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A COMPARISON OF DECISION SUPPORT AND ENTERPRISE RESOURCE PLANNING SYSTEMS: THE VIEWS OF IT AND NON IT PROFESSIONALS

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ABSTRACT

The study compares Decision Support Systems (DSS) and Enterprise Resource Planning Systems (ERP) in relation to two categories of factors (User Characteristics and Perceptions; and System Development and Organizational Issues) concerned with the implementation, adoption, and use of these systems in the context of supply chain management. Based on previous studies each factor is associated with a set of indicators and each indicator is hypothesized to have a particular role with respect to DSS and ERP systems. The hypotheses are tested using data collected by questionnaire from a sample of 108 Information Technology (IT) professionals and a sample of 73 non IT professionals. The findings present both theoretical and practical implications based on the similarities and differences between the separate views of the IT and non IT professionals. Although there is mainly agreement among both groups and the results from previous studies the IT professionals identify more differences between DSS and ERP systems than the non IT professionals while the views of both groups are compatible with their different roles and levels and types of experience with these systems. From a practical perspective project teams and especially team leaders can benefit from understanding the differences found among the views of the IT and non IT professionals about what is important in relation to DSS and ERP systems.

Keywords: decision support systems, enterprise resource planning systems, system development and organizational issues, user characteristics and perceptions

INTRODUCTION

This study compares key characteristics of Decision Support Systems (DSS) and Enterprise Resource Planning Systems (ERP) concerned with their development, implementation, adoption, and use in organizations. DSS have been developed for a wide range of applications and, because the study compares these systems, the context for the application of these systems has been constrained to supply chain management which is a recognized focus of ERP systems and is concerned with processes used to manage the supply of materials (services) and the production and distribution of products and services [13]. In this context DSS support decision making involving complex unstructured or semi-structured problems and provide information for strategic planning with production forecasting, inventory planning, scheduling, transportation and distribution systems as good examples utilizing models and complex algorithms to generate at least feasible solutions [117]. ERP systems address more structured problems with benefits derived mainly from their sophisticated support of transaction processing including the integration and tracking of transactions and activities across the organization's supply chain typically involving the management of orders, inventory, finances, and human resources. While ERP systems provide data to support operational level

decisions organizations have had less success in using them for decision making involving unstructured problems despite the claims often made by vendors [3,120, 82].

Not all characteristics of DSS and ERP systems are considered in this study and instead two of the three categories of relevant factors proposed by Eierman et al. [37] for studying DSS and ERP systems are used: User Characteristics and Perceptions (UCP); and System Development and Organizational Issues (SDO). Eierman et al. [37] included a third category (Technical) concerned with technical aspects of the construction of the software such as: mathematical modeling and data analysis techniques; computer algorithms; software building and testing; data access and storage technologies; and the technical configuration of the software systems. This Technical category is not examined in this study because, as noted by Setzekorn et al. [110], Avison and Fitzgerald [15], and Duplaga and Astani [36], the technical aspects of DSS and ERP software systems are not the main areas of concern in determining the success of their development, implementation, adoption, and use in the context of supply chain management. Table 1 lists the factors associated with the two categories which are examined.

Table 1: Categories and factors

Category	Factors
System Development and Organizational Issues (SDO)	Organizational Context
	Change Management
	Business Process Redesign
	Development Methodology
	Project Management
User Characteristics and Perceptions (UCP)	User's Perceptions of the System
	Cognitive Styles of Users
	System Usage
	Personal Characteristics of Users

In Table 1 the factors associated with each category are derived mainly from Eierman et al. [37] supported by other studies by Finlay and Forghani [40], Turban and Aronson [120], Setzekorn et al. [110], Avison and Fitzgerald [15], and Duplaga and Astani [36]. For example, Finlay and Forghani [40] identified six factors to consider when evaluating system success: system usage; user satisfaction; organizational profitability; cost savings; time savings; and repeated use of the system while Turban and Aronson [120] identify a similar list of seven factors: expert opinion; institutionalization of the system; ratios of benefits to costs; project completion time; users' attitudes to the system; managers' attitudes to the system; and achievement of project objectives. It is expected that the factors in Table 1 will have varying importance with respect to DSS and ERP systems.

The study is motivated by the need to understand the similarities and differences between DSS and ERP systems in the context of supply chain management for at least the following reasons: (a) both types of systems are important for supply chain management, they are difficult and expensive to implement, and project teams include necessarily members with quite different perspectives on what is important [13]; (b) the functionality of ERP systems has developed over time which, at least from a user's perspective, has "blurred" the distinction between DSS and ERP especially with respect to their capabilities with respect to decision support [3]; and (c) previous studies have focused on these systems separately and detailed comparisons have not been examined. This is especially true in Thailand where despite a competitive market with at least 56 vendors of both DSS and ERP systems as well as national ICT policies which call for improved supply chain management there are very few studies other than a small set of specific case studies that examine implementation issues for either type of system and none were found that compared DSS and ERP systems.

Based on findings from previous studies indicators are identified for each of the factors in Table 1 and a research hypothesis is presented regarding the role of each indicator with respect to DSS and ERP systems (section 2). The research design and methodology is described in section 3. The results of data preparation and analyses and the testing of each research hypothesis for the two groups of respondents (IT and non IT professionals) are presented in section 4. The findings of the study are discussed in detail in section 5 with overall conclusions in section 6.

RESEARCH HYPOTHESES AND RELATED LITERATURE

There is a vast literature on DSS and ERP systems and in this study the focus is on studies published after about 1980 that relate to the role of DSS and ERP systems in supply chain management and the factors studied in the two categories in Table 1. Based on the findings in previous studies, each factor in Table 1 is decomposed into a set of indicators and for each indicator a research hypothesis is presented concerning the role of the indicator in relation to DSS and ERP systems.

User Characteristics and Perceptions (UCP): Factors, Indicators, and Hypotheses

Table 2 shows the indicators derived from the referenced studies related to the four factors in the UCP category.

User's Perceptions of the System are defined as psychological states reflecting the affective or evaluative feelings of the users concerning particular aspects of the system [4, 82, 123].

Changes in the user's performance and their satisfaction with the system depend largely on the user's acceptance of the system and explanations of acceptance have been strongly influenced by the technology acceptance model (TAM) derived from intention models in social psychology which assume that behavioral intention operates prior to every behavior [31]. In the TAM the underlying concept is that two constructs, perceived usefulness and perceived ease of use, determine the user's attitude toward the system and their intention to use the system. Perceived usefulness is the degree to which a user believes that using the system enhances their work performance and perceived ease of use is the degree to which a user believes that using the system is free of effort [103]. The 12 indicators representing the user's perceptions of the system are acknowledged as being associated with these two TAM constructs. In this study the DSS and ERP systems are already being used in the organizations and the use of these systems is considered mandatory rather than voluntary. Consequently, subjective norms were considered to be less important and instead the focus is on indicators related to usefulness and ease of use. In particular, Ramayah, Lo, and May [95] reported that perceived usefulness was the most influential indicator for predicting a user's intention to use an ERP system and a system that is perceived to be useful reduces the user's task ambiguities and eventually increases their work-related performance.

Venkatesh and Davis [124] identified a user's judgment of the job relevance of a system as an important determinant of acceptance and Kieras and Polson [61] and Polson [92] argue that users have distinct knowledge about their job situations, which they use as a basis for determining the tasks that can be performed with a given system. The existence of well-defined knowledge structures regarding job goals is supported by research in personnel psychology where job relevance is a cognitive judgment that exerts a direct effect on perceived usefulness and is distinct from social influences [98].

Based on the findings from previous studies 12 research hypotheses related to the indicators for the User's Perceptions of the System are shown in Table 3.

Table 2: User Characteristics and Perceptions (UCP) factors, indicators, and related literature

Indicators	References
User's Perceptions of the System	
▪ *The usefulness of:* System functions, System output, User documentation, Help support ▪ The performance of the system ▪ *The ease of:* Interaction with the system, Learning to use the system ▪ The time taken to learn the system ▪ Personal gains from using the system ▪ *The system's impact on the individual's:* Job security, Work procedures, Job satisfaction	[7] [69] [25] [31] [4] [8] [18] [37] [50] [119] [14] [35] [78] [120] [110] [16] [77] [82] [123] [125] [11] [130]
Cognitive Styles of Users	
▪ *The user's ability to:* Learn new skills and knowledge, Analyze quantitative information, Analyze qualitative information, Reason heuristically, Make judgments and decisions, Adopt rules, Understand the context of a problem, Deal with uncertainty, Deal with ambiguity	[42] [19] [20] [46] [69] [8] [37] [89] [114] [97] [16] [32] [11] [117]
System Usage	
▪ *System Usage:* Frequency, Duration ▪ Proportion of work done with the system	[106] [50] [89] [40] [109] [60] [110]
Personal Characteristics of Users	
▪ *Experience in:* Current position, Previous work positions, Using computer based systems ▪ *The user's*: Age, Gender, Level of education, Type of education, Communication skills, Interpersonal skills, Teamwork skills	[85] [116] [7] [20] [8] [37] [89] [114] [13] [60] [76] [120]

Table 3: Hypotheses related to the User's Perceptions of the System

Hypothesis
UCP 1(a): The usefulness of the systems functions is significantly different for DSS and ERP systems.
UCP 1(b): The usefulness of outputs from the system is significantly different for DSS and ERP systems.
UCP 1(c): User documentation is more important for DSS than for ERP systems.
UCP 1(d): Help support is more important for DSS than for ERP systems.
UCP 1(e): The importance of the performance of the system is significantly different for DSS and ERP systems.
UCP 1(h): The time taken to learn the system is significantly more for DSS than for ERP systems.
UCP 1(i): Personal gain from working with the system is significantly different for DSS and ERP systems.
UCP 1(f): The importance of the ease of interaction with the system is significantly different for DSS and ERP systems.
UCP 1(g): The importance of the ease of learning the system is significantly different for DSS and ERP systems.
UCP 1(j): The impact of the system on increasing job security is higher for DSS than ERP systems.
UCP 1(k): The impact of the system on improving work procedures is higher for ERP than DSS systems.
UCP 1(l): The impact of the system on increasing an individual's job satisfaction is higher for ERP systems than for DSS.

Cognitive Styles of Users are defined as the approaches adopted by users to handle data and information and confront problem situations [10]. Cognitive styles have been studied in relation to technology implementation but their effects on technology acceptance have received less attention although previous studies have noted the importance of the user's cognitive style in assessing their acceptance of a technology and their decision making ability.

For DSS the user's weaknesses and limits should be incorporated in the design [135, 59, 102] and Holsapple and Whinston [57] propose that DSS should exhibit six characteristics: a body of knowledge that describes aspects of a decision maker's world that specifies how to accomplish various tasks and indicates what conclusions are valid in various circumstances; an ability to acquire and maintain descriptive knowledge (data and information) and other kinds of knowledge (procedural and reasoning); an ability to present knowledge on an ad hoc basic in various customized ways as well as in standardized reports; the ability to select any desired subset of stored knowledge for either presentation or deriving new knowledge in the course of problem recognition and/or problem solving; the ability to interact directly with a decision maker in such a way that the user has a flexible choice in requesting a sequence of knowledge management activities; and the ability to coordinate and facilitate interactions among multiple participants in decision making.

Alavi and Joachimsthaler [8] recommend that although cognitive style is a multi-dimensional construct most research has focused on the analytic/heuristic dimension, which reflects an individual's propensity either for using models and systematic processes or for relying on experience and intuition, respectively. Most previous studies recommend that computer based systems should be flexible and adaptable to the different cognitive styles of users and should not enforce a specific process [9, 118, 73]. Cognitive style has been analyzed using different classification schemas. For example, according to adaptive-innovation theory [62] a person's cognitive style in a problem solving or decision making context can be classified on a continuum ranging from adaptive to innovative. The effectiveness of adopting decision rules comes from a reduction in inconsistencies in unaided decision making due to the impact of irrelevant information on the decision [64]. However, as problems become increasingly complex insight and intuition may be used more effectively with the aid of a computerized system but users need to perceive the system as being easy to use [26, 96].

Based on the findings from previous studies nine research hypotheses related to the indicators for the User's Cognitive Styles are shown in Table 4.

System Usage is defined as the duration and frequency of systems use and the proportion of the user's work done with the system [50]. System usage has been one of the most frequently used measures of system success [33, 31, 34] and in different contexts it has been operationalized using one or more of the three indicators used in this study.

Based on the findings from previous studies three research hypotheses related to System Usage are shown in Table 5.

Table 4: Hypotheses related to the User's Cognitive Styles

Hypothesis
UCP 2(a): Learn new skills and knowledge is significantly more important for DSS than for ERP systems.
UCP 2(b): Analyze quantitative information is significantly more important for DSS than for ERP systems.
UCP 2(c): Analyze qualitative information is significantly more important for DSS than for ERP systems.
UCP 2(d): Reason heuristically is significantly more important for DSS than for ERP systems.
UCP 2(e): Make judgments and decisions is significantly more important for DSS than for ERP systems.
UCP 2(f): Adopt rules is significantly more important for DSS than for ERP systems.
UCP 2(g): Understand the context of a problem is significantly more important for DSS than for ERP systems.
UCP 2(h): Deal with uncertainty is significantly more important for DSS than for ERP systems.
UCP 2(i): Deal with ambiguity is significantly more important for DSS than for ERP systems.

Table 5: Hypotheses related to System Usage

Hypothesis
UPC 3(a): The frequency of system usage is significantly different for DSS and ERP systems.
UPC 3(b): Significantly more time is required to complete tasks using DSS than is required to complete tasks using ERP systems.
UPC 3(c): The proportion of work done using DSS is significantly greater than the proportion of work done using ERP systems.

Personal Characteristics of Users are defined as those that influence a user's system use, decision performance, and decision making time.

Fenichel [39] found that performance was affected by both general searching experience and experience with a technology. Mackey and Elam [75] reported that experienced decision makers have a deeper understanding of the problem characteristics and solution qualities than inexperienced decision makers and that they use more direct and effective problem solving approaches. In addition, age, education, and previous work experience influence decision performance [20, 94]. Older DSS users perform better than their younger colleagues, although they may take longer to make decisions [116]. According to Swink [114] DSS users with a more analytically oriented educational background will make better decisions than their less analytic counterparts. Older and less educated users, particularly males, have been observed to display less positive attitudes toward computers [71, 72, 81]. Lynn [74] found that females generally have a more negative attitude to abstract problem solving than males. Powell et al. [93] observed differences in attitudes between male and female managers and suggested that males and females differ with respect to their cognitive abilities, problem solving motivation, risk attitudes, confidence, and their decision styles. All male groups were found to perform better on problem solving tasks than all female groups but females in mixed gender groups performed at least as well as the males working in all male groups [79].

Based on the findings from previous studies 10 research hypotheses related to Personal Characteristics of Users are shown in Table 6.

System Development and Organizational Issues (SDO): Factors, Indicators, and Hypotheses

Table 7 shows the indicators derived from the referenced studies related to the five factors in the SDO category.

Table 6: Hypotheses related to Personal Characteristics of Users

Hypothesis
UCP 4(a): The amount of experience a user has in their current position is significantly more important for DSS than for ERP systems.
UCP 4(b): The amount of experience a user has had in previous work positions is significantly more important for DSS than for ERP systems.
UCP 4(c): The amount of experience a user has had with computer-based systems is significantly more important for DSS than for ERP systems.
UCP 4(d): Older users have significantly more success in using DSS and ERP systems than younger users.
UCP 4(e): Male users have significantly more success in using DSS and ERP systems than female users.
UCP 4(f): The level of formal education of users is significantly more important for DSS than for ERP systems.
UCP 4(g): The type of formal education is significantly more important for DSS than for ERP systems.
UCP 4(h): The importance of communication skills is significantly different for the use of DSS and ERP systems.
UCP 4(i): The importance of interpersonal skills is significantly different for the use of DSS and ERP systems.
UCP 4(j): The importance of teamwork skills is significantly different for the use of DSS and ERP systems.

Table 7: System Development and Organizational Issues (SDO) factors, indicators, and related literature

Indicators	References
Organizational Context	
▪ *The organization's:* Mission and strategy, IT strategy, Maturity in using IT, Scope of activities, Financial position	[7] [119] [14] [77] [82] [47] [123]
Change Management	
▪ *Managing changes to:* Organizational roles and structures, Communications, Training and education, Performance management, Management practices	[49] [65] [37] [52] [22][109] [86] [110] [77] [23]
Business Processes	
▪ *Determining the costs of:* Existing processes, New processes ▪ Modeling and designing processes ▪ Redesigning and re-engineering processes	[115] [22] [80] [77] [82] [123] [134] [41]
Development Methodology	
▪ *Development approaches:* Traditional systems development life cycle, Incremental/evolutionary, Small releases, Customized frameworks ▪ *Techniques and tools:* Process modeling, Data modeling, Prototyping tools, CASE tools	[72] [7] [37] [40] [48] [90] [15]
Project Management	
▪ *Support from the organization's:* Senior management, IT department, vendors/suppliers ▪ *Involvement of:* Users, Other stakeholders ▪ Project management software and tools ▪ *An effective project:* Manager, Team ▪ *A clear definition of:* Project goals, System requirements ▪ *Project outcomes:* System capabilities, System quality, System security, Technical systems documentation, System maintenance, Completion time, Adherence to budget	[7] [127] [37] [89] [104] [52] [40] [100] [44] [51] [43] [69] [48] [86] [110] [15] [77] [82] [123]

Organizational Context refers to characteristics of the organization in which the computer based system is implemented.

Little [70] claimed that the development of technology was not the real problem but instead the problem was getting managers to be able to incorporate the appropriate use of technologies in their organization in order to achieve organizational strategies and objectives. He observed that people tend to reject technologies that they do not understand and too many managers do not understand the relationship between technologies and the organization's mission, strategies, and objectives as well as the manner in which technologies impact operations. In organizations which have a high level of maturity in using IT there is a much clearer understanding of these relationships. In particular, Turban and Aronson [120] claim that these issues are among the reasons why there is a high failure rate with the implementation of many DSS projects and Jiang et al. [60] reported that user resistance was one of the reasons for information systems failure and the effect was greater for DSS than for ERP systems. Udo and Guimaraes [121] propose that the organization's competitiveness was one way to evaluate the benefits of DSS and Davenport [29] emphasized the importance of the organizational impact of ERP systems stating that they tend to impose their own logic on company strategy, the organization, and its culture.

Based on the findings from previous studies five research hypotheses related to Organizational Context are shown in Table 8.

Table 8: Hypotheses related to Organizational Context

Hypothesis
SDO 1(a): The importance of knowing the organization's mission and strategic plans before the project starts is significantly different for DSS and ERP projects.
SDO 1(b): Knowing the organization's IT strategic plans before the project starts is significantly more important for ERP projects than for DSS projects.
SDO 1(c): The importance of knowing the organization's level of maturity in the use of information technology before the project starts is significantly different for ERP and DSS projects.
SDO 1(d): Knowing the scope of the organization's activities before the project starts is significantly more important for ERP projects than for DSS projects.
SDO 1(e): The importance of knowing the organization's financial position before the project starts is significantly different for DSS and ERP projects.

Change Management is a widely cited success factor for DSS and ERP systems which requires the implementation team to prepare a formal change management program [21, 88, 67].

One of the key tasks in change management is to build user acceptance of the project and a positive employee attitude [2, 101, 66, 58, 108]. Palvia and Chervany [89] studied the implementation of a DSS with the objective of measuring the importance of: the amount of time spent in each change step; the level of support provided by a project champion; the ability to reverse the proposed system change; and the success in the preceding change step. They found that sufficient time should be budgeted in all steps of the change process and that pressure for quick results should be carefully weighed against the potential long-run gains that arise from allowing people to come to grips with the system at a measured pace. An important part of building user acceptance involves securing the support of opinion leaders throughout the organization and team leaders need to negotiate between various political turfs [5, 111]. Wood and Caldas [132] emphasize that in planning an ERP project it must be regarded as a change management initiative rather than an IT initiative. Finney et al. [41] note that in an ERP implementation change management is extremely important because, although many strategies may be proposed, strategies alone are not sufficient and important questions to be answered include: What tactics are required?; Are there different stakeholder views regarding what are appropriate tactics?; and How do influences like power, control, and resistance impact the selection of proper tactics?. The five indicators associated with change management used in this study are among 11 factors identified by Meyers et al. [84] that influence the implementation of new technologies.

Based on the findings from previous studies five research hypotheses related to Change Management are shown in Table 9.

Table 9: Hypotheses related to Change Management

Hypothesis
SDO 2(a): The importance of managing changes to organizational roles and structures is significantly different for DSS and ERP projects.
SDO 2(b): Managing changes to communications is significantly more important for DSS projects than for ERP projects.
SDO 2(c): Providing user training and education is significantly more important for ERP projects than for DSS projects.
SDO 2(d): The importance of managing changes to performance management is significantly different for DSS and ERP projects.
SDO 2(e): The importance of preparing for changes to management practices is significantly different for DSS and ERP projects.

Business Processes are defined as logically related tasks performed to achieve a defined outcome where processes are any activity or group of activities that take an input, add value to it, and provide an output to an internal or external agent [55]. Davenport and Short [28] claim that thinking about information technology should be in terms of how it supports new or redesigned business processes, and business processes and process improvements should be considered in terms of the capabilities that information technology can provide. This approach to process management is referred to as the new industrial engineering, business process redesign, process reengineering, or process innovation and it is seen as an enabler of organizational transformation [27, 30, 54, 126].

Organizations engage in process redesign when they believe that a radical improvement can be achieved by marrying changes to processes, organizational structure, and IT. An ERP system may be viewed as a process management tool and its implementation affects the whole enterprise and always requires work flow redesign [28, 29] Business process redesign is often needed before ERP implementation and a company with experience in process management is more likely to succeed with an ERP implementation. Umble et al. [122] recommend that the implementation of an ERP system should force key business processes to be reengineered and cause a corresponding realignment in organizational control to sustain the effectiveness of the reengineering effort. A company implementing an ERP must obtain a sincere commitment to the change process across all functions and levels of the organization. Robert-Witt [99] reported that ERP systems are designed to streamline back-end business processes and although an ERP system integrates knowledge and provides repertory tools for users to examine and analyze data, decision support is not the primary purpose. This is reinforced by White [133] who claims that, although organizations have found that ERP systems offer benefits supporting transaction processing, they haven't been so successful in using them for decision making. Consequently, it is expected that a successful ERP implementation has a stronger relationship with process redesign than may be the case for a successful DSS implementation.

Based on the findings from previous studies four research hypotheses related to Business Processes are shown in Table 10.

Table 10: Hypotheses related to Business Processes

Hypothesis
SDO 3(a): The importance of determining the costs of existing processes is significantly different for DSS and ERP projects.
SDO 3(b): The importance of determining the costs of new processes is significantly different for DSS and ERP projects.
SDO 3(c): The importance of determining the costs of modeling and designing processes is significantly different for DSS and ERP projects.
SDO 3(d): Determining the costs of redesigning and re-engineering processes is significantly more important for ERP projects than for DSS projects.

A Development Methodology is defined as a planned approach based on compatible strategies, the methods, the techniques, and the tools used to implement a computer based system and methodologies may be related to different philosophical bases [15]. Methodologies may be considered from two related perspectives: the overall approach used (e.g. traditional systems development life cycle, incremental/ evolutionary or small releases, and customized frameworks); and the

techniques and tools used (e.g. process and data modeling, prototyping tools, and CASE tools).

According to Turban and Aronson [120] and Eierman et al. [37] DSS are usually developed using a prototyping approach while operational systems are usually developed using the traditional structured systems development life cycle (SDLC) approach. Finlay and Forghani [40] noted that using the SDLC for DSS development was inappropriate because the problem to be addressed by the system is usually fluid, unstructured, and not well understood by the users. Gazmuri and Maturana [48] emphasize that using an evolutionary approach for operations research type IT projects improves the success rate and incremental or evolutionary approaches accommodate volatile user requirements [6, 21, 40, 65]. Bailey [17] promoted the use of an iterative evolutionary method for the development of enterprise-wide information systems but success is very dependent on careful planning for resources such as time and finances. The small releases approach is closely related to the iterative evolutionary method and is a practice that is evident among extreme programming methodologies [90]. Customized frameworks involve the selection and use of compatible methods, techniques, and tools based on the characteristics of an individual project and this provides developers with increased flexibility compared to using a single methodology [15]. Because different DSS projects are likely to have very different characteristics while ERP projects are likely to be more homogeneous in nature it is expected that customized frameworks may be more useful in relation to DSS than ERP systems.

Alavi [6] stresses the importance of prototyping tools as a means of supporting techniques used in a variety of methodologies especially iterative and evolutionary approaches. On a broader scale computer aided system engineering (CASE) tools provide support across a range of methods and techniques used in most approaches to systems development. In particular, they are able to support the use of customized development frameworks and they are very useful in maintaining changes to models as development progresses which suggests that they are more useful in relation to DSS than ERP systems where requirements a relatively more stable. However, CASE tools are essentially aids for analysts and designers and are not intended for use by end-users.

Based on the findings from previous studies eight research hypotheses related to Development Methodologies are shown in Table 11.

Table 11: Hypotheses related to Development Methodologies

Hypothesis
SDO 4(a): Using a traditional system development life cycle approach is significantly more appropriate for ERP projects than for DSS projects.
SDO 4(b): Using an incremental/evolutionary system development approach is significantly more appropriate for DSS projects than for ERP projects.
SDO 4(c): Using a small release approach to system development is significantly more appropriate for DSS projects than for ERP projects.
SDO 4(d): Using a customized framework as the approach to system development is significantly more appropriate for DSS projects than for ERP projects.
SDO 4(e): Techniques and tools used for process modeling are significantly more important for ERP projects than for DSS projects.
SDO 4(f): The importance of techniques and tools for data modeling is significantly different for ERP projects and DSS projects.
SDO 4(g): Prototyping techniques and tools are significantly more important for DSS projects than for ERP projects.
SDO 4(h): CASE tools are significantly more important for DSS projects than for ERP projects.

Project Management is concerned with a wide range of issues related to the activities which are defined by the systems development methodology [12, 91]. Consequently, project management methodologies and their methods, techniques, and tools complement development methodologies but do not replace them [15]. The purpose of project management is to manage the implementation process efficiently and effectively in order to deliver a high quality complete system on time and within budget. Slevin and Pinto [112] argued that in order to manage a project successfully project managers must be capable in both strategic and tactical project management activities.

A business plan prior to the start of the project which outlines the proposed strategic and tangible benefits, resources, costs, risks, and a timeline is critical

since this keeps a focus on the business benefits [128] and there should be a clear business model of how the organization will operate after the implementation effort [58] and a justification for the investment based on the business problem and organizational changes tied directly to the direction of the organization [38].

Vendor support is important for ERP implementation and includes three dimensions: the vendor's service response time; qualified consultants with knowledge of the organization's business processes and information technology; and the vendor's level of participation in the ERP project. ERP systems are not implemented as one time or phased projects like other information systems. An ERP system is not just a project it is a "way of life" [29] and the parameters of ERP systems interface directly with enterprise system security management where: cross-platform capabilities to manage the business environment require authorizations; event and resource management requires monitoring to alert management to a perilous condition; ERP systems are mission critical and rely on database backup and recovery procedures; and ERP systems have a business process orientation which relies on role based security [83]. Organizations that are implementing ERP have to cope with a host of different stakeholders inside and outside the organization who affect the attainment of objectives. Therefore, it is prudent for an organization to understand its multiple stakeholders and learn how best to manage them. To do so, organizations need to develop good relationship with and between stakeholders as greater interconnectedness among members of a network enables rapid communication and facilitates information exchange so that norms and expectations diffuse and become institutionalized [45]. Such relationships increase the identification of stakeholders improving their motivation to reach group goals and encouraging supportive behavior towards other in-group members [107]. Stakeholders should be aligned on a common set of goals improving communication, reducing re-work, and enhancing the possibility of overall success [56, 63].

For ERP implementation top management support has been consistently identified as the most crucial success factor [22, 24, 113, 53, 105, 123]. Slevin and Pinto [112] define top management support as the willingness of senior managers to provide the necessary resources and authority or power for project success. Welti [129] suggests that top management support is important in order to provide enough resources, fast decisions, and support for the acceptance of the project throughout the organization. Project managers must receive approval from top management and the ERP project team should be cross-functional in its composition and include the best people in the organization [113, 128]. The project team will be challenged to match the functionality of the application to current business processes or find ways to adapt or change current process and the team could face resistance within the organization to changes in the status quo [68]. Successful ERP implementation calls for strong leadership, a clear plan, and a constant watch on the budget by the project manager. The most important issue is a clear implementation plan and a strategy to implement that plan [131]. Because many ERP implementations are oversold, both on the time required for the implementation and on how quickly the benefits will appear, project team members should agree on the scope of the project, the goals, and expectations before the project begins and these issues need to be tracked formally throughout the project [82]. In addition to tracking progress Mandal and Gunasekaran [77] recommend providing to all of the stakeholders a detailed plan of the implementation and how it achieves business objectives.

Eierman et al. [37] found that carefully defined system requirements had a significant positive effect on the success of DSS implementation. Umble et al. [123] and Gazmuri and Maturana [48] emphasize that successful DSS implementations require good project management techniques and in particular an appropriate amount of time and financial resources should be allocated to the project. Palvia and Chervany [89] stated that quick results should be carefully weighed against the potential long-run gains when implementing DSS and they suggest that allowing the users more time to adjust to the new system would be beneficial in the long run.

In view of the common practice of outsourcing all, or selected aspects, of systems development the intensity and the management of the relationship between the organization and vendors involved is very important for DSS and ERP systems. This is particularly relevant for ERP implementations as these systems are highly complex, wide in scope, and strategic to the organization [1].

Based on the findings from previous studies 17 research hypotheses related to Project Management are shown in Table 12.

Table 12: Hypotheses related to Project Management

Hypothesis
SDO 5(a): The importance of support from the organization's senior management is significantly different for DSS and ERP projects.
SDO 5(b): Support from the IT department is significantly more important for DSS projects than for ERP projects.
SDO 5(c): Support from vendors/suppliers is significantly more important for ERP projects than for DSS projects.
SDO 5(d): The involvement of users is significantly more important for DSS projects than for ERP projects.
SDO 5(e): The involvement of all stakeholders is significantly more important for ERP projects than for DSS projects.
SDO 5(f): The use of project management software and tools is significantly more important for ERP projects than for DSS projects.
SDO 5(g): An effective project manager is significantly more important for ERP projects than for DSS projects.
SDO 5(h): An effective project team is significantly more important for ERP projects than for DSS projects.
SDO 5(i): The importance of defining project goals before the project starts is significantly different for DSS and ERP projects.
SDO 5(j): Systems requirements are significantly more difficult to determine for DSS than for ERP systems.
SDO 5(k): The delivery of system capabilities is significantly more important for ERP projects than for DSS projects.
SDO 5(l): Quality assurance of the system is significantly different for DSS and ERP projects.
SDO 5(m): Systems security is more important for ERP than DSS.
SDO 5(n): Technical systems documentation is more important for DSS than for ERP systems.
SDO 5(o): Systems maintenance is more important for DSS than for ERP systems.
SDO 5(p): The completion time needed for development and implementation is underestimated more often in DSS projects than in ERP projects.
SDO 5(q): The importance of adhering to the project budget is significantly different for DSS and ERP projects.

RESEARCH DESIGN AND METHODOLOGY

This is a quantitative cross-sectional field study which aims to develop theoretical understandings with practical implications for the development, implementation, and use of DSS and ERP systems. Data was collected using a structured self administered questionnaire from two groups referred to as IT and non IT professionals. The IT professionals include those who work for organizations that provide DSS or ERP systems and services in the marketplace or who are employed in organizations that use these systems. The non IT professionals are employed within organizations that use these systems and include expert users and other stakeholders with experience in the development, implementation, and use of DSS and ERP systems. Because of the level of investment required for DSS and ERP systems the organizations using these systems are at least medium in size (i.e. more than 50 employees and with total fixed asset in excess of 50 million baht, as defined by the Thailand Ministry of Industry).

The questionnaire was developed in the Thai and English languages and was checked by a focus group including three non IT and three IT professionals. Their comments, which included improved descriptions of DSS and ERP systems at the start of section 2 (see Appendix A1), were incorporated into both language versions and the Thai version was used in a pilot study with five IT and five non IT professionals. No further modifications were required so the Thai version was then used in the full study. The final English language version is in Appendix A1 with notations to identify the labels for variables and the measurement scales.

A judgmental non probability sampling procedure was used as this is appropriate for situations where the size of the population is unknown and individuals with particular expertise are being sought [87]. The following directories were used as sampling frames in order to identify specialized vendor and user organizations: Thailand Company Information (2006-2007); Organizations Database (ICT Ministry); and The Association of Thai ICT Industry (ATCI). From these directories it is estimated that there are 56 specialist vendors of DSS and ERP systems operating in Thailand and at least 50 appropriate user organizations. It was anticipated that a sample of 100 IT and 100 non IT professionals could be obtained. Initially, a total of 300 questionnaires were distributed by mail, email, and fax according to the wishes of the organizations that were contacted with equal numbers to IT and non IT professionals. As is normal with a judgmental sampling procedure it was done in stages so that responses with

missing answers or from respondents with inappropriate levels of experience with DSS and ERP systems were identified and discarded and a replacement respondent was sought. After a deadline, contact was made with organizations with missing responses and final samples of usable responses were obtained from 108 IT and 73 non IT professionals.

DATA PREPARATION AND ANALYSIS

The purpose of this section is to present the results of analyzing the data. This forms the basis for the discussion of the findings presented in the next section 5.

The data from the 108 responses from IT professionals and the 73 non IT professionals was entered into a statistical worksheet and a randomly selected 10 percent were checked for data entry errors. No errors were found and there were no missing answers to any of the questions. Descriptive statistics (mean, standard deviation, skewness, and kurtosis) were computed for the distributions of the variables involved in the research hypotheses in section 2 of the questionnaire and frequency counts and cross tabulations were used to analyze characteristics of the respondents based on their responses in section 1 of the questionnaire. All of the standard deviations were less than 1 which indicates that the mean is a good indicator of the responses, there were no outlier values (i.e. values 3 or more standard deviations from the mean), and the measures of skewness and kurtosis were all within acceptable limits of 3 and 7, respectively, which satisfies the conditions for the use of t-tests.

Characteristics of Respondents

The analysis of the characteristics of respondents and their type of experience with information systems are presented in Appendix Tables A1 and A2, respectively. From Table A1 it is seen that:

The distributions of the ages of IT and non IT professionals are very similar with means of 36 years and 35 years, respectively. None of these professionals are less than 20 years of age and the proportion of the oldest (51-65 years) is only slightly higher for IT professionals (7 percent) compared to 6 percent for non IT professionals. The majority of IT professionals (63 percent) are males but for the non IT professionals the balance is reversed with the majority being females (53 percent).

For IT and non IT professionals the minimum level of formal education is a bachelor degree. The majority of IT professionals (59 percent) hold a master degree with 37 percent holding a bachelor degree and a small proportion (4 percent) have doctoral degrees. However, for the non IT professionals the majority (64 percent) holds a bachelor degree and 36 percent hold a master degree and there are no doctoral degree graduates. Both groups have sufficiently high enough levels of education to participate in the study.

The only difference between IT and non IT professionals with respect to their number of years of professional experience concerns those with 5-20 years of experience. In this range 56 percent of IT professionals have 5-10 years of experience while for the non IT professionals 58 percent have 11-20 years of professional experience. Among the IT professionals 73 percent are in middle to senior level IT positions above the level of IT officer which means that it can be expected that they have sufficient experience and are senior enough to provide insightful responses to the questionnaire. Among the non IT professionals there is evidence of a good mixture of professionals across the employment position categories. The 26 percent who indicated "Other" as their employment position is self employed with responsibilities commensurate with professionally skilled employees. Consequently, the sample of non IT professionals is also expected to be experienced and skillful enough to participate in the study.

T-tests were used to examine significant differences between male and female IT professionals as well as non IT professions with respect to age, number of years of experience, and level of education. No significant differences ($p < 0.05$) were found for the IT professionals but for the non IT professionals the average age of males (36 years) is significantly greater than the average age of females (31 years) and males have significantly more experience (average 12 years) compared to females (average 9 years). Additional t-tests showed that there were no significant differences between IT and non IT professionals with respect to age, number of years of experience, and level of education.

From Table A2 it is seen that across the 16 different types of information systems there were many where the majority of IT and non IT indicated that they had not had experience in the development or the use of the systems and this is not surprising as these 16 systems span a wider range of applications than most people would be expected to have experienced. However, across all of these 16 types of information systems there were no IT or non IT professionals in the final samples who did not have development, use, or both types of experience with at least 10 of the 16 information systems. Consequently, it is proposed that the samples of IT and non IT professionals have a broad enough base of experience with information systems of the various types

in Table A2 to enable them to provide valid and reliable responses to the questionnaire.

The strength of associations between the type of professional (IT and non IT) and the type of experience they have had with each of 16 information systems were examined using contingency coefficients. The results showed that there was no significant ($p < 0.05$) difference between the type of experience that IT and non IT professionals have had with any of the 16 types of information systems.

Decisions for Research Hypotheses

As presented in section 2 there are 73 research hypotheses and each hypothesis is tested separately for IT and non IT professionals using t-tests with a significance level of 0.05. Table 13 and Table 14 show the decisions for hypotheses concerning indicators for factors in the User Characteristics and Perceptions (UCP) and the System Development and Organizational Issues (SDO) categories, respectively.

Table 13: Decisions for User Characteristics and Perceptions (UCP) hypotheses

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
User's Perceptions of the System		
UCP 1(a): The usefulness of the systems functions is significantly different for DSS and ERP systems.	Supported The usefulness of systems functions is significantly less for DSS than ERP systems.	Not Supported
UCP 1(b): The usefulness of outputs from the system is significantly different for DSS and ERP systems.	Not Supported	Not Supported
UCP 1(c): User documentation is more important for DSS than for ERP systems.	Not Supported	Not Supported
UCP 1(d): Help support is more important for DSS than for ERP systems.	Not Supported	Supported.
UCP 1(e): The importance of the performance of the system is significantly different for DSS and ERP systems.	Not Supported	Not Supported
UCP 1(h): The time taken to learn the system is significantly more for DSS than for ERP systems.	Supported	Supported
UCP 1(i): Personal gain from working with the system is significantly different for DSS and ERP systems.	Supported Personal gains are significantly greater for DSS than ERP.	Not Supported
UCP 1(f): The importance of the ease of interaction with the system is significantly different for DSS and ERP systems.	Not Supported	Not Supported
UCP 1(g): The importance of the ease of learning the system is significantly different for DSS and ERP systems.	Not Supported	Not Supported
UCP 1(j): The impact of the system on increasing job security is higher for DSS than ERP systems.	Not Supported	Not Supported
UCP 1(k): The impact of the system on improving work procedures is higher for ERP than DSS systems.	Supported	Not Supported
UCP 1(l): The impact of the system on increasing an individual's job satisfaction is higher for ERP systems than for DSS.	Not Supported	Not Supported

Table 13: Decisions for User Characteristics and Perceptions (UCP) hypotheses (cont.)

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
Cognitive Styles of Users		
UCP 2(a): Learn new skills and knowledge is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(b): Analyze quantitative information is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(c): Analyze qualitative information is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(d): Reason heuristically is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(e): Make judgments and decisions is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(f): Adopt rules is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(g): Understand the context of a problem is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(h): Deal with uncertainty is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 2(i): Deal with ambiguity is significantly more important for DSS than for ERP systems.	Supported	Supported
System Usage		
UPC 3(a): The frequency of system usage is significantly different for DSS and ERP systems.	Supported The frequency of usage is significantly less for DSS than ERP systems.	Supported The frequency of usage is significantly less for DSS than ERP systems.
UPC 3(b): Significantly more time is required to complete tasks using DSS than is required to complete tasks using ERP systems.	Supported	Supported
UPC 3(c): The proportion of work done using DSS is significantly greater than the proportion of work done using ERP systems.	Not Supported The proportion of work done using DSS is significantly less than the proportion of work done using ERP systems.	Not Supported The proportion of work done using DSS is significantly less than the proportion of work done using ERP systems.

Table 13: Decisions for User Characteristics and Perceptions (UCP) hypotheses (cont.)

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
Personal Characteristics of Users		
UCP 4(a): The amount of experience a user has in their current position is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 4(b): The amount of experience a user has had in previous work positions is significantly more important for DSS than for ERP systems.	Supported	Supported
UCP 4(c): The amount of experience a user has had with computer-based systems is significantly more important for DSS than for ERP systems.	Supported	Not Supported
UCP 4(d): Older users have significantly more success in using DSS and ERP systems than younger users.	(i) Supported for DSS. (ii) Not supported for ERP where younger users have more success than older users.	(i) Supported for DSS. (ii) Not supported for ERP where younger users have more success than older users.
UCP 4(e): Male users have significantly more success in using DSS and ERP systems than female users.	(i) Supported for DSS (ii) Not supported for ERP where females have more success than males.	(i) Supported for DSS (ii) Not supported for ERP where females have more success than males.
UCP 4(f): The level of formal education of users is significantly more important for DSS than for ERP systems.	Supported	Not Supported
UCP 4(g): The type of formal education is significantly more important for DSS than for ERP systems.	Supported	Not Supported
UCP 4(h): The importance of communication skills is significantly different for the use of DSS and ERP systems.	Supported Communication skills are significantly more important for DSS than ERP systems.	Supported Communication skills are significantly less important for DSS than ERP systems.
UCP 4(i): The importance of interpersonal skills is significantly different for the use of DSS and ERP systems.	Supported Interpersonal skills are significantly more important for DSS than ERP systems.	Supported Interpersonal skills are significantly more important for DSS than ERP systems.
UCP 4(j): The importance of teamwork skills is significantly different for the use of DSS and ERP systems.	Supported Teamwork skills are significantly less important for DSS than ERP systems.	Supported Teamwork skills are significantly less important for DSS than ERP systems.

Table 14: Decisions for System Development and Organizational (SDO) hypotheses

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
Organizational Context		
SDO 1(a): The importance of knowing the organization's mission and strategic plans before the project starts is significantly different for DSS and ERP projects.	Supported Knowing the organization's mission and strategic plans before the project starts is significantly more important for DSS than ERP systems.	Supported Knowing the organization's mission and strategic plans before the project starts is significantly more important for DSS than ERP systems.
SDO 1(b): Knowing the organization's IT strategic plans before the project starts is significantly more important for ERP projects than for DSS projects.	Not Supported	Not Supported
SDO 1(c): The importance of knowing the organization's level of maturity in the use of information technology before the project starts is significantly different for ERP and DSS projects.	Supported Knowing the organization's level of maturity in the use of information technology before the project starts is significantly more important for DSS than ERP systems.	Supported Knowing the organization's level of maturity in the use of information technology before the project starts is significantly more important for DSS than ERP systems.
SDO 1(d): Knowing the scope of the organization's activities before the project starts is significantly more important for ERP projects than for DSS projects.	Not Supported	Not Supported
SDO 1(e): The importance of knowing the organization's financial position before the project starts is significantly different for DSS and ERP projects.	Not Supported	Not Supported
Change Management		
SDO 2(a): The importance of managing changes to organizational roles and structures is significantly different for DSS and ERP projects.	Not Supported	Not Supported
SDO 2(b): Managing changes to communications is significantly more important for DSS projects than for ERP projects.	Supported	Not Supported
SDO 2(c): Providing user training and education is significantly more important for ERP projects than for DSS projects.	Supported	Not Supported
SDO 2(d): The importance of managing changes to performance management is significantly different for DSS and ERP projects.	Not Supported	Not Supported
SDO 2(e): The importance of preparing for changes to management practices is significantly different for DSS and ERP projects.	Not Supported	Not Supported

Table 14: Decisions for System Development and Organizational (SDO) hypotheses (cont.)

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
Business Process Redesign		
SDO 3(a): The importance of determining the costs of existing processes is significantly different for DSS and ERP projects.	Not Supported	Not Supported
SDO 3(b): The importance of determining the costs of new processes is significantly different for DSS and ERP projects.	Supported Determining the costs of new processes is significantly more important for DSS than ERP systems	Supported Determining the costs of new processes is significantly more important for DSS than ERP systems
SDO 3©: The importance of determining the costs of modeling and designing processes is significantly different for DSS and ERP projects.	Supported Determining the costs of modeling and designing processes is significantly more important for DSS than ERP systems	Not Supported
SDO 3(d): Determining the costs of redesigning and re-engineering processes is significantly more important for ERP projects than for DSS projects.	Not Supported	Not Supported
SDO 4(a): Using a traditional system development life cycle approach is significantly more appropriate for ERP projects than for DSS projects.	Supported	Supported
SDO 4(b): Using an incremental/evolutionary system development approach is significantly more appropriate for DSS projects than for ERP projects.	Supported	Supported
SDO 4©: Using a small release approach to system development is significantly more appropriate for DSS projects than for ERP projects.	Supported	Supported
SDO 4(d): Using a customized framework as the approach to system development is significantly more appropriate for DSS projects than for ERP projects.	Not Supported	Supported
SDO 4(e): Techniques and tools used for process modeling are significantly more important for ERP projects than for DSS projects.	Supported	Not Supported
SDO 4(f): The importance of techniques and tools for data modeling is significantly different for ERP projects and DSS projects.	Not Supported	Not Supported
SDO 4(g): Prototyping techniques and tools are significantly more important for DSS projects than for ERP projects.	Not Supported	Supported
SDO 4(h): CASE tools are significantly more important for DSS projects than for ERP projects.	Supported	Supported

Table 14: Decisions for System Development and Organizational (SDO) hypotheses (cont.)

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
Project Management		
SDO 5(a): The importance of support from the organization's senior management is significantly different for DSS and ERP projects.	Not Supported	Not Supported
SDO 5(b): Support from the IT department is significantly more important for DSS projects than for ERP projects.	Not Supported	Not Supported
SDO 5(c): Support from vendors/suppliers is significantly more important for ERP projects than for DSS projects.	Supported	Not Supported
SDO 5(d): The involvement of users is significantly more important for DSS projects than for ERP projects.	Not Supported	Not Supported
SDO 5(e): The involvement of all stakeholders is significantly more important for ERP projects than for DSS projects.	Supported	Not Supported
SDO 5(f): The use of project management software and tools is significantly more important for ERP projects than for DSS projects.	Supported	Supported
SDO 5(g): An effective project manager is significantly more important for ERP projects than for DSS projects.	Not Supported	Not Supported
SDO 5(h): An effective project team is significantly more important for ERP projects than for DSS projects.	Supported	Supported
SDO 5(i): The importance of defining project goals before the project starts is significantly different for DSS and ERP projects.	Supported Defining project goals before the project starts is significantly more important for DSS than ERP systems.	Not Supported
SDO 5(j): Systems requirements are significantly more difficult to determine for DSS than for ERP systems.	Supported	Supported
SDO 5(k): The delivery of system capabilities is significantly more important for ERP projects than for DSS projects.	Not Supported	Supported
SDO 5(l): Quality assurance of the system is significantly different for DSS and ERP projects.	Supported Quality assurance of the system is significantly more important for ERP than DSS projects.	Not Supported
SDO 5(m): Systems security is more important for ERP than DSS.	Not Supported	Not Supported
SDO 5(n): Technical systems documentation is more important for DSS than for ERP systems.	Not Supported Technical systems documentation is more important for ERP than DSS systems.	Not Supported Technical systems documentation is more important for ERP than DSS systems.
SDO 5(o): Systems maintenance is more important for DSS than for ERP systems.	Not Supported	Supported

Table 14: Decisions for System Development and Organizational (SDO) hypotheses (cont.)

Hypothesis	Decision for IT Professionals	Decision for Non IT Professionals
SDO 5(p): The completion time needed for development and implementation is underestimated more often in DSS projects than in ERP projects.	Supported	Supported
SDO 5(q): The importance of adhering to the project budget is significantly different for DSS and ERP projects.	Supported The importance of adhering to the project budget is significantly more important for DSS than ERP projects.	Supported The importance of adhering to the project budget is significantly more important for DSS than ERP projects.

DISCUSSION OF THE FINDINGS

The discussion is based on the decisions for the research hypotheses presented in Table 13 and Table 14 and is organized to indicate the areas where the IT and non IT professionals either agree or disagree about the issue tested by a research hypothesis concerning DSS and ERP systems.

Areas of Agreement between IT and Non IT Professionals

Table 15 shows indicators where the IT and non IT professionals agree that the indicator is equally important for both DSS and ERP systems.

Table 15: Indicators of equal importance for DSS and ERP systems agreed to by both groups

User's Perceptions of the System and System Usage
Usefulness of system output and user documentation, The performance of the system, Ease of interaction with the system, Ease of learning to use the system, The system's impact on the individual's job security and job satisfaction
Organizational Context
Knowing the Organization's: IT strategic plans before the project starts, Scope of activities before the project starts, Financial position before the project starts
Change Management
Managing Changes to: Organizational roles and structures, Performance management, Management practices
Business Process Redesign
***Determining the Costs of*:** Existing processes, Redesigning and re-engineering processes
Development Methodology
Data modeling techniques and tools
Project Management
Support from the organization's senior management, Support from the IS department, The involvement of users, An effective project manager, Systems security

From Table 15 it is seen that as expected indicators that influence a user's perception of the ease of use, usefulness, and actual use of the system are equally important for both DSS and ERP systems these issues are important for almost any information system. Information about the organization's activities, financial status, and IT strategic plans is essential before starting either a DSS or an ERP project as are plans for managing organizational changes resulting from the implementation of either type of system including the costing and redesign of business processes. Data modeling techniques and tools are equally important in relation to DSS and ERP implementations and, as expected, so are support from the organization's senior management, the IS department, and the users as well as an effective project manager and attention to the security of the system.

Table 16 shows indicators where the IT and non IT professionals agree that the indicators have a different level of importance for DSS and ERP systems.

Table 16: Indicators of different importance for DSS and ERP systems agreed to by both groups

User's Perceptions of the System and System Usage
The time taken to learn the system is more for DSS than for ERP systems. The frequency of usage of DSS is less than for ERP systems. The proportion of work done using DSS is less than for ERP systems. More time is required to complete tasks using DSS than is required using ERP systems.
Cognitive Styles of Users
Each of these cognitive styles and abilities is more important for users of DSS than for users of ERP systems: Learn New Skills and Knowledge, Analyze Quantitative Information, Analyze Qualitative Information, Reason heuristically, Make judgments and decisions, Adopt rules, Understand the context of a problem, Deal with uncertainty, Deal with ambiguity
Personal Characteristics of Users
Each of these characteristics of users is more important for DSS than for ERP systems: Experience in Current Position, Experience in Previous Positions, Interpersonal Skills
Teamwork skills are more important for ERP systems than for DSS.
Older users and males have more success in using DSS. Younger users and females have more success in using ERP.
Organizational Context
Knowing the organization's mission and strategic plans before the project starts is more important for DSS than ERP systems. Knowing the organization's level of maturity in the use of information technology before the project starts is more important for DSS than ERP systems.
Business Process Redesign
Determining the costs of new processes is more important for DSS than ERP systems.
Development Methodology
Incremental/evolutionary and small releases approaches to development are more important for DSS than ERP systems. The use of CASE tools is more important for DSS than ERP systems.
The traditional systems development life cycle approach is more important for ERP systems than DSS.
Project Management
The use of project management software and tools more important for ERP projects than for DSS projects. An effective project team is more important for ERP projects than for DSS projects. Technical systems documentation more important for ERP projects than for DSS projects.
A definition of requirements is more difficult to determine for DSS than for ERP systems. Project completion time is underestimated more often for DSS than for ERP projects. It is more important to adhere to the project budget for DSS projects than for ERP projects.

From Table 16 it is seen that IT and non IT professionals agree that compared to ERP systems users need a longer time to learn how to use DSS even though they are used less frequently for a relatively smaller proportion of the user's work and they require more time when used to complete tasks. As described in many previous studies a wide range of cognitive, problem solving, and interpersonal skills are more important for using DSS than ERP systems including the user's current and previous levels of work experience. However, teamwork skills are seen as more important for using ERP systems than DSS and while young female users have more success than others using ERP systems older male users have more success in using DSS.

Prior knowledge of the organization's mission, strategic plans, and level of maturity in the use of IT are seen to be more important for DSS than ERP projects. Determining the costs of new processes is more important in relation to DSS than ERP systems which is surprising since changes to business processes is often associated more strongly with ERP than DSS implementations. In accordance with previous studies a definition of requirements and being able to adhere to planned completion time and budget is more difficult with DSS than ERP projects and so incremental/evolutionary and small releases approaches including the use of CASE tools are seen as more appropriate for the development of DSS than ERP systems while the traditional systems life cycle approach is more appropriate for ERP systems.

Several aspects of project management are considered to be more important for ERP projects than for DSS projects (using project management software and tools, an effective project team, and provision of technical systems documentation) all of which reflect the broader scope of the influence of ERP implementations within an organization.

Areas of Disagreement between IT and Non IT Professionals

Table 17 identifies the indicators where only one of the groups has identified a significant difference between the importance of the indicator for DSS and ERP systems while the other group considers the indicator to be equally important for both types of systems.

Table 17: Indicators of different importance for DSS and ERP according to only one of the groups

User's Perceptions of the System and System Usage
Only non IT professionals indicate that the usefulness of help support is more important for DSS than ERP systems.
Only IT professionals indicate that: Personal gains are greater for DSS than for ERP systems System functions are more useful for ERP systems than for DSS ERP systems improve work procedures more than DSS
Personal Characteristics of Users
For only IT professionals communication skills are more important for DSS than for ERP systems For only non IT professionals communication skills are more important for ERP systems than for DSS.
Only IT professionals indicate that: Experience with computer based systems is more important for DSS than for ERP systems Level of formal education is more important for DSS than for ERP systems Type of formal education is more important for DSS than for ERP systems
Change Management
Only IT professionals indicate that: Managing changes to communications is more important for DSS than ERP systems. Providing training and education is more important for ERP systems than for DSS.
Business Process Redesign
Only IT professionals indicate that modeling and designing processes is more important for DSS than ERP systems.
Development Methodology
Only non IT professionals indicate that: The use of customized frameworks is more important for DSS than ERP systems The use of prototyping techniques and tools is more important for DSS than ERP systems
Only IT professionals indicate that techniques and tools for process modeling are more important for ERP systems than DSS.
Project Management
Only IT professionals indicate that: Support from vendors/suppliers is more important for ERP systems than DSS The involvement of all stakeholders is more important for ERP systems than DSS Quality assurance of the system is more important for ERP systems than DSS Defining project goals before the start of the project is more important for DSS than ERP systems
Only non IT professionals indicate that: The delivery of systems capabilities is more important for ERP systems than DSS Systems maintenance is more important for DSS systems than ERP systems

Differences between DSS and ERP Systems identified by IT Professionals Only: From Table 17 it is seen that compared to the equal importance of the following indicators for DSS and ERP systems among the non IT professionals the IT professionals consider that there are differences:

ERP system functions are more useful and improve work procedures on a wider organizational scale than DSS functions which are more focused on individual tasks with greater personal gains for the user than derived from ERP functions.

Experience with computer based systems and level and type of formal education are all more important personal characteristics of users of DSS than ERP systems where higher levels of formal education are preferred and refer to at least a bachelor degree with a focus on problem solving skills using qualitative and quantitative methods. However, specific user training for ERP systems is considered to be more important than specific training

DSS which relates to the normally larger number of interacting ERP users across the organization and the importance of correct usage in terms of fundamental operational business activities.

Managing changes to communications and modeling and designing processes are more important in relation to DSS than ERP implementations. These emphases by IT professionals on organizational changes in relation to DSS, especially those affecting business processes, are notable since their importance is often presented in the literature to be more relevant to ERP systems. However, IT and non IT professionals acknowledge the importance of managing changes to organizational roles, structures, and performance as well as the need to determine the costs of existing, new, redesigned, and re-engineered processes in relation to ERP systems and IT professionals emphasize that techniques and tools for process modeling are more important for ERP systems than DSS.

Defining project goals before the start of the project is seen as more important for DSS than for ERP systems projects and this is almost certainly related to the difficulty in determining requirements for DSS. Indicators related to project management (support from vendors/suppliers, involvement of all stakeholders, and quality assurance of the system) are considered to more important for ERP than DSS projects which reflects the broader scope and influence of ERP projects within the organization.

Differences between DSS and ERP Systems identified by Non IT Professionals Only: From Table 17 it is seen that compared to the equal importance of the following indicators for DSS and ERP systems among the IT professionals the non IT professionals consider that there are differences:

Help support, systems maintenance, and the use of customized frameworks and prototyping techniques and tools for development are more important for DSS than ERP systems. These emphases reflect perceptions by non IT professionals that DSS are more technically complex and idiosyncratic than ERP systems with less well structured requirements suggesting that customized approaches to development employing prototyping are appropriate.

The delivery of systems capabilities is more important for ERP systems than DSS which again reflects the wide organizational dependency on the use of ERP for basic business activities compared to the narrower more strategic focus of DSS.

From Table 17 it is noted that the IT professionals have identified more differences between DSS and ERP systems than the non IT professionals. The differences identified by the IT professionals reflect their additional technical knowledge and possibly broader range of experiences with both types of systems while the differences identified by the non IT professionals are understandably focused on the actual use of these systems in their organizations and their possibly limited experience with DSS compared to ERP systems. This evidenced in completely different view of each group about the importance of an individual's communication skills where IT professionals consider these to be more important for DSS than for ERP systems while the emphasis is reversed among non IT professionals. The IT professionals recognize the strong importance of an individual being able to communicate effectively to others in the organization the results they derived as an individual from using a DSS whereas the non IT professional sees the need for communication skills to be higher when ERP users are sharing outputs with others across the organization.

CONCLUSION

The study formulated and tested a wide range of hypotheses derived from previous studies concerned with differences and similarities between indicators related to the development, implementation, and use of DSS and ERP systems. The indicators were all associated with factors organized in two categories dealing with User Characteristics and Perceptions (UCP) and System Development and Organizational Issues (SDO). In addition, each hypothesis was tested using a sample of IT professionals and non IT professionals all of whom had relevant experience and expertise in relation to DSS and ERP systems.

The findings of the study (section 5) indicate mainly clear agreement among both groups and the findings from previous studies regarding the similarities and differences between DSS and ERP systems. The findings also identified that the IT professionals see more differences between DSS and ERP systems than the non IT professionals and the comparisons between the views of the two groups are compatible with their different roles and levels and types of experience with these systems. The findings in section 5 are expected to enhance theoretical and practical understandings important for the successful implementation of DSS and ERP systems. From a theoretical perspective there appear to be significant differences between DSS and ERP systems from the view points of both non IT and IT professionals which means that project teams need to understand the differences between these two types of systems as a prerequisite to planning and commencing implementations. From a practical perspective project teams need to understand that among the IT and non IT

members of the project team there are different views about what is important in the implementation of either a DSS or an ERP system. This is very important information for the project leader but it is also important for other team members and stakeholders in order to ensure understanding and effective communication and cooperation among all those associated with the project.

There are limitations on the findings which can only be addressed by repeating the study. Even though the experience of those who participated in the study was considered appropriate it would be desirable to have samples of individuals (IT and non IT professionals) with more experience in the development and use of both DSS and ERP stems. In practice, there appear to be numerous individuals with relevant experience With ERP systems but those with adequate experience with DSS are much harder to locate. The distinction between DSS and ERP systems, particularly in the minds of non IT professionals, is becoming "blurred" by the fact that ERP systems are often promoted by vendors as providing decision support. This is true to some extent as ERP systems do play a role in operational level decision making and to a less extent strategic level decisions but this role is certainly not the specialized strategic decision support role of DSS as understood by IT professionals. To try and clarify the difference between a DSS and ERP system this study presented questionnaire respondents with descriptions of DSS and ERP systems. However, it is possible especially among non IT professionals that the distinction was not completely clear in which case this matter needs to be considered carefully in further studies.

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APPENDIX

A1: Questionnaire

The questionnaire has been abbreviated and includes the notations used for the variables and the measuring scales for the variables.

Section One: ***Personal Information***
1. Age (years): (**age**) ☐ Under 20 **(1)** ☐ 20-35 **(2)** ☐ 36-50 **(3)** ☐ 51-65 **(4)** ☐ 0ver 65 **(5)**
2. Gender: (**gender**) ☐ Male **(1)** ☐ Female **(2)**
3. Professional experience (years): (**exp**) ☐ Less than 5 **(1)** ☐ 5-10 **(2)** ☐ 11-20 **(3)** ☐ 21-30 **(4)** ☐ Over 30 **(5)**
4. Current professional position

Information Technology (IT) Positions (itpos)		**Non-IT Positions (nonitpos)**	
	Score		**Score**
CIO	9	Senior executive	7
IT manager	8	Senior manager	6
IT strategist	7	Middle manager	5
IT project manager	6	Supervisor	4
Systems Analyst/Designer	5	Consultant	3
System Engineer	4	Officer	2
IT consultant	3	Other (Please specify):	1
IT officer	2		
Other (Please specify):	1		

5. Highest level of formal education: (**edu**) ☐ High School (or equivalent) **(1)** ☐ Bachelor's degree **(2)** ☐ Master degree **(3)** ☐ Doctoral degree **(4)**
6. Please indicate (√) the types of experiences you have had with these the types of information systems:

Type of System	**Variable Name**	**Helped to Develop/Implement**	**Experience in Using**
Demand forecasting	**demand**		
Order management	**order**		
Human resources	**human**		
Distribution/Warehouse management	**distrib**		
Financial systems	**finance**		
Inventory planning	**invent**		
Strategic planning	**strat**		
Shop floor tracking	**shop**		
Data warehouse	**data**		
Supply Chain Management	**supply**		
Capacity planning	**capacity**		
Manufacturing scheduling	**manu**		
Transportation scheduling	**trans**		
Sales and marketing	**sales**		
Business intelligence	**business**		
Customer relationship management	**customer**		

Scoring: 0 if there is no answer; 1 if *Helped to Develop or Implement* only; 2 if *Experience in Using* only; 3 if both *Helped to Develop and Implement* and *Experience in Using*.

Section Two: ***Characteristics of DSS and ERP Systems***

DSS *are used to provide information for strategic planning and decision making and production forecasting, inventory planning, factory floor scheduling, transportation and distribution planning systems are all good examples of DSS which utilize models and complex computer algorithms to generate optimal, or more commonly, feasible business solutions where no single business solution is the right solution.*
ERP *systems are used to keep track of routine transactions and elementary activities of an organization and that order management, inventory movement, financial management, and human resource management systems are all good examples.*

1. Please indicate (√) on the scales provided for DSS and ERP the level of importance of each of the characteristics for each type of system where, ***1*** means ***Unimportant*** and ***5*** means ***Very Important***.

Characteristics	DSS					ERP				
	1	2	3	4	5	1	2	3	4	5
Characteristics of the System: Variables: s1d, s1e , s2d, s2e, **…**, s11d, s11e (d stands for DSS and e for ERP)										
The usefulness of system functions										
The usefulness of system output										
The usefulness of user documentation										
The usefulness of help support										
The performance of the system										
Personal gains from using the system										
Ease of interaction with the system										
Ease of learning to use the system										
The system's impact on increasing the individual's job security										
The system's impact on improving the individual's work procedures										
The system's impact on increasing the individual's job satisfaction										
Characteristics of the Users: Variables: u1d, u1e , u2d, u2e, **…**, u17d, u17e (d stands for DSS and e for ERP)										
Ability to learn new skills and knowledge										
Ability to analyze quantitative information										
Ability to analyze qualitative information										
Ability to reason heuristically										
Ability to make judgments and decisions										
Ability to adopt rules										
Ability to understand the context of a problem										
Ability to deal with uncertainty										
Ability to deal with ambiguity										
Experience in current position										
Previous work experience										
Experience with computer based systems										
Level of education										
Type of education										
Communication skills										
Interpersonal skills										
Teamwork skills										
Characteristics of the Organization: Variables: o1d, o1e, o2d, o2e, …, o5d, o5e (d stands for DSS and e for ERP)										
Mission and strategy										
IT strategy										
Maturity in using IT										
Scope of activities										
Financial position										
Change Management Activities: Variables: a1d, a1e, a2d, a2e, …, a9d, a9e (d stands for DSS and e for ERP)										
Managing changes to organizational roles and structures										

Characteristics	DSS					ERP				
	1	2	3	4	5	1	2	3	4	5
Managing changes to communications										
Managing changes to training and education										
Managing changes to performance management										
Managing changes to management practices										
Determining the costs of existing processes										
Determining the costs of new processes										
Determining the costs of modeling and designing processes										
Determining the costs of redesigning and re-engineering processes										
Systems Development and Implementation: Variables: i1d, i1e, i2d, i2e, …, i23d, i23e (d stands for DSS and e for ERP)										
Using a traditional systems development life cycle										
Using an incremental/evolutionary methodology										
Using a small releases methodology										
Using customized frameworks for development										
Process modeling										
Data modeling										
Using prototyping tools										
Using CASE tools										
Support from the organization's senior management										
Support from the IT department										
Support from the vendors/suppliers										
Involvement of users										
Involvement of other stakeholders										
Project management software and tools										
An effective project manager										
An effective project team										
A clear definition of project goals										
The delivery of system capabilities										
Quality assurance of the system										
System security										
Technical systems documentation										
Systems maintenance										
Adhering to the project budget										

2. Please indicate (√) the amount of time taken by users to learn how to use each type of system.

System	Variable	Very Little Time 1	2	3	4	A Lot of Time 5
DSS	**ltimed**					
ERP	**ltimee**					

3. Please indicate (√) how often users use each type of system.

System	Variable	Infrequently 1	2	3	4	Frequently 5
DSS	**used**					
ERP	**usee**					

4. Please indicate (√) how much time it takes users to complete tasks with each type of system.

System	Variable	Very Little Time 1	2	3	4	A Lot of Time 5
DSS	**comd**					
ERP	**come**					

5. Please indicate (√) the proportion of a user's workload that is done using each type of system.

System	Variable	0 - 20 Percent 1	21 - 40 Percent 2	41 - 60 Percent 3	61 - 80 Percent 4	81 - 100 Percent 5
DSS	**prod**					
ERP	**proe**					

6. Please indicate (√) the amount of success that older and younger users have in using each type of system.

System	User	Variable	Very Little Success 1	2	3	4	A Lot of Success 5
DSS	35 years or older	**oldd**					
	Younger than 35 years	**youngd**					
ERP	35 years or older	**olde**					
	Younger than 35 years	**younge**					

7. Please indicate (√) the amount of success that male and female users have in using each type of system.

System	User	Variable	Very Little Success 1	2	3	4	A Lot of Success 5
DSS	Males	**susedm**					
	Females	**susedf**					
ERP	Males	**suseem**					
	Females	**suseef**					

8. Please indicate (√) the amount of difficulty in determining system requirements for each type of system.

System	Variable	Very Easy to Determine 1	2	3	4	Very Difficult to Determine 5
DSS	**difd**					
ERP	**dife**					

9. Please indicate (√) the level of success achieved in estimating the completion time needed development and implementation.

System	Variable	Always Underestimated 1	2	3	4	Always Overestimated 5
DSS	**ctimed**					
ERP	**ctimee**					

Table A1: Characteristics of respondents

Characteristic	IT Professionals			Non IT Professionals			
	Frequency	Percent	Cumulative Percent	Frequency	Percent	Cumulative Percent	
Age							
20 - 35	57	52.8	52.8	40	54.8	54.8	
36 - 50	43	39.8	92.6	29	39.7	94.5	
51 - 65	8	7.4	100.0	4	5.5	100.0	
Total	108	100	-	73	100.0	-	
Gender							
Male	68	63.0	63.0	34	46.6	46.6	
Female	40	37.0	100.0	39	53.4	100.0	
Total	108	100.0	-	73	100.0	-	
Level of Education							
Bachelor Degree	40	37.0	37.0	47	64.4	64.4	
Master Degree	64	59.3	96.3	26	35.6	100.0	
Doctoral Degree	4	3.7	100.0	0	0	100.0	
Total	108	100.0	-	73	100.0	-	
Years of Experience							
5 - 10	54	50.0	50.0	28	38.4	38.4	
11 - 20	43	39.8	89.8	38	52.1	90.4	
21 - 30	7	6.5	96.3	5	6.8	97.3	
Over 30 years	4	3.7	100.0	2	2.7	100.0	
Total	108	100.0	-	73	100.0	-	
Employment Position	Frequency	Percent	Cumulative Percent		Frequency	Percent	Cumulative Percent
IT Officer	29	26.9	26.9	Other	19	26.0	26.0
IT Consultant	6	5.6	32.4	Officer	25	34.2	60.3
Systems Engineer	14	13.0	45.4	Consultant	6	8.2	68.5
Systems Analyst/Designer	22	20.4	65.7	Supervisor	13	17.8	86.3
IT Project Manager	14	13.0	78.7	Middle Manager	7	9.6	95.9
IT Strategist	1	0.9	79.6	Senior Manager	2	2.7	98.6
IT Manager	16	14.8	94.4	Senior Executive	1	1.4	100.0
CIO	6	5.6	100.0	*Total*	73	100.0	-
Total	108	100.0	-				

Table A2: IT and non IT professionals experience with information systems

Information System	Percentage of IT Professionals	Percentage of Non IT Professionals	Information System	Percentage of IT Professionals	Percentage of Non IT Professionals
Demand Forecasting			**Order Management**		
Not Develop and Not Use	70.4	61.6	Not Develop and Not Use	57.4	53.4
Develop Only	9.3	9.6	Develop Only	13.9	9.6
Use Only	19.4	23.3	Use Only	21.3	32.9
Develop and Use	0.9	5.5	Develop and Use	7.4	4.1
Human Resources			**Distribution/Warehouse Management**		
Not Develop and Not Use	57.4	60.3	Not Develop and Not Use	63.0	63.0
Develop Only	18.5	13.7	Develop Only	14.8	11.0
Use Only	16.7	20.5	Use Only	18.5	24.7
Develop and Use	7.4	5.5	Develop and Use	3.7	1.4
Financial Systems			**Inventory Planning**		
Not Develop and Not Use	57.4	54.8	Not Develop and Not Use	46.3	42.5
Develop Only	17.6	13.7	Develop Only	17.6	17.8
Use Only	21.3	28.8	Use Only	25.9	34.2
Develop and Use	3.7	2.7	Develop and Use	10.2	5.5
Strategic Planning			**Shop Floor Tracking**		
Not Develop and Not Use	34.3	24.7	Not Develop and Not Use	75.9	67.1
Develop Only	4.6	1.4	Develop Only	6.5	12.3
Use Only	19.4	6.8	Use Only	13.9	19.2
Develop and Use	41.7	67.1	Develop and Use	3.7	1.4
Data Warehouse			**Supply Chain Management**		
Not Develop and Not Use	43.5	41.1	Not Develop and Not Use	60.2	50.7
Develop Only	19.4	16.4	Develop Only	11.1	16.4
Use Only	29.6	37.0	Use Only	17.6	30.1
Develop and Use	7.4	5.5	Develop and Use	11.1	2.7
Capacity Planning			**Manufacturing Scheduling**		
Not Develop and Not Use	60.2	58.9	Not Develop and Not Use	73.1	58.9
Develop Only	15.7	13.7	Develop Only	10.2	12.3
Use Only	19.4	26.0	Use Only	12.0	26.0
Develop and Use	4.6	1.4	Develop and Use	4.6	2.7
Transportation Scheduling			**Sales and Marketing**		
Not Develop and Not Use	89.8	95.9	Not Develop and Not Use	73.1	61.6
Develop Only	2.8	2.7	Develop Only	13.9	12.3
Use Only	6.5	1.4	Use Only	9.3	23.3
Develop and Use	0.9	95.9	Develop and Use	3.7	2.7
Business Intelligence			**Customer Relationship Management**		
Not Develop and Not Use	74.1	74.0	Not Develop and Not Use	55.6	58.9
Develop Only	9.3	13.7	Develop Only	17.6	15.1
Use Only	13.9	9.6	Use Only	20.4	24.7
Develop and Use	2.8	2.7	Develop and Use	6.5	1.4