but the difference is not significant. Therefore, heavy users have significant higher mean for performance than light users in terms of productivity and profitability, but not with quality. The hypothesis 2a is partly supported.

Hypothesis 1b stated that IT use will be significantly and positively related to individual performance when the measure for IT use is lean and the measure for individual performance is very lean. Bank A has quite a few missing data for revenue, thus we could only use Bank B as sample. It causes a smaller sample of 139 responses. The SPSS results shows that the unstandardized coefficient between IT use and sales performance is .001, significant at .751. Thus, it is non-significant relationship between IT use and individual performance. The hypothesis 1b is not supported.

Hypothesis 3b stated that IT use will not be significantly related to individual performance when the measure for IT use is lean and the measure for individual performance is somewhat rich. For somewhat rich individual performance measure, we have three combinations—quality and profitability, quality and productivity, and productivity and profitability. Unfortunately, EQS could not converge on an acceptable solution for any of the three combinations. The sample we used to test this hypothesis in EQS was 261 responses. The sample size might have caused the problem.

Hypothesis 4b stated that IT use will not be significantly related to individual performance when the measure for IT use is lean and the measure for individual performance is rich. We have all 6 dimensions of individual performance rich measurement. The result from EQS is shown in Figure 6. Not as hypothesized, there is a significant positive relationship between system use and the 6 dimensions of individual performance as a whole. The beta is 0.616 between use and performance ($p<05$). The independent variable explained 38% of the variance of dependent variable individual performance. The hypothesis 4b is not supported.

Figure 6 EQS Result for Hypothesis 4b



Hypothesis 1c stated that IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is very lean. As of our dataset, Bank A has very limited sample for sales performance as very lean individual performance measure, thus, to test this hypothesis, we only have the sales data from bank B. We did multiple regression on SPSS, for the five applications in Bank B, including Database, SIMULATEUR, PPP, EMILI, and ASAP. The results are shown in Table 19:

Table 19 SPSS Result for Hypothesis 1c

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.009	.505		.018	.986
	DB_JR	.001	.002	.049	.596	.552
	SIMULI_JR	-.002	.006	-.033	-.372	.710
	PPP_JR	-.005	.005	-.073	-.895	.372
	EMILI_JR	.005	.007	.057	.671	.503
	ASAP_JR	.002	.004	.048	.539	.591

a. Dependent Variable: VENTE_DIFFERENCE

The results show that none of the application is significant related to sales performance and the R square is low (R square=.012), indicating these variables represent a bad model fit. None of the applications was significantly related to sales data as individual performance. Thus, the hypothesis 1c is not supported.

Hypothesis 2c stated that IT use will not be significantly related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is lean. Again, as somewhat rich use measure, we have different applications for Bank A and Bank B. Lean individual performance, we have one out of three dimensions of individual

performance, productivity, profitability and quality. Thus, we did the respective test for each bank on each dimension. The multiple regression results from SPSS show that none of the application in Bank A is significantly related to any one of the 3 dimension of individual performance. The results are summarized in Table 20. However, in Bank B, both negative and positive relationships were found. The results are summarized in Table 21 as follows:

Table 20 SPSS Results for Hypothesis 2c Bank A

Bank A	*R Square*	*Application*	*Standardized Coefficient Beta*	*Sig.*
Productivity	0.8%	Data Base	-.002	.721
		MEI	.007	.652
		WFAST	.007	.717
Profitability	1.7%	Data Base	.008	.284
		MEI	-.008	.650
		WFAST	-.006	.782
Quality	1%	Data Base	.005	.436
		MEI	-.005	.771
		WFAST	.011	.549

Table 21 SPSS Results for Hypothesis 2c Bank B

Bank B	*R Square*	*Application*	*Standardized Coefficient Beta*	*Sig.*
Productivity	12.6%	PPP	.342	p<001
Profitability	10%	PPP	.252	p<001
		EMILI	.172	p<05
Quality	8.1%	SIMUL	-.193	p<05
		PPP	.204	p<01

Therefore, the results partly supported hypothesis 2c and replicate previous empirical results from literature. No significant relationship was found between applications and either dimension of individual performance at Bank A. Meanwhile, in Bank B, significant relationships are found between the use of decision support system (PPP), mortgage management tool (EMILI), and profit simulation tool (SIMUL) and according dimensions of individual performance. The coefficient beta, significant level, and R square depend on the application examined and the dimension of individual performance explained, exactly as indicated in literature. The model explained, in descending order, 12.6% of productivity, 10% of profitability, and 8.1% of the quality. Decision support system PPP showed significant positive related with all three dimensions, productivity being the strongest relationship, profitability next, and the weakest with quality. Mortgage management tool EMILI showed significant positive relationship with profitability, while profit simulation tool Simulateur showed significant negative relationship with quality, indicating the less Simulateur is used, the better the quality of work.

Hypothesis 1d stated that IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is very lean. For rich IT use, we have 5 dimensions of IT use, and one sales data as very lean individual performance measure. The same case as in H1b and H1c, only sales data from bank B will be used as very lean individual performance to test the hypothesis. Results from SPSS are shown in Table 22:

Table 22 SPSS Results for Hypothesis 1d

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.416	.468		.888	.376
	REP	.073	.067	.114	1.087	.279
	NEG	-.084	.066	-.129	-1.272	.205
	COLDIF	.005	.070	.008	.073	.942
	LIA	-.167	.112	-.141	-1.500	.136
	PP	.110	.096	.103	1.142	.255

a. Dependent Variable: VENTE_DIFFERENCE

The multiple regression results from SPSS show that none of five aspects of use demonstrates significant relationship with sales as individual performance measure. The R square is .036. Thus, the hypothesis 1d is not supported.

Hypothesis 2d stated that IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is lean. We ran each of the 3 dimensions of individual performance on rich use measure with EQS. The results from EQS are shown in following Figure 7, 8 and 9 which were summarized in Table 23.

Figure 7 Rich IT Use with Productivity

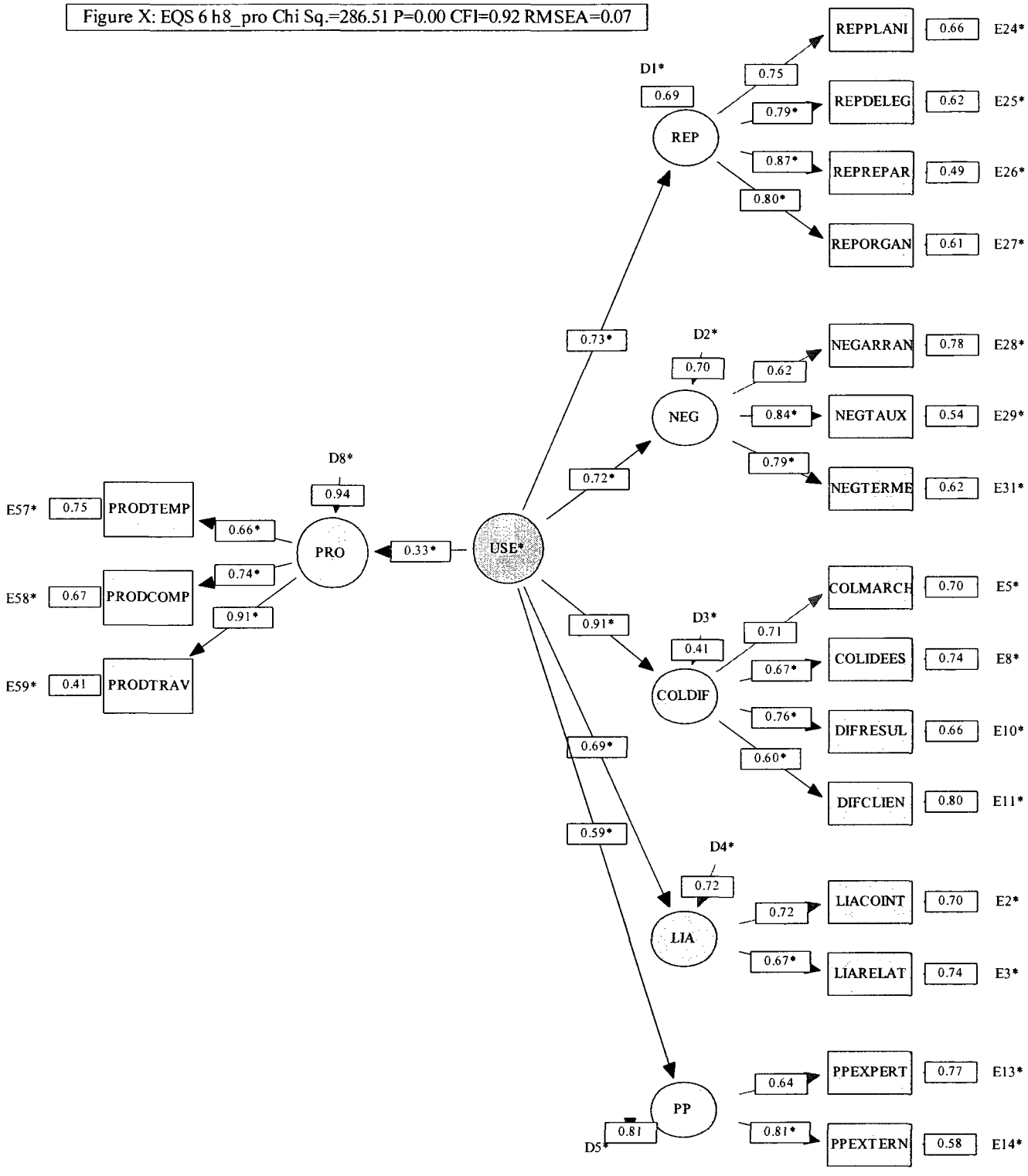


Figure 8 Rich IT Use with Quality

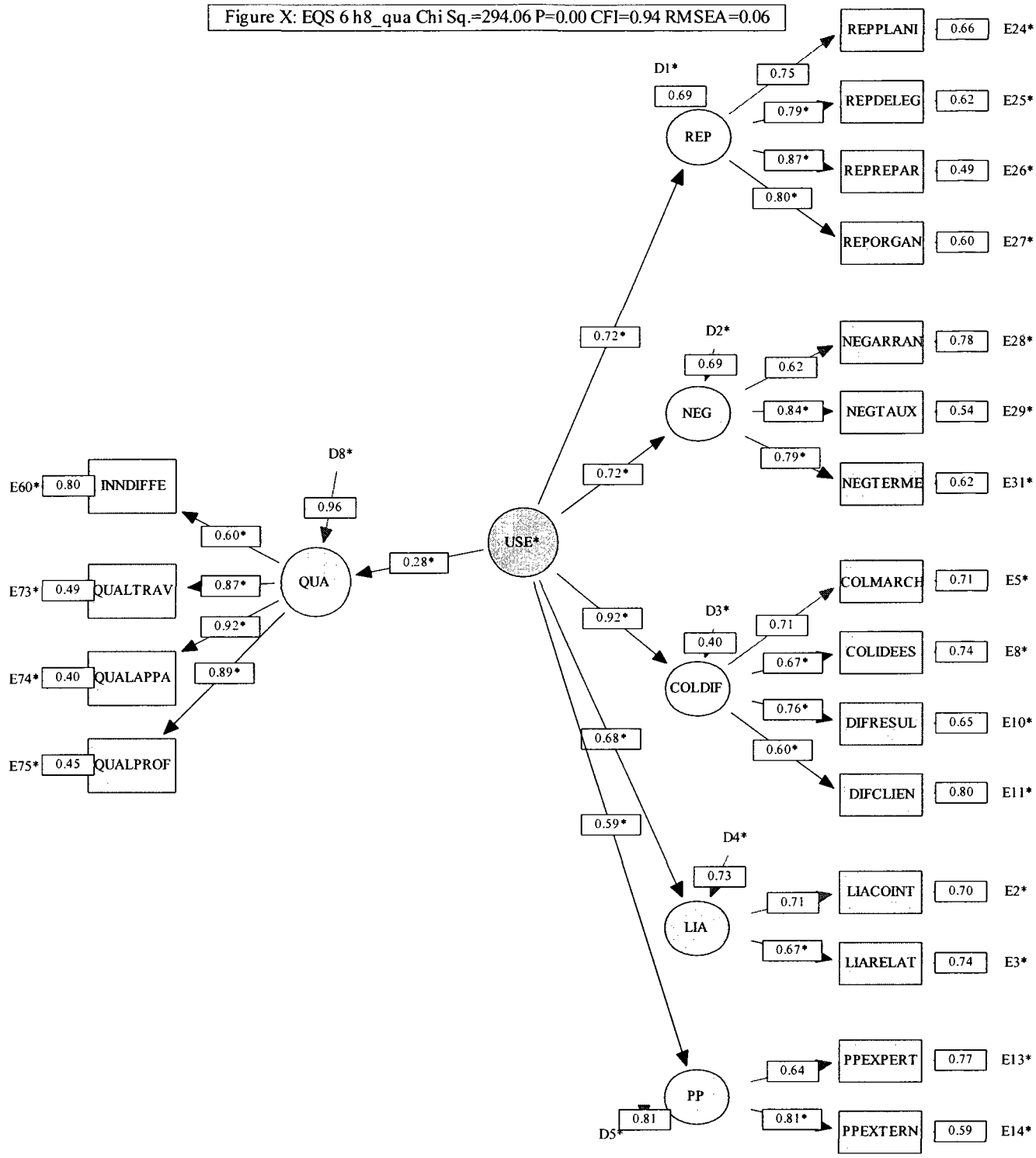


Figure 9 Rich IT Use with Profitability

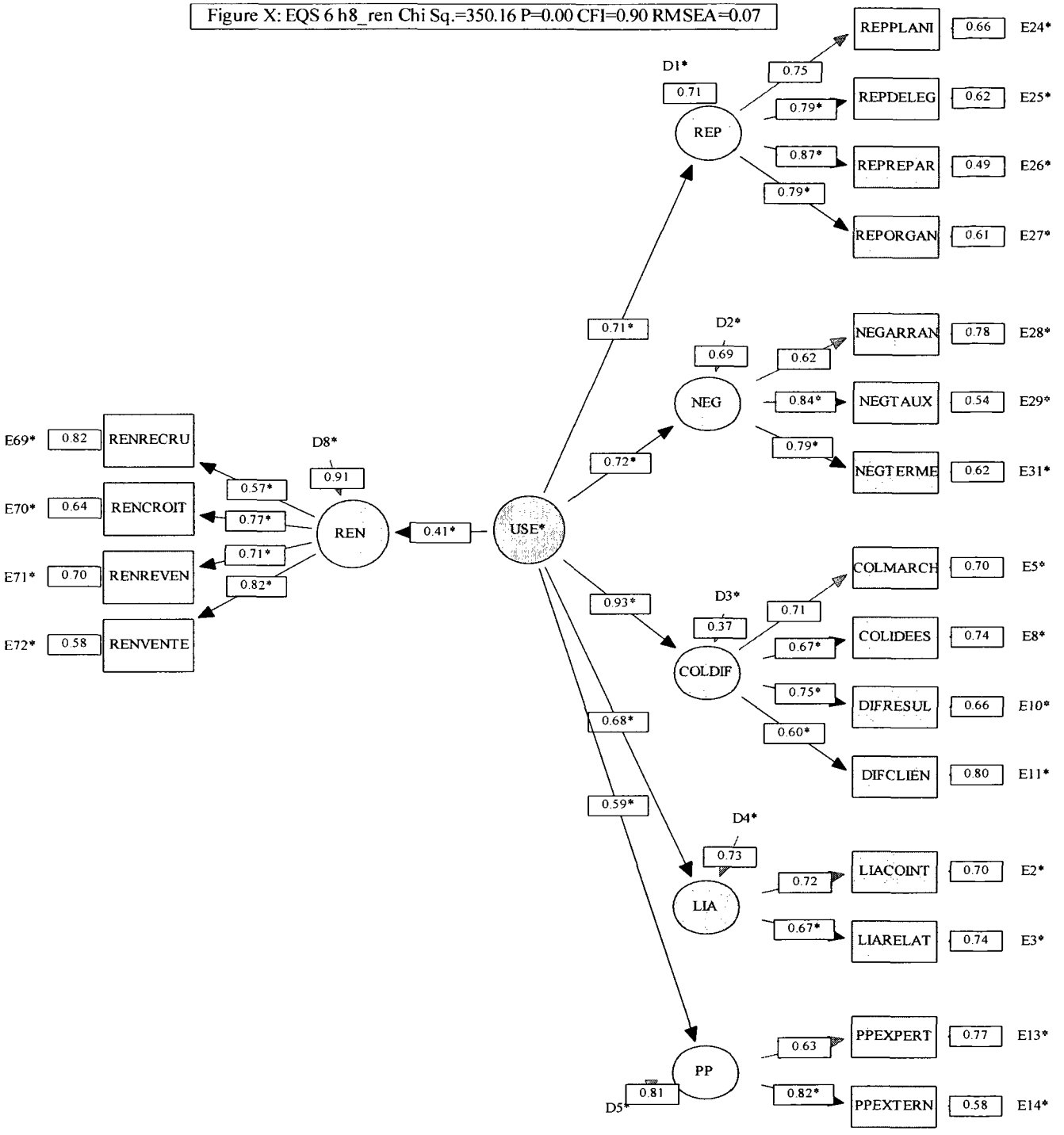


Table 23 Summary of EQS Results for Hypothesis 2d

Individual Performance Dimension	*Standardized Coefficient Beta*	*R square*	*Sig*
Profitability	.405	16.4%	p<0.05
Productivity	.329	10.8%	p<0.05
Quality	.285	8.1%	p<0.05

As can be seen from the results, as predicted in the hypothesis, use is significant on all 3 dimensions of individual performance. Use explained 16.4% of the variance of profitability. The beta was 0.405 ($p<.05$). Use explained the least of quality, with R square equals to 8.1%. The beta was 0.285 ($p<.05$). Productivity was in the middle, explained by use with 8.1%. The beta was 0.329 ($p<.05$). Thus hypothesis 2d is supported.

Hypothesis 4d stated that IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is rich. With both use and individual performance measure being rich, we ran the model on EQS. The result is shown in Figure 10. The coefficient beta between use and individual performance is .482 ($p<.05$). Use explained 23.3% of the variance of individual performance. Hypothesis 4d is thus supported.

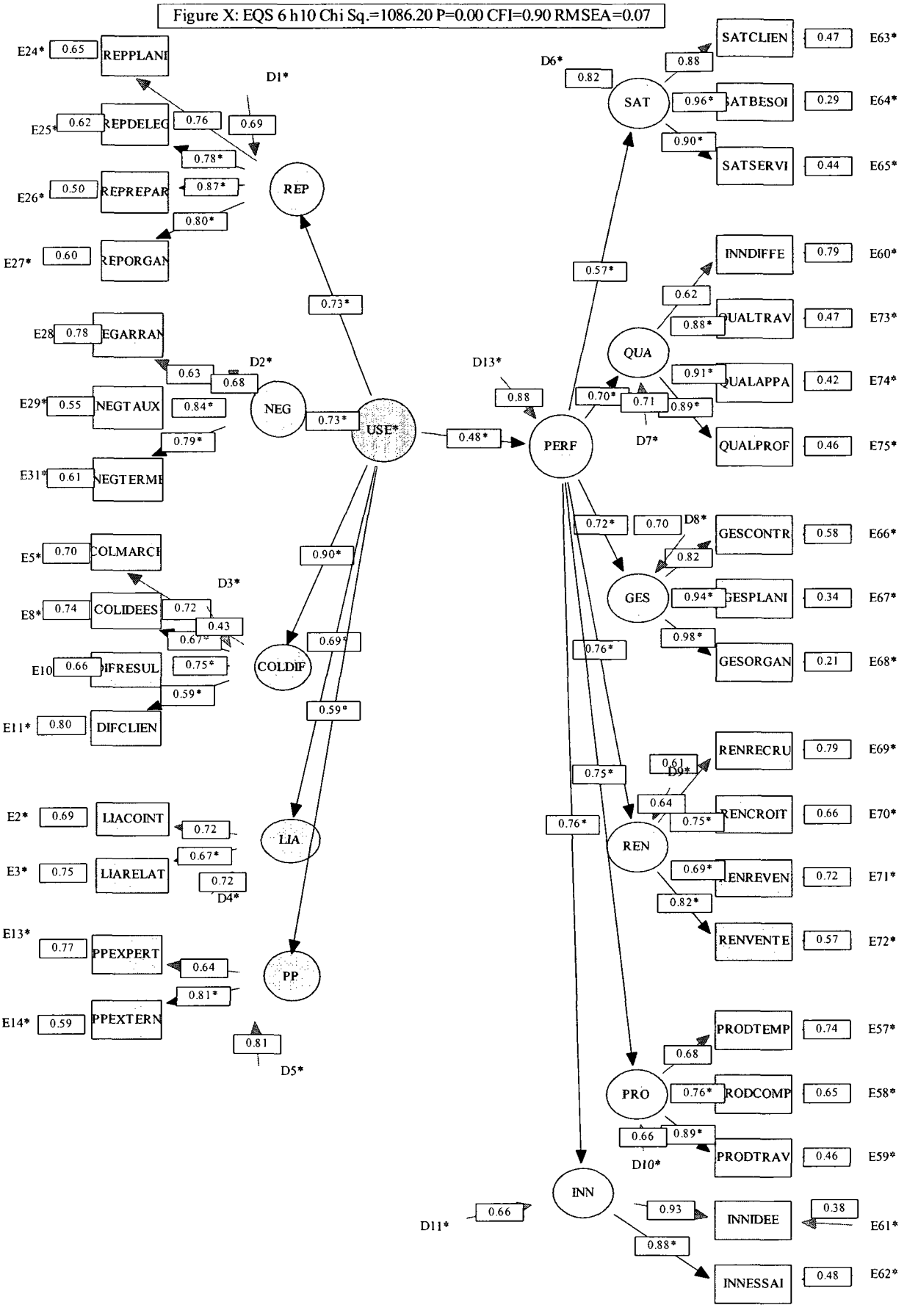


Figure 10 EQS Result for Hypothesis 4d

Hypothesis 1a stated that IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is very lean. The result from SPSS is shown in Table 24:

Table 24 SPSS Result for Hypothesis 1a

Multiple Comparisons

Dependent Variable: VENTE_DIFFERENCE

	(I) bucket	(J) bucket	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	.00	1.00	.27548	.46321	.823	-.8204	1.3714
		2.00	-.01508	.55671	1.000	-1.3322	1.3020
	1.00	.00	-.27548	.46321	.823	-1.3714	.8204
		2.00	-.29056	.48826	.823	-1.4457	.8646
	2.00	.00	.01508	.55671	1.000	-1.3020	1.3322
		1.00	.29056	.48826	.823	-.8646	1.4457

Not supporting the hypothesis, the results from One-Way ANOVA show that no significant relationship between three groups of users.

Hypothesis 2b stated that IT use will be significantly and positively related to individual performance when the measure for IT use is lean and the measure for individual performance is lean. Since the total time spent on system use is significantly different between bank A and B, we added a dummy variable Bank (0: bank B, 1: bank A) into the regression. Thus, we ran multiple regression for each of the three dimensions of individual performance for system use. The results are summarized in Table 25 as follows:

Table 25 SPSS Results for Hypothesis 2b

Dimension	*R square*	*Beta*	*Sig*
Productivity	4.3%	.241	p<001
Quality	3.9%	.209	p<01
Profitability	5.3%	.249	p<001

Use was positively related to all three dimensions of individual performance. It explained 5.3% of the variance of profitability, 4.3% of the variance of productivity, and 3.9% of the variance of quality. Thus, the hypothesis 2b is supported.

Hypothesis 3a stated that IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is somewhat rich. We ran the three buckets and two dimensions of the three dimensions of individual performance on EQS. The results from EQS are shown in following Figure 11, 12 and 13 which were summarized in Table 26.

Figure 11 Very Lean IT Use with Productivity and Quality

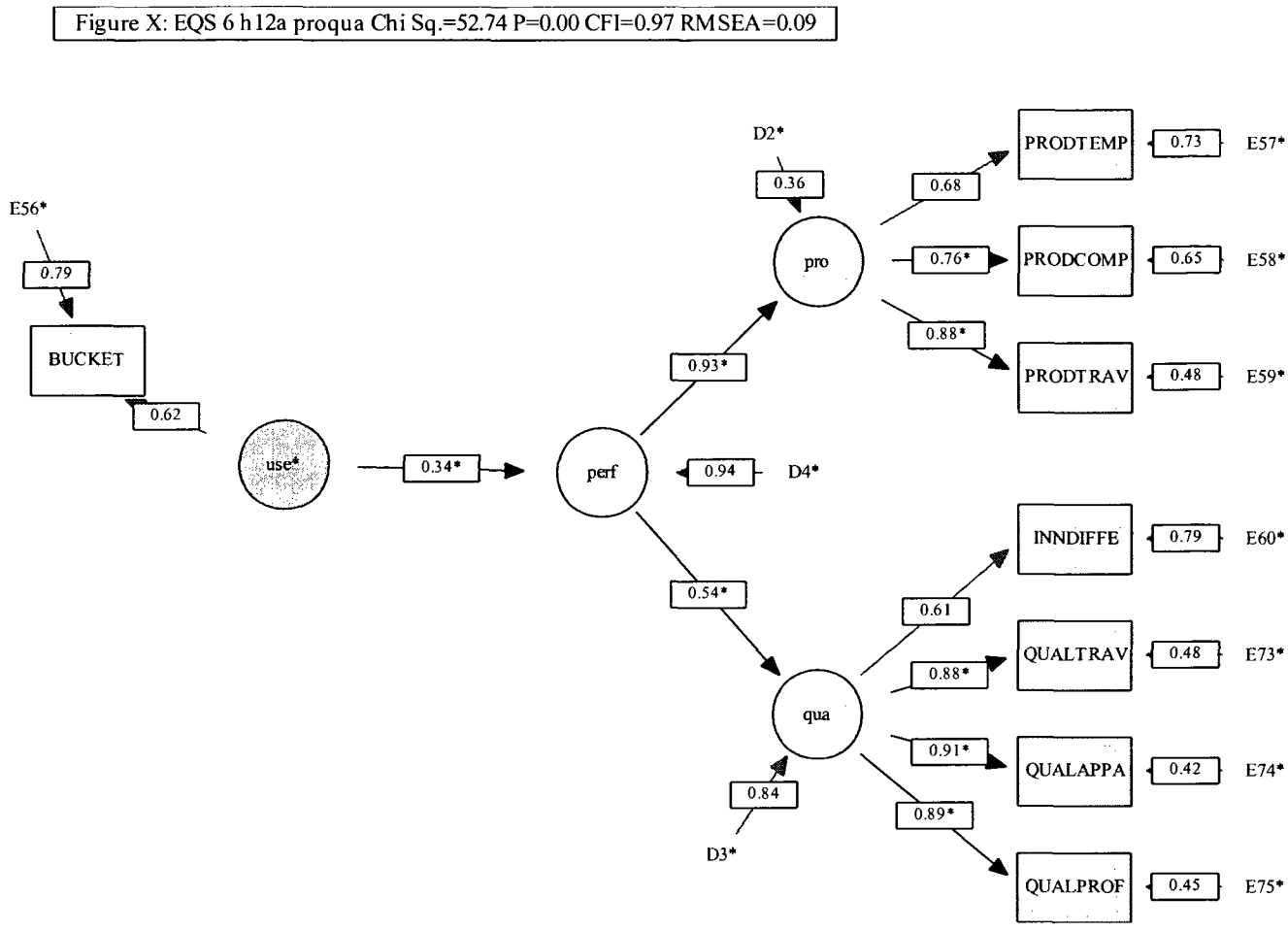


Figure 12 Very Lean IT Use with Productivity and Profitability

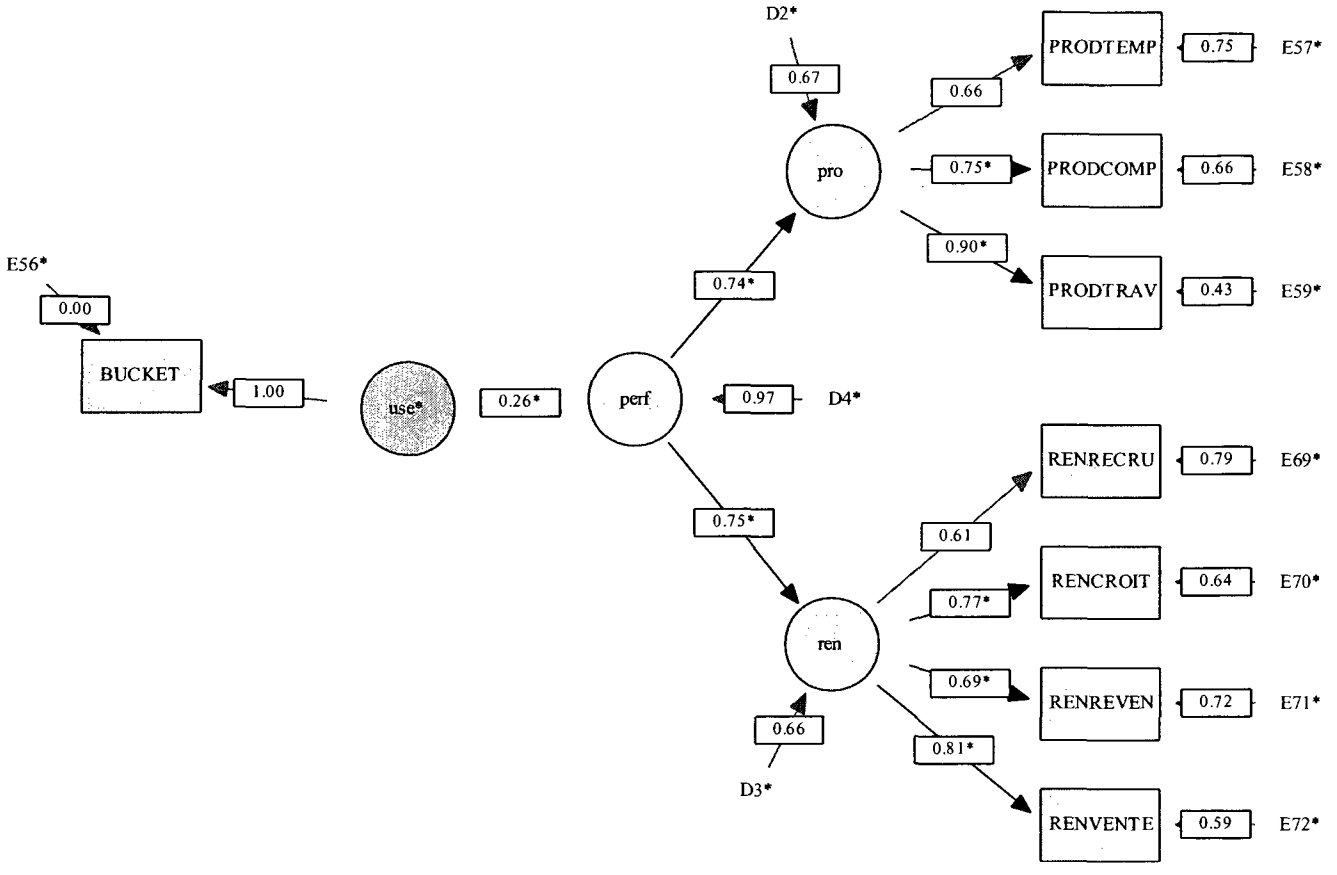


Figure 13 Very Lean IT Use with Profitability and Quality

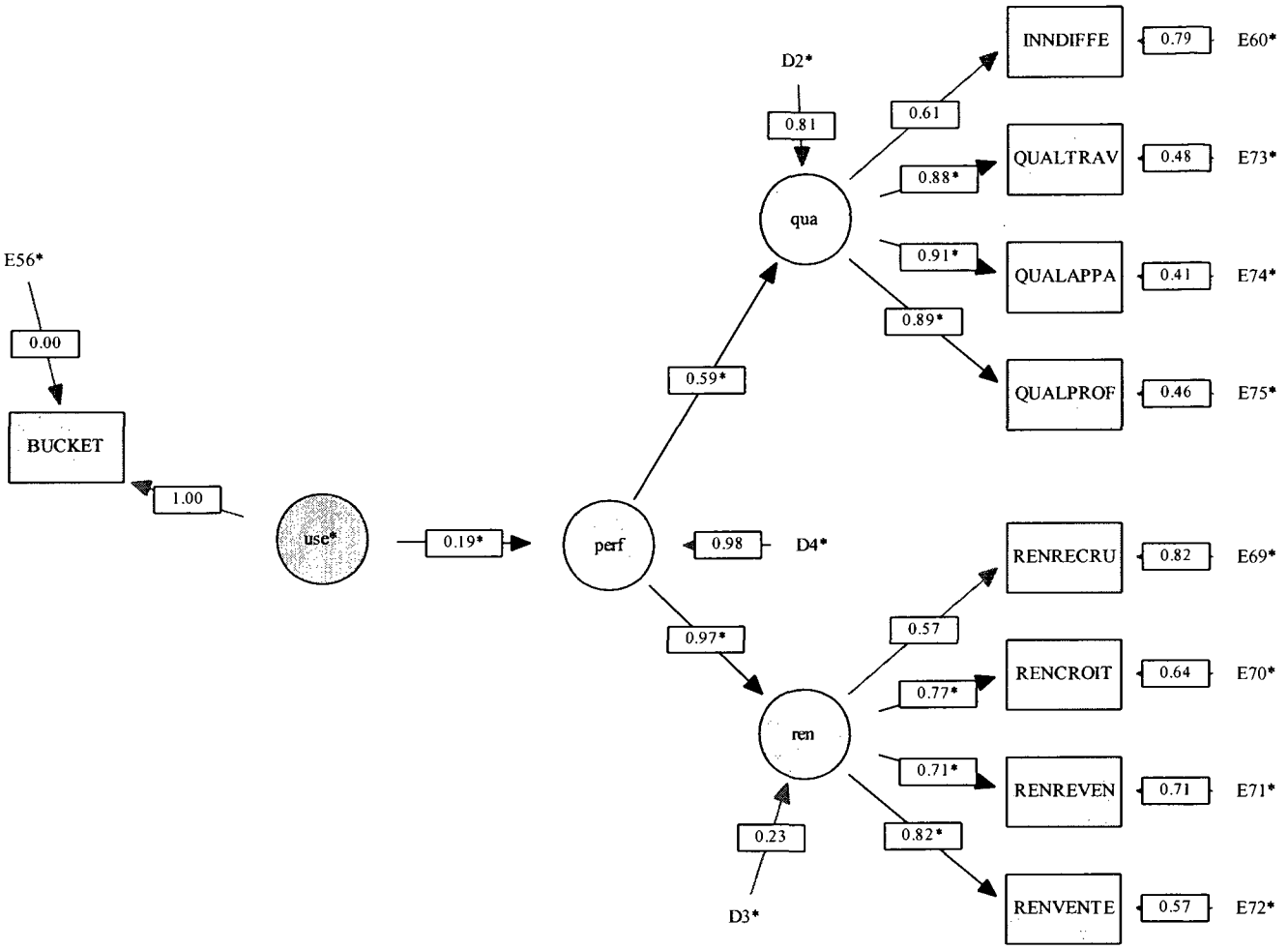


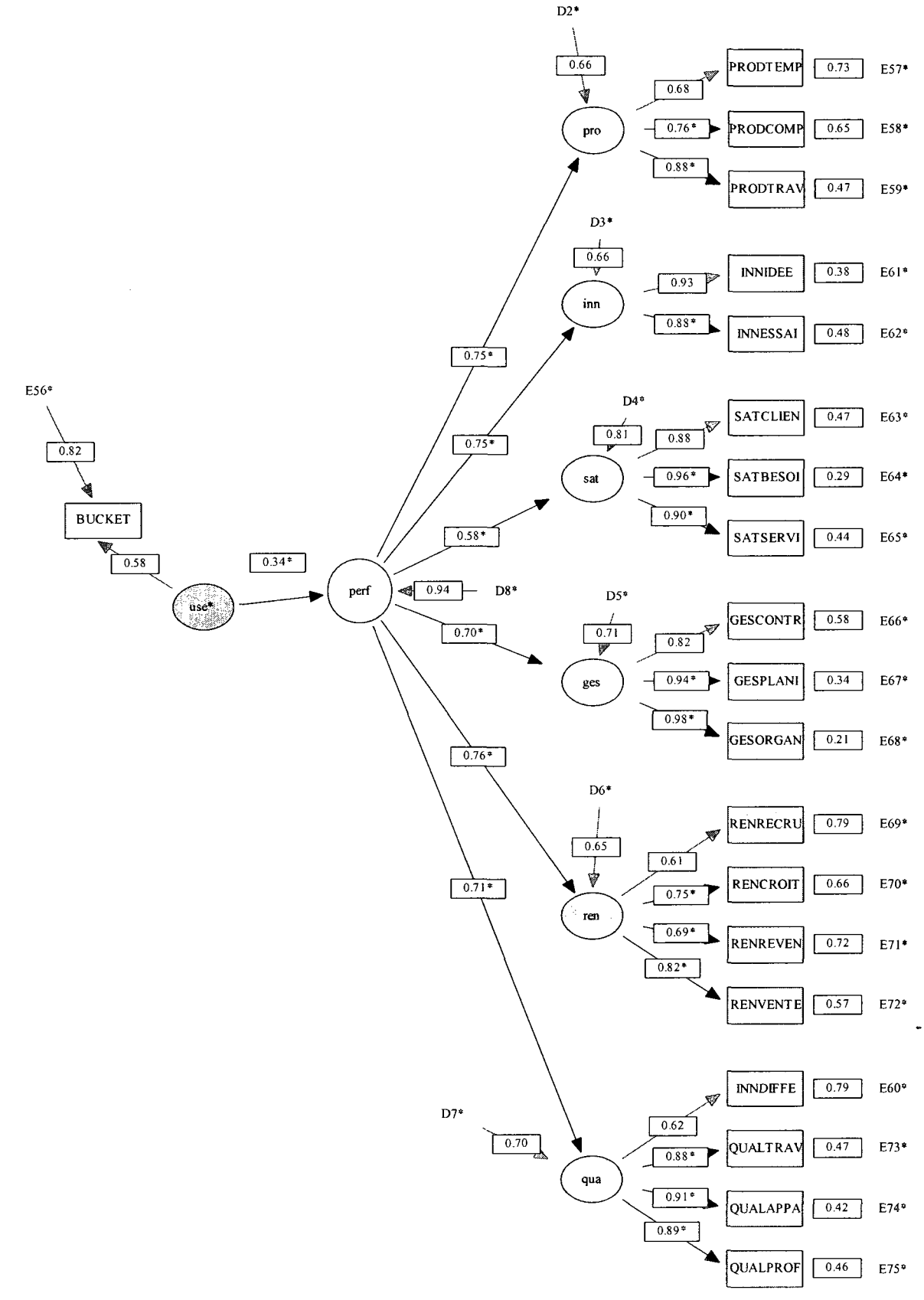
Table 26 Summary of EQS Results for Hypothesis 3a

Dimensions	*R Square*	*Beta*	*Sig.*
Quality and Productivity	11.4%	0.337	p<05
Productivity and Profitability	6.6%	0.257	p<05
Quality and Profitability	3.7%	0.192	p<05

As proposed, use was significantly and positively related to all 3 combinations. Use explained 11.4% of quality and productivity, 6.6% of productivity and profitability, 3.7% of quality and profitability. The hypothesis 3a is supported.

Hypothesis 4a stated that IT use will be significantly and positively related to individual performance when the measure for IT use is very lean and the measure for individual performance is rich. We ran system use and the 6 dimensions of individual performance on EQS. The result is shown in Figure 14. The result shows that there is significant positive relationship between use and 6 dimensions of individual performance. The standardized coefficient beta is 0.339 (p<05). Use explained 11.5% of the variance of individual performance. The hypothesis 4a is supported.

Figure 14 EQS result for Hypothesis 4a



Hypothesis 3c stated that IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is somewhat rich. For somewhat rich use measure, Bank A and Bank B have different applications. We do have the data regarding how much time spent on each application in each bank. We intended to create one variable to represent the average time spent on each application per bank, but the mean was significantly different for each bank. Thus, we had to test the hypothesis separately for each bank. Therefore, we have two separate data sets, Bank A and Bank B. Bank A has 3 applications, Database, WFAST, and MEI. Bank B has 5 applications, Database, SIMULATEUR, PPP, EMILI and ASAP. We created one variable totalling the time spent on all applications together for each bank, representing the total time spent application-wise. Unfortunately, EQS could not converge on acceptable results for any of the three combinations for either bank. A very limited small sample size might have caused the problem since after separating the samples, Bank A had 99 responses and Bank B had 162 responses.

Hypothesis 4c stated that IT use will be significantly and positively related to individual performance when the measure for IT use is somewhat rich and the measure for individual performance is rich. The concern for the sample occurred in H3c applies here as well. Thus, we ran the tests on EQS separately for Bank A and Bank B. EQS did not converge on acceptable result in the case of Bank A. However, a significant positive relationship was found between IT use and individual performance for Bank B. The coefficient beta is .993 ($p<05$). Use explained 98.6% variance of individual performance. The hypothesis 4c is supported.

Hypothesis 3d stated that IT use will be significantly and positively related to individual performance when the measure for IT use is rich and the measure for individual performance is somewhat rich. We ran the rich use measures on the three combinations of somewhat rich individual performance measures with EQS. The results from EQS are shown in following Figure 15, 16 and 17 which were summarized in Table 27.

Figure 15 Rich IT Use with Productivity and Profitability

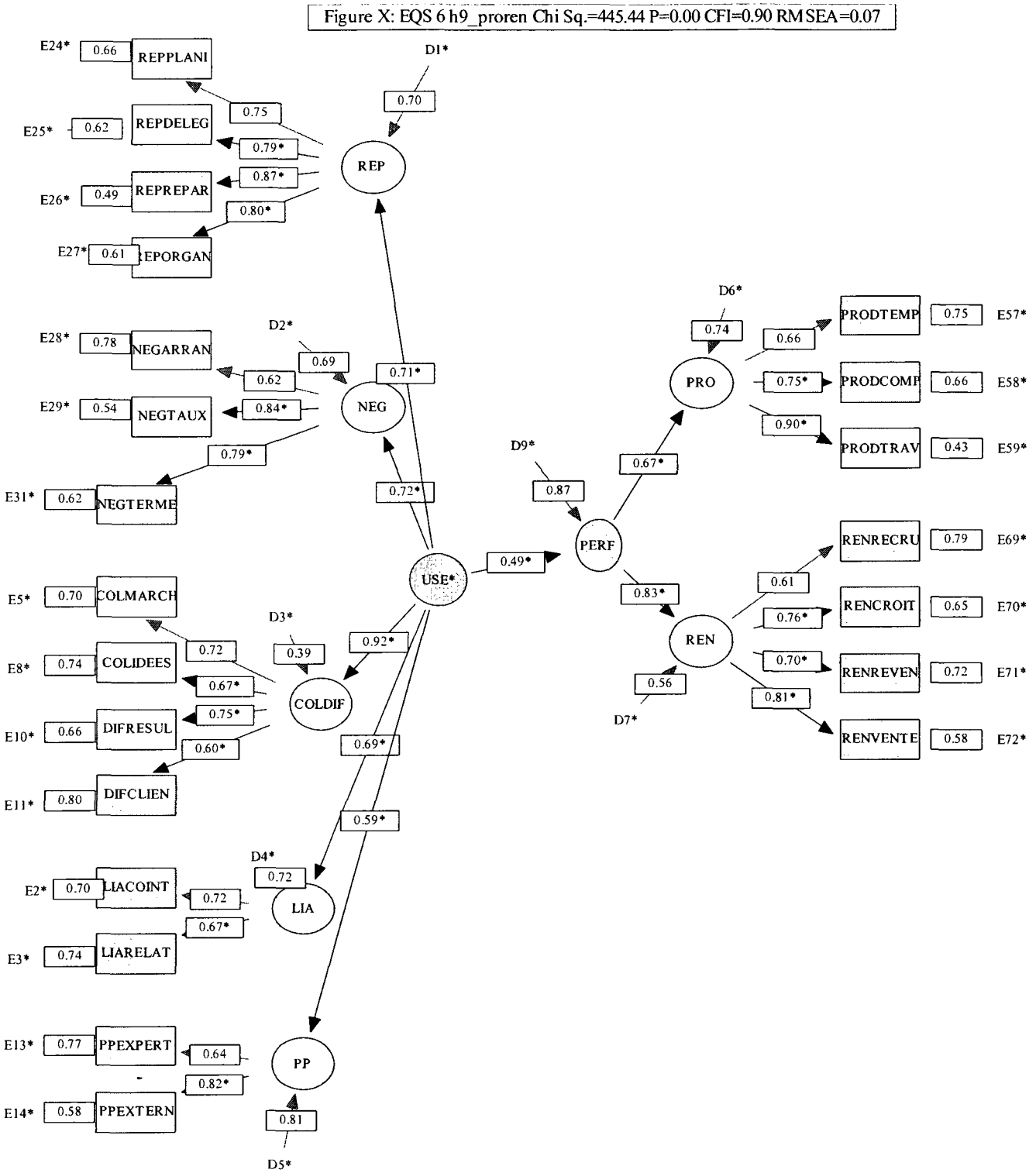


Figure 16 Rich IT Use with Quality and Profitability

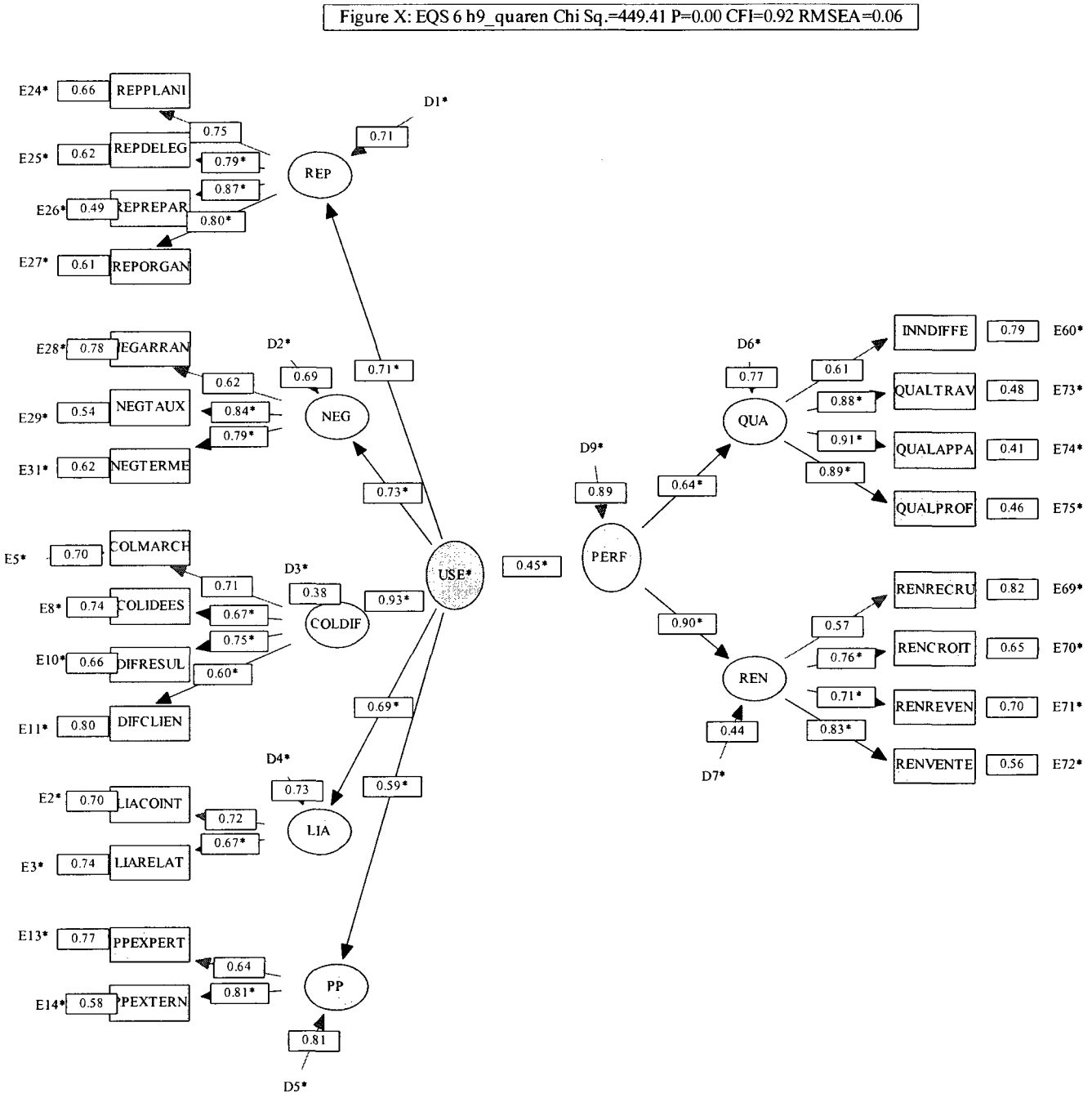


Figure 17 Rich IT Use with Productivity and Quality

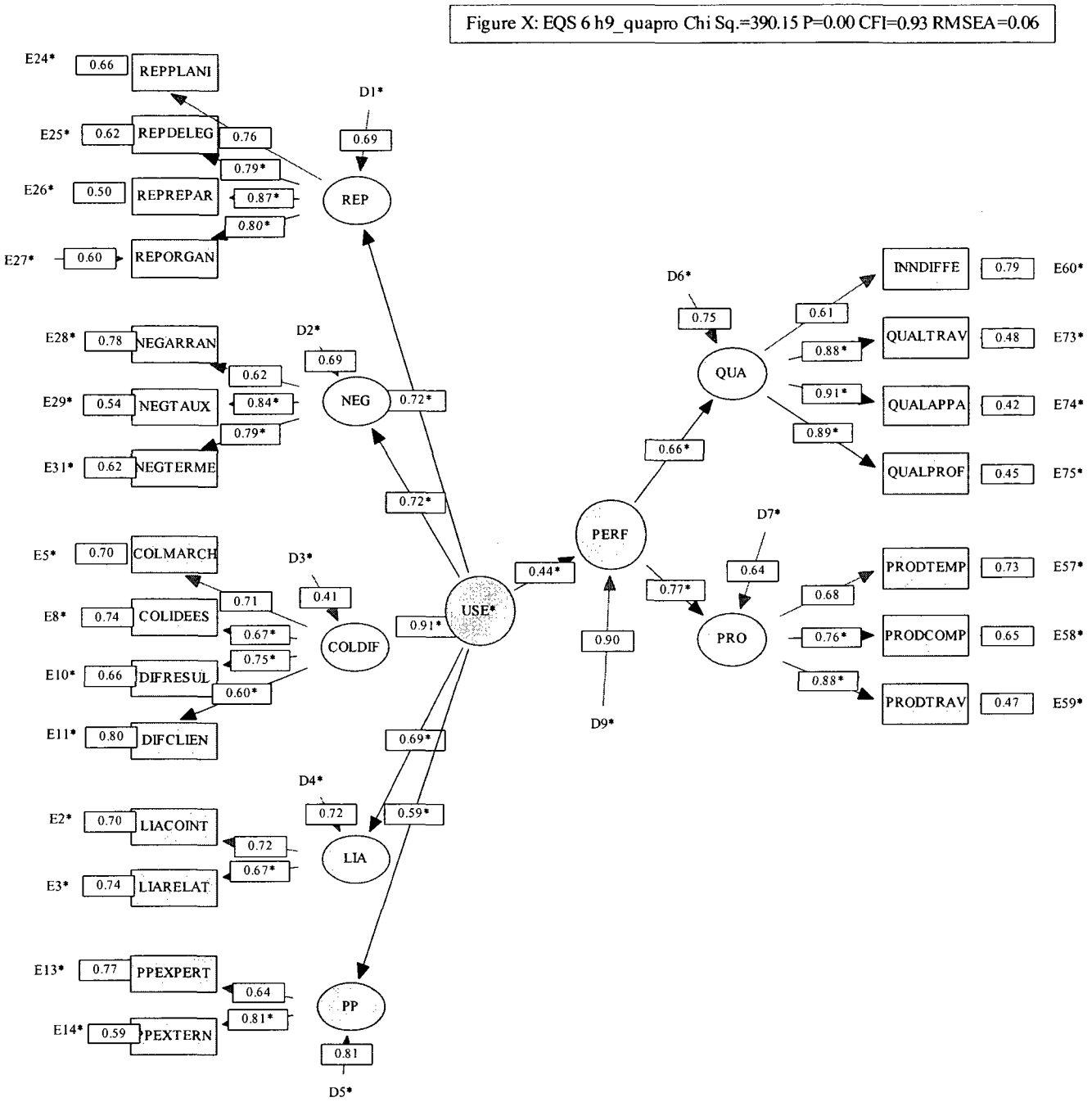


Table 27 Summary of EQS Results for Hypothesis 3d

Individual Performance Dimensions	*Standardized Beta*	*R square*	*Sig*
Productivity and Profitability	.493	24.3%	p<05
Quality and Profitability	.452	20.4%	p<05
Quality and Productivity	.436	19%	p<05

Use is significant on 3 combinations of somewhat rich individual performance. Use explained the combination of productivity and profitability the most, 24.3%; the combination of quality and productivity the least, 19%. However, the explanation power of the model and the coefficient betas are all higher than the ones in Hypothesis 2d. The hypothesis is supported.

Hypothesis 5 stated that given the same richness level of individual performance (along the same column in our case), richer IT use measurement explained more variance in IT use/individual performance relationship. We examine each column separately. In the second column (lean individual performance), the change of R square is summarized in Table 28 as follows:

Table 28 Comparison of R Square for Lean Individual Performance Measure

R square	Productivity	Profitability	Quality
H2b	4.3%	5.3%	3.9%
H2c	12.6%	10%	8.1%
H2d	10.8%	16.4%	8.1%

Only the R square for profitability increased consistently from lean use, to somewhat rich use, to rich use. However, for both productivity and quality, R square first increased from lean use to somewhat rich use, then dropped or stayed the same from somewhat rich use to rich use. In the third column (somewhat rich individual performance), the change of R square is summarized in Table 29 as follows:

Table 29 Comparison of R square for Somewhat Rich Individual Performance Measure

R square	Quality and Quality	Productivity and Profitability	Quality and Profitability
H3a	11.4%	6.6%	3.7%
H3d	19%	24.3%	20.4%

Two cells in this column are missing, thus we can only compare between very lean use and rich use. The result shows that the R square for all three combinations increased significantly. In the last column (rich individual performance), the change of R square is summarized in Table 30 as follows:

Table 30 Comparison of R Square for Rich Individual Performance Measure

R square	Individual Performance
H4a	11.5%
H4b	38%
H4c	98.6%
H4d	23.3%

Interestingly, the R square increased from very lean use to lean use. It improved significantly from lean use to somewhat rich use, but dropped drastically from somewhat rich use to rich use, dropped to the level between very lean use and lean use. Thus, the hypothesis 5 is not supported. In the next chapter, we will elaborate and discuss what the results imply for both academic and practice.

CHAPTER 5 DISCUSSION

This chapter presents a discussion of the results, outlines researcher's contributions to both academic and practice. Limitations of current research and avenues for future research are discussed next.

5.1 DISCUSSION OF DATA ANALYSIS

The literature review showed conflicting results for IT use/individual performance relationship. Burton-Jones & Straub (2006) suggested that the measure for IT use affects the IT use/individual performance relationship. However, the same concern has not been examined for individual performance. Thus, the research question of the current thesis was: How do different richness levels of IT use measures and individual performance measures affect the IT use/individual performance relationship in real organization setting? In order to answer this research question, we relied on a survey to collect data from account managers at two Canadian banks. We proposed a matrix along with 17 hypotheses to map out the IT use/individual performance relationship with various measures. The results of data analyses are summarized in Table 31:

Table 31 DATA ANALYSIS RESULTS

		Individual Performance			
		Very Lean	*Lean*	*Somewhat Rich*	*Rich*
Use	*Very Lean*	**H1a: +**	**H2a: +**	**H3a: +**	**H4a: +**
		Non-sig.	PRO: sig. ***(Low/heavy users) REN: sig. ***(Low/heavy users) QUA: not sig. (Low/heavy users)	QUAPRO: 0.337**, 11.4% PROREN: 0.257**, 6.6% QUAREN: 0.192**, 3.7%	β=0.339**, R^2=11.5%
		Not supported	Partly Supported	Supported	Supported
	Lean	**H1b: +**	**H2b: +**	**H3b: not sig.**	**H4b: not sig.**
		Non-sig.	REN: 0.249****, 5.3% PRO: 0.241****, 4.3% QUA: 0.209***, 3.9%	N/A	β=0.616**, R^2= 38%
		Not supported	Supported		Not Supported
	Somewhat Rich	**H1c: +**	**H2c: not sig.**	**H3c: +**	**H4c: +**
		Non-sig.	Bank B: PRO:12.6%, PPP 0.342**** REN:10%, PPP 0.252**** EMILI 0.172** QUA:8.1%, PPP 0.204*** SIMUL -0.193** Bank A: non-sig.	N/A	β=0.993**, R^2=98.6%
		Not supported	Partly Supported		Supported
	Rich	**H1d: +**	**H2d: +**	**H3d: +**	**H4d: +**
		Non-sig.	REN: 0.405**, 16.4% PRO: 0.329**, 10.8% QUA: 0.285**, 8.1%	PROREN: 0.493**, 24.3% QUAREN: 0.452**, 20.4% QUAPRO: 0.436**, 19%	β=0.482**, R^2=23.3%
		Not supported	Supported	Supported	Supported

**Grey areas re-state the original hypotheses, followed by the results from our data analysis. The last section in each cell summarizes whether the hypothesis is supported or not.*

**PRO=Productivity, REN=Profitability, QUA=Quality*

**Percentage represents R^2*

p≤.10 **p≤.05 ***p≤.01**p≤.001*

Seven out of 17 hypotheses were supported, 6 were not supported, 2 partly supported. EQS failed to converge on an acceptable result for 2 hypotheses. Some interesting findings are elaborated as follows: In the first column, very lean individual performance, none of the regressions is significant. However, all cells (H1a, H1b, H1c, and H1d) are hypothesized to show significant positive relationship between IT use and individual performance. Therefore, none of the hypotheses was supported. However, looking at literature, Snitkin & King (1986), and Millman & Hartwick (1987) examined effectiveness as individual performance; Szajna (1993) had a sophisticated formula to calculate profit. Compared to those studies, our study simply has data for sales difference between years, which made our individual performance measure even leaner. An extremely lean individual performance measure might fail to capture the benefits of the system. On another note, even though Lucas & Spliter (1999) and Dasgupta et al. (2002) found a positive relationship, the beta weights were comparatively small, as 0.09 in Lucas & Spliter (1999) and 0.0316 in Dasgupta et al. (2002). Lastly, only sales data from Bank B was available. Thus, it is also possible that small sample size might have resulted in the poor model fit.

In the second (lean individual performance), for H2a, significant difference was found between heavy user group and light user group in terms of productivity and profitability, but not for fair uses. However, this is understandable: the definition for very lean use was the presence of use i.e. use/non-use. Remember in our case, we did not have measures as simple as use/non-use as all our respondents were users. Thus, we created the three buckets, with heavy users and light users at the two opposite extremes, standing for use/non-use. On another note, in our literature review, Cascant et al. (2002) examined the decision making performance determined by the closeness of the solutions to the correct solutions. This is

considered as the quality of decision making performance. Interestingly, our result did not only show support for the literature but extend it to other two dimensions, productivity and profitability.

From H2b, H2c to H2d, we can observe several interesting things. First of all, from lean use measure (H2b) to somewhat rich use measure (H2c), the explanation power of use increased significantly, from around 5% to 10%. To be specific, the explanation power of IT use for profitability increased from 5.3% to 10%, the explanation power of IT use for productivity increased from 4.3% to 12.6%, the explanation power of IT use for quality increased from 3.9% to 8.1%. However, there is not much improvement in the R square from somewhat rich use (H2c) to rich use measure (H2d). The reasoning behind is, first, lean use (H2b) consider the total time spent on using the system, no matter what task or what application users were using the system for. Other than the core applications that we examined, there were other applications involved at work, including Word, Excel, Internet, Email, and Electronic agenda. Thus, total time spent on using the system includes the time spent on all these applications which are not directly contributing to individual performance. Somewhat rich use (H2c) measures the total time users spent on core applications, applications that were designed to assist manager's work performance. Thus, it is understandable that the main core applications explained more of the variance for individual performance. However, rich use (H2d) measures are task-oriented. Based on Mintzberg's (1973) managerial roles, a new set of IT use measures were developed to evaluate how often users use the system to conduct multiple tasks at work to fulfill their managerial roles. Supposedly, this will explain more of the variance of individual performance. However, only the explanation power of IT use for profitability increased from 10% to 16.4%. The explanation power of IT use for

productivity decreased from 12.6% to 10.8%, the explanation power of IT use for quality did not change. The only explanation for the fact that the R square did not improve or even dropped is that the newly developed the measure did not capture all the tasks conducted at work.

Second, for somewhat rich use measure (H2c), we had different applications for each bank. In Bank B, PPP (investment strategy DSS) was found significantly and positively related to productivity, profitability and quality. EMILI (mortgage management tool) was found only contributing to profitability. SIMUL (profit simulation tool) was found significantly but negatively related to quality, which means, the more SIMUL was used, the worse the quality of work. When we looked at literature, Szajna (1993) examined profitability of a decision making system. As we mentioned in the literature review, her result shows that time spent on using "functional" data (as opposed to "historical" data) is negatively related to profitability while time spent on "historical" data, or time spent on report, number of reports used were not significantly related to profitability. Pentland (1989) found that workcenter program had negative association with efficiency; word processing, spreadsheet, database were found to have strong positive influence on effectiveness. Comparing their results to ours, we can see that the IT use/individual performance relationship will be mixed simply depending on which application, and which dimension of performance was examined.

Lastly, for rich use measure (H2d), Jelinek et al. (2006) used three questions to evaluate sales' achievement of sales objectives. Their result shows the beta was 0.21, and use explained 11% of the variance of individual performance. This result is very similar to our result, which supported the hypothesis.

Moving on to the third column (somewhat rich individual performance), for the two cells in the middle, H3b and H3c, EQS did not converge on acceptable results. However, interesting observation can be made from the H3a and H3d in this column. First of all, very lean use (H3a) is significantly and positively related to all combinations of somewhat rich individual performance measurements, with the explanation power of IT use for quality and productivity as the highest. Interestingly, quality (or effectiveness) and productivity (or efficiency) are two most common dimensions used in literature to evaluate individual performance.

Secondly, rich use measure (H3d) is significantly and positively related to all combinations of somewhat rich individual performance as well. The R square improved significantly from H3a to H3d. The explanation power of IT use for quality and productivity improved from 11.4% to 19%, profitability and productivity increased from 6.6% to 24.3%, quality and profitability increased from 3.7% to 20.4%. This is to say, the task-oriented rich use measure did explain more of the variance of individual performance than simply the three buckets of light/fair/heavy very lean use measure. However, we notice that richer use measure explained the least of quality and productivity, and the most of productivity and profitability. The reasoning is that most items of the rich use measures are evaluating the profitability-wise tasks and productivity-wise tasks.

Thirdly, we can compare horizontally, H3d and H2d. It is not hard to notice that rich use explained more variance of somewhat rich individual performance (H3d) than lean individual performance (H2d), which is easy to interpret. Somewhat rich individual performance captures more dimensions of the variable than simply one dimension does. The

same rich level of use measure should explained more variance of a richer individual performance.

Finally, we move on to the last column (rich individual performance). All tests in this column show that IT use is positively and significantly related to individual performance. Several notes can be made: first of all, comparing H3a and H4a, given very lean use measure, there is not much difference of R square change between somewhat rich and rich individual performance (very lean use explained 11.4 % of quality and productivity, and 11.5% of 6 dimensions in total). It implies that very lean use measure capture the most variance of individual performance as in quality and productivity, at best, but not other dimensions of individual performance. Thus, the explanation power of use did not significantly improve accordingly as the dimensions of individual performance improved.

Secondly, comparing horizontally between the second column (lean individual performance measure) and the last column (rich individual performance measure), the R square improved drastically from H2b to H4b, and from H2c to H4c. R square of lean use increased from 3.9% (H2b) to 38% (H4b), R square for somewhat rich use increased from 8.1% (H2c) to 98.6% (H4c). The increase in R square indicates that, with a richer use measure (as opposed to simply three buckets of light/fair/heavy users measure), explanation power of the model improves drastically with richer individual performance measure. This indicates the more comprehensive use measure is, the more individual performance can be explained.

However, it is worth noting that, rich use (H4d) did not explain the most of variance of individual performance; it explained 23.3% of the individual performance. Somewhat rich

use measure (total time spent on core applications) explained the most of the variance for individual performance, with 98.6% as R square, followed by lean use measure (total time spent on system), which explained 38% of the variance for individual performance. Very lean use measure (light/fair/heavy user) explained 11.5% of the variance for individual performance. This result is quite interesting but understandable. Somewhat rich use measures the time users spent on the core applications, the more users integrated applications into their work, the better the performance. Lean use measure indicates the time users spent on all task at work using the system. Compared to somewhat rich use measure, lean use is more general, and included the time spent on other supplemental/supporting applications, e.g. email, Word, Excel. Thus, lean use explained less variance of individual performance. Rich use measures were a new developed set, and they are task-oriented. They explored how often users use the system to help with tasks at work as managers. It is supposed to represent the most integrative measure for how well the users take the system into their work and thus having the most explanation power. One reason why it only explained the 23.3% of the variance of individual performance may be that the new developed measures might not have captured all the tasks at work as manager position. Also during the factor analysis, 15 items were dropped. This is also why when individual performance measure improved from somewhat rich to rich, the R square did not improve much. Regarding rich use and rich individual performance, we can refer to previous research. In out literature review, the R square ranges from 10% in Almutairi & Subramanian (2005) to 28% in Igbaria & Tan (1997), similar to our results.

5.2 IMPLICATION FOR RESEARCH

First of all, according to the literature review, there is no published research which studied the relationship between IT use and individual performance in real organization to this scale. As we mentioned, two recent studies, Bernard (2004) and Burton-Jones & Straub (2006) discussed this issue. However, Bernard (2004)'s study was a meta-analysis review, Burton-Jones & Straub (2006) tested their hypotheses with lab experiments. Their studies inspired greatly current thesis, but our results complemented, extended their theories, and enhanced the external validity by testing in real organizational settings.

Secondly, we exhausted literature that discussed the relationship between IT use and individual performance in IS field. We first presented definitions and measurements for use and individual performance from previous studies. Next, we integrated all these different measurements in one matrix, and eventually formulated our research model based on the matrix. Therefore, we believe we provided a guiding map for researchers to categorize previous measurements and help compare conflicting results from prior studies.

Thirdly, we used a new measurement for IT use, which was developed based on Mintzberg's managerial-role model. As we mentioned in our result, given somewhat rich individual performance, the new task-based IT use measures did explain much more than simply the three-bucket use measures. Thus, we tested the new measurements for IT use.

Lastly but not the least, we tested the IT use/individual performance relationship and presented how both different IT use measures and individual performance measures can affect the relationship between the two. To be more specific, our result showed that very

lean use is positively related to productivity and profitability, which has never been tested in previous studies. Therefore, we extended the scope of research on benefits of IT use in terms of both quality, and profitability. Secondly, we enhanced previous studies by confirming their results. For example, our result showed that when somewhat rich use measurements was used, the strength and the direction of the relationship simply depends on which application was examined, and on what dimension of individual performance was examined. This result is consistent with Szajna (1993) and Pentland (1989). Also, our result help interpret previous studies. For example, we found that very lean use explained almost the same percentage of variance of quality/productivity (somewhat rich individual performance) and rich individual performance. Quality and productivity are the two most common used measurements for performance. In other words, very lean use captured mainly two common dimensions, quality and productivity, of individual performance. Thus, it is understandable that very early studies obtained positive results even though they had very lean use measures and not very rich individual performance measures.

5.3 IMPLICATION FOR PRACTICE

It is also of very practical use to managers as they are keen to learn the benefits of IT use but previous research did not give consistent result thus confusing the practice. Our study cleared the myth by providing a map to guide managers to select appropriate measurements to evaluate the benefits. In our study, somewhat rich use explained the most variance of individual performance and indicated that the use of core applications highly contributed to the improvement of individual performance. Thus for managers somewhat rich use (application-based) measures would be an appropriate measure to evaluate how much the system leads to individual performance improvement. If there is no significant relationship

between use and individual performance, the beta value and the R square will decrease accordingly. Managers can further interpret this result by testing different applications on certain dimension of individual performance, one dimension at a time. As shown in our result for somewhat rich use and lean performance, the relationship is decided by which application and which dimension of individual performance was measured. For example, the decision support system was shown to have significant positive relationship with productivity, profitability and quality, with productivity being the strongest relationship, and quality being the least strong relationship. Thus, from management's perspective, if productivity is desired as the main goal of business strategy, bank B should encourage account managers to use the decision support system more often by providing training session, help desk and online discussion forum in terms of how to use the system more effectively to improve productivity. Meanwhile, notice that besides decision support system, the mortgage management tool was found to improve profitability as well. Thus, if bank B's main business goal is to increase profitability, it should enhance account managers' use of mortgage management tool along with the use of decision support system. Last but not least, the profit simulation tool was found to have significant negative relationship with quality, indicating the less it is used, the better the quality of work. This scenario reflects an alarm for the bank management. It is either an unfit between the task and the system, or inappropriate use of the system. Thus, the management of bank B need to launch investigation of the issue to see where the problem lies. System analyst will need to check whether the users are using the application correctly, whether the application aids in the tasks as supposedly and then decide if users training is required or the system itself needs enhancement. Above is a simple example. In real organization, management can apply the same mechanism to conduct more complicated case in order to: 1) improve the business goal by providing proper training to

employees; 2) detect whether there is an unfit between application and the task, or the inadequacy of the system itself. Also notice that, our result showed in general the more comprehensive the use measurements, the more variance of individual performance explained by use i.e. with very lean use measures, the explanatory power of use does not improve much with richer individual performance. Thus, for practice, if managers want to learn more about whether more use of specific application of the system improves individual performance, they should measure use as comprehensively as possible at the first place so that they can obtain an accurate picture of how IT use improves individual performance across different dimensions.

5.4 LIMITATIONS

First of all, we thought our sample size was adequate. However, for very lean individual performance measure, we did not have enough sales data for Bank A. For somewhat rich use measure, two banks had different applications. Thus, we had to separate the sample. Part of the hypotheses was tested with data from only Bank B or only Bank A. Thus, the small sample size might have caused problems.

Secondly, we did not have simple binary measurement for IT use as use/non-use. This came into problem when we tested very lean use and lean individual performance. The result showed significant difference between heavy and light users, which are at two extremes. Our result might have been more straightforward, if we had the simple binary IT use measures. In the same vein, we did not have simple measures for individual performance i.e. increase/decrease/no change of individual performance as very lean measurement. Instead, we used sales data from bank B, which resulted in a reduced sample size.

5.5 FUTURE RESERACH DIRECTIONS

There are two cells in our matrix that EQS did not converge on acceptable results. We believe that it might be the small sample size that has caused the problem. We expect researchers to test them with other bigger samples thus fill in the blank and help make more sense of the matrix. Secondly, Bernard (2004) suggested subjectivity affects use/individual performance relationship. Due to the limited sample in his meta-analysis, Bernard (2004) did not find subjectivity's significant effect on IT use/individual performance relationship. We did not have objective data for IT use either. However, we would like researchers to examine the effect of subjectivity of both IT use and individual performance since, with objective richer individual performance data, more levels that were proposed in Burton-Jones (2006) can be examined as well.

5.6 CONCLUSION

Focusing on measurement issue, the current study demonstrate a successful attempt to conglomerate previous conflicting research on IT use/individual performance relationship. Our result uncovered the significant role of different richness level of measurement for both IT use and individual performance on the use/performance relationship. Even though future research is required to further validate our results, our study mapped out a quite comprehensive guide for researchers to interpret and rationalise previous research on this topic. Moreover, the result is of great use to practitioners as well. Managers have been keen to learn the benefits of new system. Current research helps them choose appropriate instruments to measure the system benefits, to detect fitness between task and technology.

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APPENDIX A: MEASUREMENT TOOLS

Very lean individual performance

Pour l'année 1997, quel était le montant total approximatif de vos ventes de fonds mutuels?

- ❑ 0 à 249 999$
- ❑ 250 000 à 499 999$
- ❑ 500 000 à 749 999$
- ❑ 750 000 à 999 999$
- ❑ 1 000 000 à 1 249 999$
- ❑ 1 250 000 à 1 499 999$
- ❑ 1 500 000 à 1 749 999$
- ❑ 1 750 000 à 1 999 999$
- ❑ 2 000 000 à 2 249 999$
- ❑ 2 250 000 à 2 749 999$
- ❑ 2 750 000 à 2 999 999$
- ❑ 3 000 000 à 3 499 999$
- ❑ 3 500 000 et +

Pour l'année en cours, quel sera le montant total approximatif de vos ventes de fonds mutuels?

- ❑ 0 à 249 999$
- ❑ 250 000 à 499 999$
- ❑ 500 000 à 749 999$
- ❑ 750 000 à 999 999$
- ❑ 1 000 000 à 1 249 999$
- ❑ 1 250 000 à 1 499 999$
- ❑ 1 500 000 à 1 749 999$
- ❑ 1 750 000 à 1 999 999$
- ❑ 2 000 000 à 2 249 999$
- ❑ 2 250 000 à 2 749 999$
- ❑ 2 750 000 à 2 999 999$
- ❑ 3 000 000 à 3 499 999$
- ❑ 3 500 000 et +

Lean IT use

Dans le cadre d'une journée normale de travail,

Combien de temps allouez-vous à chacune des tâches suivantes? Durant cette période, pendant combien de temps utilisez-vous *(system name)*?

Planification ou organisation de votre travail _____
Recherche, rédaction et lecture de documents
(lettres, rapports, courrier) _____
Suivi des comptes clients (analyse de dossiers) _____
Rencontres formelles à l'interne (réunions, comités) _____
Prospection de nouveaux clients _____
Rencontres avec des clients _____

Lean individual performance

Productivity: 3 items
(system name) me permet de sauver du temps.
(system name) me permet de gérer plus de comptes qu'avant.
(system name) me permet d'accomplir plus de travail que je ne pourrais en faire sans lui.

Profitability: 4 items
(system name) m'aide à recruter de nouveaux clients.
(system name) m'aide à faire croître la valeur de mes comptes.
(system name) me permet d'augmenter mes revenus
(system name) m'aide à atteindre mes objectifs de vente.

Quality: 4 items
(system name) me permet d'éviter des erreurs.
(system name) m'aide à augmenter la qualité de mon travail.
(system name) m'aide à améliorer l'apparence de mon travail.
(system name) m'aide à produire un travail de qualité plus professionnelle.

Somewhat rich IT use

Dans le cadre d'une journée normale de travail, pendant combien de temps utilisez-vous en moyenne chacune des technologies suivantes : (si vous ne disposez pas de certaines technologies, veuillez inscrire : S/O)

Bank A
- Base de données clients _____
- Winfast _____
- MEI _____

Bank B
- Base de données clients (Liaison) _____
- Simulateur _____
- PPP _____
- Emili _____
- ASAP _____

Rich IT use: 30 items

J'utilise *(system name)* pour maintenir mon réseau de contacts à l'interne.
J'utilise *(system name)* pour développer des relations personnelles avec des employés de d'autres unités administratives.
J'utilise *(system name)* pour développer des contacts avec des gens de l'extérieur.
J'utilise *(system name)* pour me tenir au courant des tendances du marché et des changements qui peuvent avoir des impacts important pour la Banque.
J'utilise *(system name)* pour me tenir au courant des opérations de la Banque.
J'utilise *(system name)* pour collecter de l'information sur les clients, les compétiteurs, etc.
J'utilise *(system name)* pour me tenir au courant des nouvelles idées provenant de l'extérieur.
J'utilise *(system name)* pour transmettre de l'information à mes collègues.
J'utilise *(system name)* pour transmettre mes résultats ou mes objectifs.
J'utilise *(system name)* pour partager de l'information concernant un concurrent, un client ou le marché.
J'utilise *(system name)* pour répondre à des demandes d'information.

J'utilise *(system name)* lorsqu'on m'a demandé d'agir en tant qu'expert à l'externe.
J'utilise *(system name)* pour donner de l'information à des gens de l'externe en ce qui concerne les plans, projets ou produits de la Banque.
J'utilise *(system name)* pour répondre, au nom de la Banque, à des lettres ou demandes d'information diverses provenant de l'extérieur.
J'utilise *(system name)* pour informer les clients au sujet des produits et services de la Banque.
J'utilise *(system name)* pour résoudre des problèmes.
J'utilise *(system name)* pour trouver de nouvelles opportunité d'affaires.
J'utilise *(system name)* pour proposer des changements dans nos procédures de travail.
J'utilise *(system name)* pour changer la séquence ou la fréquence d'exécution de mes tâches.
J'utilise *(system name)* pour régler des problèmes internes inattendus.
J'utilise *(system name)* pour résoudre les problèmes des clients.
J'utilise *(system name)* pour réagir à des problèmes imprévus.
J'utilise *(system name)* pour planifier le travail ou établir les priorités.
J'utilise *(system name)* pour déléguer ou proposer de déléguer certaines tâches.
J'utilise *(system name)* pour répartir du travail.
J'utilise *(system name)* pour organiser mon temps de travail.
J'utilise *(system name)* pour négocier de meilleurs arrangements avec des clients.
J'utilise *(system name)* pour négocier de meilleurs taux.
J'utilise *(system name)* pour obtenir de meilleures conditions pour mes clients.
J'utilise *(system name)* pour déterminer ou modifier les termes des contrats.

Individual performance: 6 dimensions

Productivity: 3 items

(system name) me permet de sauver du temps.
(system name) me permet de gérer plus de comptes qu'avant.
(system name) me permet d'accomplir plus de travail que je ne pourrais en faire sans lui.

Profitability: 4 items

(system name) m'aide à recruter de nouveaux clients.
(system name) m'aide à faire croître la valeur de mes comptes.
(system name) me permet d'augmenter mes revenus
(system name) m'aide à atteindre mes objectifs de vente.

Quality: 4 items

(system name) me permet d'éviter des erreurs.
(system name) m'aide à augmenter la qualité de mon travail.
(system name) m'aide à améliorer l'apparence de mon travail.
(system name) m'aide à produire un travail de qualité plus professionnelle.

Innovation: 3 items

(system name) me permet de faire les choses différemment.
(system name) m'aide à trouver de nouvelles idées pour faire mon travail.
(system name) me permet d'essayer mes nouvelles idées.

Customer satisfaction: 4 items

(system name) augmente la satisfaction des clients.
(system name) m'aide à mieux répondre aux besoins des clients.
(system name) me permet d'offrir un meilleur service à mes clients.
Depuis que j'utilise *(system name)* , le nombre de plaintes de clients a diminué.

Management control: 4 items

(system name) m'aide à mieux contrôler mon travail.
(system name) m'aide à mieux planifier mon travail.
(system name) m'aide à mieux organiser mon travail.
(system name) me permet de faire un meilleur suivi de mes comptes.

APPENDIX B: CODE AND ITEMS

		Code	Item
IT USE	REP	REPPLANI	J'utilise *(system name)* pour planifier le travail ou établir les priorités.
		REPDELEG	J'utilise *(system name)* pour déléguer ou proposer de déléguer certaines tâches.
		REPREPAR	J'utilise *(system name)* pour répartir du travail.
		REPORGAN	J'utilise *(system name)* pour organiser mon temps de travail.
	NEG	NEGARRAN	J'utilise *(system name)* pour négocier de meilleurs arrangements avec des clients.
		NETTAUX	J'utilise *(system name)* pour négocier de meilleurs taux.
		NEGTERME	J'utilise *(system name)* pour déterminer ou modifier les termes des contrats.
	COLDIF	COLMARCH	J'utilise *(system name)* pour me tenir au courant des tendances du marché et des changements qui peuvent avoir des impacts important pour la Banque.
		COLIDEES	J'utilise *(system name)* pour me tenir au courant des nouvelles idées provenant de l'extérieur.
		DIFRESUL	J'utilise *(system name)* pour transmettre mes résultats ou mes objectifs.
		DIFCLIEN	J'utilise *(system name)* pour partager de l'information concernant un concurrent, un client ou le marché.
	LIA	LIACOINT	J'utilise *(system name)* pour maintenir mon réseau de contacts à l'interne.
		LIARELAT	J'utilise *(system name)* pour développer des relations personnelles avec des employés de d'autres unités administratives.
	PP	PPEXPERT	J'utilise *(system name)* lorsqu'on m'a demandé d'agir en tant qu'expert à l'externe.
		PPEXTERN	J'utilise *(system name)* pour donner de l'information à des gens de l'externe en ce qui concerne les plans, projets ou produits de la Banque.
INDIVIDUAL PERFORMANCE	SAT	SATCLIEN	*(system name)* augmente la satisfaction des clients.
		SATBESOI	*(system name)* m'aide à mieux répondre aux besoins des clients.

		SATSERVI	*(system name)* me permet d'offrir un meilleur service à mes clients.
	QUA	INNDIFFE	*(system name)* me permet de faire les choses différemment.
		QUALTRAV	*(system name)* m'aide à augmenter la qualité de mon travail.
		QUALAPPA	*(system name)* m'aide à améliorer l'apparence de mon travail.
		QUALPROF	*(system name)* m'aide à produire un travail de qualité plus professionnelle.
	GES	GESCONTR	*(system name)* m'aide à mieux contrôler mon travail.
		GESPLANI	*(system name)* m'aide à mieux planifier mon travail.
		GESORGAN	*(system name)* m'aide à mieux organiser mon travail.
	REN	RENRECRU	*(system name)* m'aide à recruter de nouveaux clients.
		RENCROIT	*(system name)* m'aide à faire croître la valeur de mes comptes.
		RENREVEN	*(system name)* me permet d'augmenter mes revenus
		RENVENTE	*(system name)* m'aide à atteindre mes objectifs de vente.
	PRO	PRODTEMP	*(system name)* me permet de sauver du temps.
		PRODCOMP	*(system name)* me permet de gérer plus de comptes qu'avant.
		PRODTRAV	*(system name)* me permet d'accomplir plus de travail que je ne pourrais en faire sans lui.
	INN	INNIDEE	*(system name)* m'aide à trouver de nouvelles idées pour faire mon travail.
		INNESSAI	*(system name)* me permet d'essayer mes nouvelles idées.