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# The Impact of ERP Systems on Business Performance: A Research Agenda

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## Abstract

The research reported in this paper aims at providing an exploration of the relationship between Enterprise Resource Planning (ERP) systems and business performance in general. Although there is a large volume of research concerning the impact of ERP systems on business performance, in many cases the conclusions are mixed and in several occasions vague. In addition, in most cases, they do not offer any practical implications or theoretical foundations. In our view, this can be attributed to the fact that certain important dimensions of ERP systems have not been considered extensively and exclusively as having an impact on firm performance. In this paper, we are especially interested in pinpointing, firstly, the special characteristics of ERP systems that contribute to their success and, additionally, differentiate them from other business information systems, and secondly, their relationship with several dimensions of business performance. In this on-going research, following an extensive search of the literature, we initially identified certain characteristics of ERP systems that seem to be related or having an impact on business performance. Business performance dimensions are also discussed and initial research questions concerning ERP systems and business performance are postulated.

**Keywords:** business performance, enterprise resource planning, ERP systems, organizational effectiveness, competitive advantage

## 1. Introduction

ERP systems are now the prevailing business information systems platform in most enterprises worldwide. Taking into account the fact that ERP research has been conducted extensively during the last twenty years, it is

rather surprising the large number of ERP systems failures reported in the last years, which had a negative or even a severe consequence on the adopting organizations. Nonetheless, the delivery of benefits from IT investments has been questioned in the past and described by the general term “IT paradox” (Brynjolfsson, 2003). There are even studies questioning the causality between IT investments and firm performance. Hu et al.(2001) for example, found no evidence to support the impact of IT investment in one period on reducing costs or increasing sales in the subsequent period. Other managerial and organizational factors related to IT/IS seem to play a crucial role for achieving company’s goals. It has been argued for, example, that human factors have a decisive role in explaining why and how enactments of information technologies change over time (Boudreau and Robey, 2005). Data and methodological problems have been blamed as the source for the contradictory results reported (Brynjolfsson, 2003). Nonetheless, the inconsistency of the findings regarding IT investment’s impact on firm performance confirms the complexity and elusiveness of the subject (Stefanou 2001, Law and Ngai 2007). It should be noted, however, that an ERP system failure is incomparable to failed standard IT projects. Failure in ERP projects, due to the pervasive nature of the software, entails not only costs but serious risks for the company as well. Firms that have abandoned of experienced failed ERP projects have also experienced lost revenue, wasted time and cost overruns (Bradley, 2008). But these failures could also have serious consequences for firm performance and even for the company existence. They could actually be a ‘bet-our-company’ type of failure, as it has been described by Brown and Vessey (2003).

In any case, there is no unanimous view concerning IT and especially ERP impact on business performance. The current research aims at shedding light in this important area of ERP literature, which has significant practical consequences, offering at the same time a ground for theory building. Specifically, based on an extensive search of the literature, we aim at identifying significant factors affecting the business performance, in order to develop a research model depicting relationships between distinctive ERP system characteristics and dimensions of business performance and encompassing as well other important control variables that seems to affect significantly these relationships.

In this endeavor we are motivated by the mixed results of previous academic work, the limited research regarding the identification of what are the important dimensions of ERP systems, the unexpected rate of ERP systems failures even in 2012, after 20 years of researching and implementing ERP systems, which deteriorates business performance. We are based on suggestions by the post implementation review (PIR) of ERP (Nicolau 2004), the DeLone and McLean model of information systems success (DeLone and McLean, 1992), the technology acceptance model (Davies, 1989, Venkatesh and Bala, 2008) and the management theory of business process reengineering (BPR) (Hammer and Champy, 1993).

The rest of this paper is structured as follows: The following section reviews the literature concerning ERP impact on business performance. Then,

the distinct characteristics of ERP software are discussed. Finally, conclusions, potential limitations and suggestions for future research are presented.

## 2. Business Performance and ERP systems

Business performance is a general term and takes a variety of forms and content according to the context it is referred to. In this paper we view company performance broadly, as having both a financial and a non-financial dimension. This is absolutely required, because ERP software has usually an impact on organizational and operational excellence which is not reflected immediately in the financial indices or in severe cost reductions. According to Beard & Sumner (2004), the use of an ERP system does not reduce business costs more than if the system had not been implemented. Most of the benefits of ERP fall under the 'added value' criterion, such as improved customer service. It can also have a positive impact on specific organizational functions, such as accounting and management (see e.g. Spathis and Ananiades, 2005). Long-term cost reductions may occur, but currently there is no clear evidence that companies can achieve a competitive advantage through cost reductions induced by the ERP system alone. On the other hand, the researchers argue that businesses can reap the benefits through the right planning of the ERP system and successful management of the ERP project, business process reengineering and post-implementation alignment of the ERP system with the organization's strategy. Stefanou (2001) has also suggested that cost reductions would be a source of competitive advantage, although these reductions do not derive from the use of the ERP system per se, but they follow the re-organization and re-engineering of business processes as a result of implementing the ERP system. This is so because in most cases, enterprises have to adapt their processes to the software's best practices, rather the other way round, due to the extreme complexity of the software and the serious risks involved in ERP implementations.

Bendoly et al. (2009) argued that the correct use of information in conjunction with operational excellence and customer intimacy can lead to an increase in strategic performance, engendering business profitability. Their research showed that most companies are planning ERP systems in cooperation with the companies that develop such systems. But few of these companies reach their goal, namely the proper implementation of systems that increases the competitive advantage. Instead, there is a decline in systems performance which is attributed to the facts that there is insufficient knowledge of the partners and ERP consultants in the design of the system, there is not a proper evaluation system installed, and the system is not often understood by the partners themselves and by users.

As far as financial performance is concerned, there are many studies reporting that ERP systems influence positively the financial performance of the adopting organization and enhances its competitive advantage (e.g. Poston and Grabski 2001, Hunton et al, 2003, Sudzina et al. 2011). Hunton et

al (2003) report the improvement of financial indices such as return on assets (ROA) and return on investment (ROI), which were significantly better over a 3-year period for the ERP adopting forms as compared to non-adopters. However, they also found that there is no difference in the improvement of financial performance between pre and post-adoption of the ERP system, a finding consistent with Poston and Grabski (2001). This however indicates a decline in the financial performance of non-adopters rather than an improvement in the financial performance because of the implementation of the ERP system.

A number of studies have been concentrated on the relationship between the operational performance and the implementation status (modules installed) of the ERP software. Madapusi and D'Souza (2012) confirmed the findings from other studies, that ERP system implementations influences operational performance.

From the above literature review, it follows that business performance in ERP environments falls broadly into three categories; financial performance, non-financial performance and competitive advantage. Financial performance refers to the short-run business performance and is measured mainly by financial indices, such as Return on Assets (ROA) and Return on Investment (ROI). Market reaction to this performance is mirrored to the company's stock price in the market. Non-financial performance, such as organizational excellence and smooth execution of business functions has a rather mid-term dimension and is measured mainly by non-financial performance indices, such as customer service and information sharing. And finally, competitive advantage refers to the long-run position of the firm in the marketplace and is measured by both financial and non-financial indices, such as the quality of information available for strategic decision making and financial indices suitable for the long-term assessment of the firm.

### 3. Characteristics of ERP software

The proposed research model presented below, includes, firstly, the main characteristics of ERP systems acting as independent variables and, secondly, specific dimensions of business performance, presented in the previous section, considered as dependent variables. In a related research, Stefanou and Athanasaki (2012), after an extensive literature review, identified the following important dimensions of ERP systems, which have been widely recognized to impact the effectiveness of an ERP system; ERP system integration, ERP implementation, Business Process Re-engineering (BPR), User satisfaction and ERP evaluation and Post Implementation Review.

The integrative nature of ERP software is probably the most important characteristics of ERP systems and this is why these systems are also called company or enterprise-wide information. The connection between the degree of ERP integration and ERP system success has been widely considered in the literature (Stefanou and Athanasaki, 2012). In their effort to support



changing and additional information needs, enterprises extend the functionality of standard ERP software with add-on systems such as Customer Relationship Management (CRM), Supply Chain Management (SCM), and Business Intelligence (BI) systems offering an integrated, web-based solution aiming at integrating all the company operations and business processes. Current research suggest that, especially in today's modern business environment, BI systems should be incorporated into ERP systems in order to understand and utilize the information flow inside organizations (Koh et al, 2011).

The implementation phase of the ERP system's life-cycle is the most researched subject in the ERP literature. Proper implementation requires the consumption of many company resources, the existence of technical, managerial, organizational and IT skills, determination to complete the project in time and within budget. A thorough requirements analysis is also essential though no sufficient. Poor implementation of the ERP system is bound to result in poor performance and can have dramatic consequences for the adopting enterprise (see e.g. Brown and Vessey, 2003). It is now a well-established fact that ERP systems implemented by nearly the same way by vendors or implementing companies, in the shortest period of time possible and with limited budgets, may result in incomplete, faulty and irreversible implementation, resulting in deterioration of business performance. This 'common systems' approach used for implementing ERP systems (Beard and Sumner, 2004) may not provide a competitive advantage; instead, the main sources for a competitive advantage could be the successful management of ERP projects, business process reengineering (see Hammer and Champy, 1993) and post-implementation alignment of the ERP system with the organization's strategy.

User satisfaction has been another concept extensively researched in the IS literature. A proper implementation may lead to ERP users' satisfaction and consequently to an increased business performance. Perceived ease of use and perceived usefulness of the systems affect users' satisfaction, which in turn influence the level of the implemented system ERP success and this can have a positive influence on the performance of the organization (Delone and McLean, 1992, Wu and Wang, 2007, Pepper et al, 2008, Venkatesh and Bala, 2008, Kanellou and Spathis 2011).

Despite its importance, the concept of the Post Implementation Review (PIR) has not received much attention by researchers. The evaluation of an ERP system is a detailed and complex activity but essential in evaluating and aligning the ERP system with the ever changing business and information requirements. The evaluation needs to examine whether the scope and planning of the implemented system are compatible and in line with the anticipated benefits (Nicolaou, 2004). PIR activities related to better system implementation planning and business process effectiveness result to a significant improvement as far as ROI and other financial ratios are concerned (Nicolaou and Bhattacharya, 2008).

Following the above findings from the literature review, we propose the research framework depicted in figure 1. Control variables affecting the

hypothesized relationships between independent and dependent variables should also be considered in the final specification of the model.

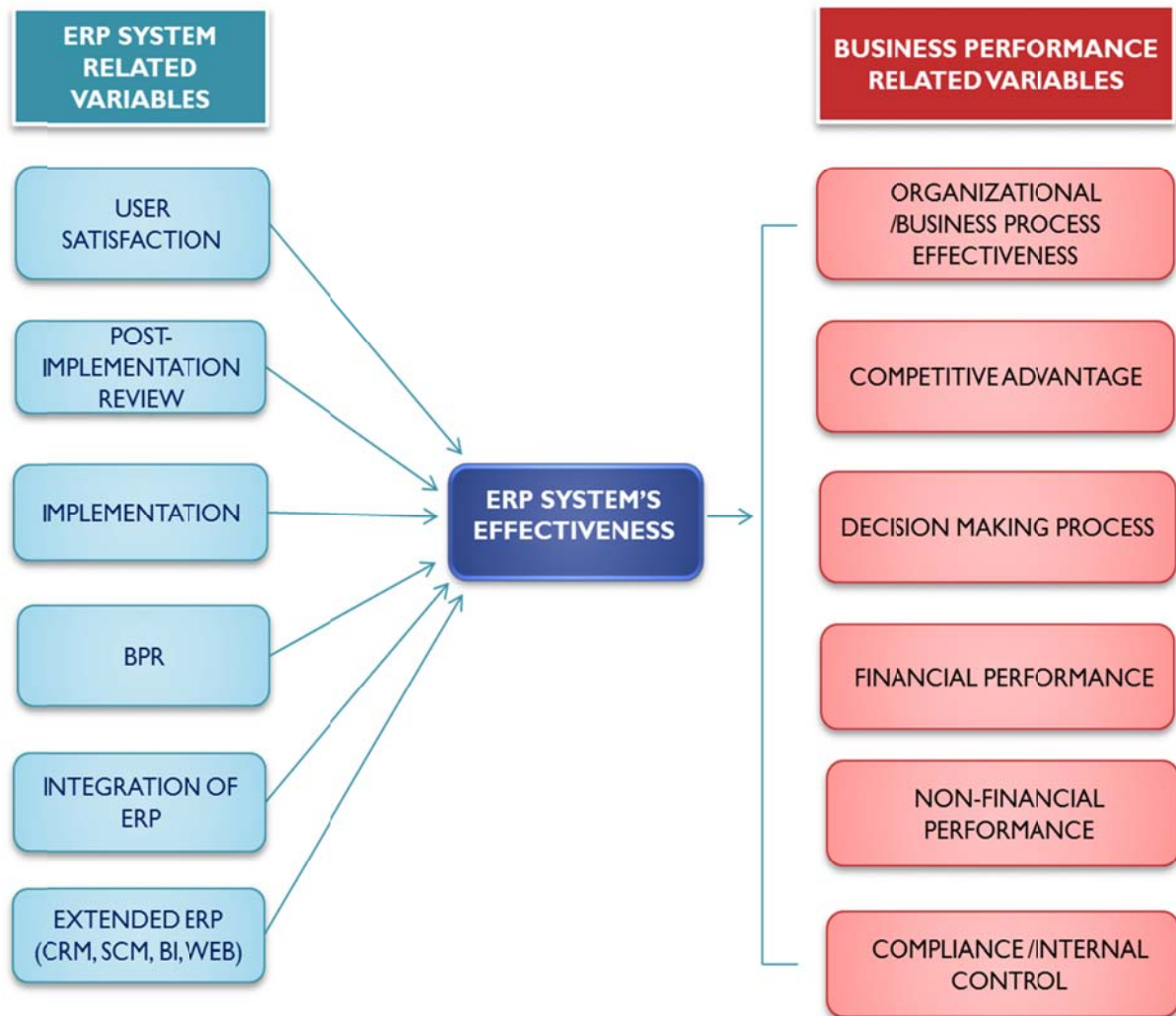


Figure 1: Research framework

## 4. Conclusions

In this paper we considered several important characteristics of ERP systems and provided a research framework of the ERP impact on business performance, which we think is worth pursuing further. Of course our research framework calls for empirical research aiming at investigating the relationships identified between the proposed variables. Several dimensions of ERP software, such as the extent of BPR performed in an organization in aligning ERP with business processes and strategy, successful implementation, user



satisfaction the extent of the post implementation review of the ERP system, the degree of ERP system's integration across business processes and the extended functionality of ERP software following the implementation of add-on systems such as SRM and CRM systems, have been identified as major characteristics of ERP software contributing to its effectiveness. In addition, dimensions of short term, mid-term and long-term business performance have been identified. Financial performance, operational excellence and competitive advantage are the three main categories embracing the dimensions of business performance and success. Up to the present state of the study, several potential limitations exist: The study has not considered the global economic environment in which many ERP adopting organizations operate. For example in SCM environments, the performance of the ERP systems is greatly influenced by the ERP systems of the other supply chain members. If the ERP systems of the members are incompatible, this would most certainly result in a reduction in ERP system performance (Chang et al. 2008) and could consequently deteriorate business performance. In addition, certain control factors identified in the literature of IS, such as the size of the enterprise, should be considered in conducting the empirical research. Also, we have not considered other interesting relationships, such as, e.g. the interaction between ERP systems and other related important managerial functions such as continuous auditing and monitoring, which could have an important effect on controlling managerial and organizational activities and reduce operating costs. Finally, we would suggest an international research in order to obtain a different sample and see if cultural differences are significant.

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## The Relationship between Internal Audit Function, Audit Committee and Corporate Governance

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### Abstract

In the last few years the concept of corporate governance has become more important than ever before because some of the recent fraud scandals (e.g. Enron) has attributed in weak governance structures. For this reason the field of corporate governance has attracted the interest of many authoritative bodies which reviewed its conceptual framework. Thus, the need for developing strong governance structures and the changes have been brought into the field of corporate governance have led many researchers to examine the new framework of corporate governance and to explore its relationship with critical functions of the organization concerning the monitoring process. The most important function of an organization related to monitoring is the internal audit function which aims to increase the quality of financial information, to ensure the transparency in financial reporting and therefore to increase the confidence between managers and shareholders. There are some important studies in the literature which tried to investigate the relationship between internal audit function and corporate governance. In this relationship the audit committee seems to play an important role, because it can be considered as a link between these two fields which improves on the one hand the internal audit quality and on the other hand contributes to the development of governance structures by monitoring the board of directors. This study tries to review the theoretical background on internal audit and corporate governance, taking into consideration the recent changes in the conceptual framework and the different aspects which have an impact on these two fields such as the audit committee. This study also presents and analyzes the results of the existing literature about the relationship between internal audit and corporate governance and draw useful assumptions and implications for further research on the topic.

**Keywords:** Internal Audit Function, Internal Audit Quality, Corporate Governance. Audit Committee, Agency Theory

## 1. Introduction

The increasing need for the transparency in the operations and in the financial reporting is of paramount importance for an organization to be successful at this unstable period for the economy. To this direction, the fields of internal audit and corporate governance have attracted too much attention by authorities and researchers (Dewing and Russell, 2004). Corporate governance defines the corporate structures within an organization, defines the relationships and responsibilities of the various parties of the organization and reassures the transparency in these relationships, whereas internal audit is considered as a tool for enhancing the transparency of financial information which is used by interesting parties of the organization. The recent great corporate scandals (such as Enron), many of which are attributed to weak corporate governance structures, have create now more than ever before the need of examination and understanding the different aspects of corporate governance and its relationship with the organization bodies which are responsible for monitoring processes, such as the internal audit department and the audit committee. For these reasons and after the recent regulations published for corporate governance and internal audit the conceptual framework of these two fields must be analyzed and the relationship between corporate governance and internal audit must be examined in order the critical points of this relationship to be highlighted

Although there are a significant number of studies which explore the relationship between internal audit and corporate governance, there are still some critical factors of this relationship which needs to be identified and reviewed. In spite of the fact that by reviewing the literature, it can't be supported the existence of one specific straightforward model of corporate governance, there are studies that intended to explore the factors which improves the corporate governance. In the majority of these studies, it is stated that there is a positive relationship between the internal audit and corporate governance (Paape et al., 2003; Krishnan, 2001; Suyono and Hariyando, 2012; Sarens and Abdolmohammadi, 2011) whereas some other studies raise doubts about this relationship (Regoliosi and d'Eri, 2012; Goodwin-Stewart and Kent, 2006). The present study tries to analyze and present the theoretical background and the recent changes in the fields of internal audit and corporate governance and also to examine the relationship between the internal audit and corporate by reviewing the literature, taking into considerations the different aspects of these two fields. Furthermore, it is an attempt to draw important assumptions about the interaction of these two fields and to set a framework in which the relationship of corporate governance and internal audit could be investigated in the future.

## 2. Theoretical background

### 2.1 Internal Audit

Taylor and Glezen (1991, p.2) generally defines auditing as “a systematic process of objectively obtaining and evaluating *evidence* regarding *assertions* about economic actions and events to ascertain the degree of correspondence between these assertions and established criteria and communicating the results to interested users”. The above definition can be separated into different actions that have to be done by the staff of the Internal Audit department throughout the auditing process. By analyzing these actions, the most important for an auditor, according to the definition, is firstly to objectively obtain the evidence concerning economic transactions, second to compare this evidence with the generally accepted criteria, rules and regulations which is applied in each company, and finally to present the report of this process to everyone who is interested, from the internal or the external environment of the company. From the early stages of economic history there is a rising need for companies of all kind of sizes to control their transactions and their economic relationships in their internal or external environment. That is the need of stakeholders and shareholders to have a clear and realistic image of the organization’s financial and non-financial operations in order to achieve better performance.

The audit can be defined as external or internal, according to the reason for which the audit is conducted. The external audit focuses merely on checking the validity of a company’s financial statements and is conducted by independent external auditor. This study deals with the internal audit which is conducted by the employees of the Internal Audit department of the company and is defined as a function which is conducted within the organization in order to control and evaluate the company’s operations and add value to the organization (Taylor and Glezen, 1991). More specifically internal control is the process throughout which internal auditors examines the efficiency of operations, the validity of financial statements and the organization’s conformity to the laws and regulations (Messier, 1997). The report of COSO (1992) recognized five parts which constitute the internal control process and are interrelated: control environment, risk assessment, control activities, information and communications, and Monitoring. The Committee of Sponsoring Organizations of the Treadway Commission (COSO) published in 1992 a report named *Internal Control – Integrated Framework* with a view to help auditors to meet the new requirements in internal audit and contribute to the improvement of the audit quality. For this reason, it analyzes the internal control into five components, each one of which has a great importance in the internal control process. Control environment refers to the human resource of the company and the ways that organization influences their control behaviours, such as moral values or qualifications of the employees. Risk assessment deals with the identification and evaluation of organizational risk and how this risk can be addressed while Control activities are more operational activities such as separation of tasks or review of performance. As



concerns of information and communication, this component means the way that reports and any kind of data are communicated within the organization or to the external environment. Finally, monitoring refers to the evaluation of the effectiveness of the internal control system by the professionals or by regarding everyday operations (Lindow and Race, 2002).

The need for auditing has been made even more important in the recent years of financial crisis and also after the recent auditing scandals which led large companies to financial disaster (Messier, 1997). Despite the fact that, the existence of Internal Audit department is not mandatory in every company, organizations seems to understand the benefits of internal audit not only for the everyday operations, but also for management and organization's governance matters (Goodwin and Seow, 2002). Companies have now the tendency to invest on internal audit, after the recommendations of several authoritative committees (COSO Report, 1992), in order to enhance their control activities. In consistency with the above there are some researchers' studies in the literature, such as Beasley et al. (2000) who has concluded that organizations which suffered from financial misstatements and financial fraud, are more likely not to have applied internal audit function.

## **2.2 The value-added role of Internal Audit**

Many changes have been brought into internal audit over the last years. The application of new rules and regulations concerning internal audit, the evolution of new technologies and the need for more intensive and continuing auditing by companies have resulted in many changes, not only in the function of internal audit but also in the role of internal auditors and the scope of internal audit. In 2004, the Institute of Internal Auditors reviewed the definition, the meaning and the objective of internal audit in order to give directions to internal auditors. In the reviewed definition it is highlighted a more holistic and managerial approach for internal audit and internal auditors rather than the previous widely established opinion that internal auditors are strictly restrained to internal control activities. In this new approach, the consulting role of internal audit with view to business strategic matters is emphasized. It is also stated that internal audit is a service that adds value to an organization and contributes to the achievement of the corporate goals. The new expanded scope of internal audit also focuses on the contribution of internal audit to the addressing of risk management and corporate governance issues (Hass, et al., 2006).

One of these recent regulations that had an impact on the internal audit function is the Sarbanes-Oxley Act (SOX) in 2002. The SOX imposed stricter rules concerning organizations' internal control system and its evaluation and this fact has led companies to spent resources for the improvement of their internal control systems in order to comply with the new regulations (Agrawal, et al., 2006). According to a survey of PWC (2006) on auditors, it is stated that almost the half of USA companies' internal audit resources were used to meet SOX control requirements. This means that there is the need for companies to

review their internal audit systems in order to allocate their resources in a way that contributes to the achievement of corporate goals.

Defining the reviewed scope of internal audit, Bou-Raad (2000) stated that it is the most important function that serves the information needs within an organization with respect to corporate governance matters. The fact that internal audit act interactively with the other control bodies of an organization as a function of monitoring, along with its consulting role through which adds value in an organization, has established internal audit function as one of the most important factors that define and improve corporate governance structures. Thus it can be regarded as an independent service for an organization, the value of which can be measured as being a kind of “intangible asset” (Regoliosi and d’Eri, 2012). Summarizing this transition from the traditional internal audit approach to a more progressive approach, it can be stated that internal audit tends to be more business-oriented rather than audit-oriented and this means that the reference point is the customer and not the financial statements of the organization. The involvement of the internal audit process on the risk management practices of the company is another trend which is resulted from the changes. Generally, it can be said that the internal audit function tends to comply with corporate strategies and objectives instead of just dealing with transactions and compliance with regulation (Lindow and Race, 2002).

### **2.3 Internal Audit Quality**

Researchers have put much effort on exploring ways of measuring the effectiveness of internal audit and defining the term “Internal Audit Quality”. It is obvious that due to the intangible nature of internal audit function, it is difficult for the organization to evaluate the quality of internal audit and to measure the contribution of audit service to the company (Regoliosi and d’Eri, 2012). However, the great importance of internal audit created the necessity for academics and stakeholders of investigating ways in order to assess the effectiveness of internal audit function within the organization. Taking into consideration the consulting role of internal audit and its contribution to corporate governance matters, it is important to analyze the different mechanisms which defines Internal Audit Quality and to assess the effectiveness of internal audit to the organization taking into account the different aspects of this function. DeAngelo (1981), defines audit quality by separating the internal audit activity into two stages; first, the auditor may detect an irregularity on financial statements of an organization and second may report these irregularities. In these terms, audit quality depends on the one hand in the abilities of the internal auditor and the extent of the audit and on the other hand on the degree of auditor’s independence in order to be able to report the findings of the audit (O’Sullivan, 2000). Davidson and Neu (1993) in their definition for audit quality also relate the audit quality with the competences and the expertise of the auditor while Palmrose (1988) defines audit quality as the possibility that financial statements do not include irregularities after the completion of the audit function. From the auditor’s point

of view, the quality of audit can be measured in terms of compliance with accounting and auditing standards or can be evaluated by measuring the auditees' satisfaction (stakeholders and shareholders) (Al-Ajmi, 2009).

There are a number of studies in the literature that have tried to identify and analyze the different factors that determine audit quality. In one of them, Carcello et al. (1992) present 12 factors that are considered by auditors and users of financial statements as determinants of audit quality, the most important of which are the firm size, the composition of the audit team, the compliance with accounting standards, the involvement of audit committee, auditor's personal responsibility, the involvement of company's executive and compliance with the organizational needs. In another study, Eichenseher and Shields (1983) state that the quality of audit is the result of the interaction of 11 factors, according to the financials managers' perceptions. The most important of these factors are moral standards, auditor's expertise, auditors' fees, technical competencies, employees' relationships in the organization, frequency and deadlines of audit team's meetings and communication with the audit team (Al-Ajmi, 2009). More specifically, concerning the quality of the internal audit function, Regoliosi and d'Eri (2012) in their study identify and present some of the most important indicators of the effectiveness of Internal Audit Departments drawn by more recent studies in the literature. First of all, it is the hierarchical position of the internal auditor within the organization as well as the independence that can assure the effectiveness of the internal audit function. Experienced and skillful employees of the Internal Audit department, in order to assess the audit techniques and to reassure management for the efficiency of the internal audit function. A high ratio between the auditors and the total employees of the organization seems to be a crucial indicator for internal audit quality according to Sarens and Abdolmohammadi (2011). In addition, formal methods of assessment of the audit function may be applied in an organization, such as Quality Assessment Review (QAR), otherwise the assessment may be based on Key Performance Indicators or surveys among the company's personnel. Another important indicator is feedback and comments provided the auditees concerning the effectiveness of the internal audit function. Furthermore, with a view to the consulting and value-added role of internal audit, the percentage of time that is spent for consulting services must be taken into consideration in the assessment of internal audit function.

## 2.4 Agency Theory

The need for auditing in an organization is attributed by many researchers and academics to agency theory which refers to the contradictory interests of managers and shareholders with a view to corporate governance. These conflicts result to agency costs for management which can be reduced with the existence of internal audit and the disclosure of information about financial statements in the interested parties (Clatworthy and Peel, 2013). Agency theory is defined by Berle and Means (1931, p.7) as "the separation of ownership from control which produces a condition where the interests of

owner and of ultimate manager may, and often do, diverge, and where many of the checks which formerly operated to limit the use of power disappear" (Paape et al., 2003). According to this theory, an organization influenced by the conflicts between the owners of financial resources (principals) and the managers who are charged with using and managing these resources (agents) (Jensen and Meckling, 1976). This theory states that both the shareholders and the managers act in a way that can maximize their wealth. Consequently, there are occasions where the interests of those two parties are not to the same direction and the conflicts between principals and agents are unavoidable. In such occasion the management of the company may act in a way that while it serves their own financial needs, at the same time it may contradicts the interests of shareholders. These kind of dilemmas for management called "moral hazard problems" (Adams, 1994). Another assumption of the agency theory is that managers have easier and more direct accessibility to company's financial information than the shareholders have. This asymmetry of information results in a problem which called "adverse selection" and means the inability of owners to know if managements' decisions serve appropriately the owner's interests. The ideal situation between the two parties occurs when none of them can act at the expense of the other and this is known as "pareto-optimality". In order to achieve a state of "pareto-optimality", both managers and investors experience contracting costs. On the one hand managers implement internal audit activities in order to provide financial information to shareholders and reassure them that they manage the firm effectively and on the other hand shareholders employ external auditors in order to monitor management's action. According to the above, it is obvious that internal audit contributes to the reduction of information asymmetry and therefore to the alleviation of the conflicts between principals and agents (Sarens and Abdolmohammadi, 2011).

## 2.5 Corporate Governance

The agency theory and the principal-agent problem makes the meaning of corporate governance very crucial for an organization because with the appropriate structures and policies of corporate governance, a better communication between management and ownership can be achieved and the interests of both parties can be towards the same direction (Rustam, et al., 2013). Corporate governance mechanisms can act as a tool of protecting investor's interests and also can result in a stable market environment within an organization and can contribute to the market development as a whole. Additionally, the implementation of appropriate corporate governance structures will decrease the agency costs which are the result of the principal-agent problem. This is enhanced by Core et al., (1999) who states that organizations which don't invest in corporate governance have higher agency costs and their managers' personal interests seems not to be in line with the organization's interests. Corporate governance is defined as a nexus of procedures, policies, laws and regulations which play important role in the way that an organization is governed and controlled, determine the

relationships between the management, the ownership and the other interested parties of the organization and also sets the corporate goals (Broni and Velentzas, 2012). The aim of the corporate governance is that the organization will be directed under specific structures throughout which every party of the organization, such as board of directors, managers, employees, suppliers, customers and others will be benefited and their interests will be served. It is also important that corporate governance structures for an organization must, at the same time comply with each country's formal laws and regulations and the generally accepted accounting principles as well as with the ethical standards and the cultural differences.

According to Broni and Velentzas (2012) corporate governance includes two different concepts; the long term concept concerning the relationship and communication between managers and shareholders for a productive cooperation and the financial relationship between the two parties which is based on structures of corporate governance, rules and regulations in order to achieve a high level of information disclosure and transparency and therefore mutual confidence in their transactions. There are five elements which constitute corporate governance and they are presented by Hart (1995) as the different aspects of corporate governance which must be taken into consideration when corporate governance is structured. These items are about organization's internal environment such as long term strategic goals and human resources and the external environment such social responsibility, relationship with suppliers and customers and compliance to rules and regulations. Generally, there are two basic different models of corporate governance depending on the country and the composition of the company's authoritative boards. In the "Anglo-American" model there is a single board of directors which is constituted of both executive and non-executive members who are chosen by the shareholders. Non-executive members are usually more than executive ones and constitute the audit committee which is a board responsible for corporate governance matters. In the rest of Europe a two-tiered model of corporate governance prevails. According to this model there are two different boards; the Executive board which is composed by executive members of the company and the Supervisory board which is composed by non-executive members who represent the shareholders and have similar rights and responsibilities to the audit committee (Broni and Velentzas, 2012). The crucial importance of corporate governance is confirmed by the recently increasing concern of authoritative bodies which provide organizations with guidelines and regulations about corporate governance to which companies must adhere in order to be benefited. The Organization for Economic Cooperation and Development (OECD) proposed in 2004 six principles concerning corporate governance. The first principle states that corporate governance must be built upon a framework of laws and regulations imposed by the authorities. It is emphasized the need for protection of shareholders' rights as well as the equitable treatment of shareholders. Another issue that is highlighted is also the role and the rights of stakeholders within the governance structure. Timely and valid Disclosure of financial information and



transparency on financial reporting are also a matter of concern in concerning corporate governance structure. Finally, it is of great importance the role and the responsibilities of the board of directors and its control mechanisms for the management and the shareholders (Robertson et al., 2013)

## 2.6 The Audit Committee

The audit committee is a subcommittee of the board of directors which plays a very important role in corporate governance mechanisms and the internal audit function by monitoring managers' activities concerning financial disclosure in order to protect shareholders' interests (Sarens and Abdolmohammadi, 2011). According to a survey of the Canadian Institute of Chartered Accountants (CICA) in 1981 amongst organizations' executives, directors, auditors and chairman of audit committees, there are five aspects concerning the responsibilities and objectives of audit committees. First of all, the audit committee must help the board of directors in governance matters especially those concerning financial reporting. The audit committee must also facilitate the communication and the cooperation between the board of directors and the external auditors while at the same time it must reassure the independence of external auditors in their audit work. Probably the most important objective of the audit committee is to enhance the validity of financial disclosure and to guarantee the transparency in financial reporting. Finally it aims to enhance the position of outside directors by improving the relationship and the communication between outside directors, company's directors, managers and auditors (Green, 1994).

The audit committee has attracted the interest of many researchers who recognize it as one of the most important elements of corporate governance. In order to improve the efficiency of audit committees, KPMG in 2006 published a report which proposed five guiding principles for audit committees. The first principle is that there is not a specific structure and size of audit committee which are effective for all organizations but it depends on each company's needs. The selection of the right members who constitute the audit committee is also a determinant factor of its effectiveness. Monitoring and controlling are the first priorities of the audit committee, with the right "tone at the top". The audit committees' monitoring procedures must intent to ensure the transparency of financial reporting. And finally it is obliged to form the relationship between the external auditors and the company's boards which is the board of directors and the audit committee (Al-Ajmi, 2009). In addition the Sarbanes-Oxley act in 2002 published another six obligations for audit committees with a view to the audit function and corporate governance. Concerning the composition of the audit committee the Sarbanes-Oxley act stated that it must be constituted exclusively by independent non executive members coming from the board of directors. Audit committee is also completely responsible for the selection and the monitoring of external auditors as well as for the audit fees. It also has the right if it is needed to ask the contribution of outside advisors. Companies must provide to the audit committees the necessary economic resources in order to reach its



objectives. The audit committee must be informed by auditors about the company's accounting policies and the auditing methods. Finally, it is recommended by the Blue Ribbon Committee (1999) that an annual report published by the audit committee must be included in the company's financial reports (Rezaee et al., 2003). However, in spite of this increasing concern and the recently published guidelines and regulations for the audit committees, Cohen et al., (2002) found in their study that audit committees, according to auditors perceptions, don't have the expertise to reach their objectives and to communicate effectively with auditors and the board of directors.

### **3. Literature Review on the topic**

#### **3.1 The Relationship between Internal Audit Function and Corporate Governance**

The recent changes and the review of regulation from many authoritative bodies concerning corporate governance and internal audit, and also the great concern of companies for these topics have drawn the attention of many researchers to examine the relationship between corporate governance and internal audit function. The study of Paape et al. (2003) provides some indicative results about the perceptions of auditors concerning the relationship between corporate governance and internal audit. In this study, it is stated that 40% of the respondents believe that one of the most important factors in implementing the internal audit function is corporate governance. It is more important the fact that 79% stated that changes in corporate governance will redefine the role and the responsibilities of the internal audit function. Another remarkable result in the study is that a very high percentage of auditors (93%) believe that one of the most important objective of the internal audit function harmonization with company's policies rules and regulations. In the study of Cohen et al. (2002), auditors as a part of the internal control system of a company, are considered as important players in the corporate governance field. In the same study, the association between the audit process and the corporate governance is enhanced by the fact that weak corporate governance structures seems to cause a decrease in the quality of financial information reported and even to result in financial fraud. The above is also in consistence with Krishnan's study (2001) who stated that problems in internal audit function are related to weak governance structures. According to the above and taking into consideration the reviewed management-oriented scope of internal audit it is obvious that corporate governance mechanisms can influence the planning and the implementation of internal audit. Thus, it is important for the organizations to develop strong governance mechanisms which ensure an effective monitoring process and also it is important for the auditors to examine and capture these corporate governance structures in developing the audit function in order to be efficiency and effective (Cohen et al., 2002).

There are also studies in the literature which have examined adversely the same relationship and showed that internal audit function has a positive effect

in improving the corporate governance structures. Suyono and Hariyando (2012) in a more recent study examined the association of corporate governance with internal control, internal audit and organizational commitment. The results showed that internal control and internal audit function have a positive significant relationship with good corporate governance. In the study of Sarens and Abdolmohammadi (2011) the results showed that the size of companies' internal audit departments and therefore the internal audit plan, depends on the various elements of corporate governance such as the obligation of the existence of internal audit department, the percentage of the outside directors in the board of directors or the control environment. Regoliosi and d'Eri (2012) in their study tried to examine the relationship between the various elements of corporate governance and the quality of internal audit departments. The results of their survey did not clearly proved the relationship between the two fields, because while some of the corporate governance elements seems to be positively affect the internal audit quality, it is not proved for all the variables of corporate governance that reflect an effective internal audit. In line with the above study is also the survey of Goodwin-Stewart and Kent (2006) that did not find a strong support for the relationship between internal audit and "good" corporate governance.

### **3.2 Audit Committee and Corporate Governance**

After the recent regulations for the audit committee concerning the mandatory publication of reports about the achievement of its objectives, it was expected the audit committee to contribute even more to the improvement of corporate governance by facilitating and reassuring the transparency of financial reporting (Rezaee et al., 2003). However, there is no straightforward relationship between the creation and activity of the audit committee and specific corporate governance structures. The association of audit committee with corporate governance characteristics and internal audit function provide important evidence that with the creation of audit committees some weaknesses in corporate governance can be handled but this fact can not be generalized in terms that the adoption of audit committees will result in specific corporate governance strictures (Turley and Zaman, 2004). While, it have been expressed the opinion that the creation and the activity of the audit committee has a symbolic role in the organization, there are a number of studies that recognize the contribution of the audit committee to the corporate governance. Knapp (1987) had highlighted the importance of the audit committee as a connection between the auditors and the management. In a more recent study, Abbott et al., (2000) concluded that an effective and independent audit committee can contribute in the improvement of financial disclosure quality. In other studies the determinants of the adoption of audit committees are investigated, such as Klein (2002b) who found that the adoption of the audit committee is depends on the elements associated with corporate governance. In investigating the independence of the audit committee, it is also stated that it is affected by the corporate governance

structure, considering the management-oriented nature of the audit committee controls (Regoliosi and d'Eri, 2012).

#### 4. Conclusion

Internal audit function is one of the most important functions in the organization because it is considered as a valuable tool for increasing the financial information quality and ensuring the validity of financial reporting. At the same time, in developing a strong corporate governance structure, according to the agency theory, it is important to alleviate the possible conflicts of interests between management and company's shareholders which is caused by the asymmetry of financial information between these two parties. This asymmetry of information can be handled with the contribution of an effective and independent internal audit function which provides the needed financial information to both managers and shareholders in order to improve the level of confidence between each other. The consulting role of internal audit, its new management-oriented scope and the consideration that it adds value to the organization, as it is stated in the Sarbanes-Oxley Act (2002), enhance the role of internal audit in corporate governance matters and makes it an important player in developing a strong governance structure. Furthermore, the audit committee seems to play a very important role in this relationship because it can be considered as a link between the internal audit function and the corporate governance mechanisms. Some of the most important responsibilities of an independent and effective audit committee is to participate in the audit planning and to monitor the audit work and also to monitor the activity of the board of directors which means that it has an impact on defining corporate governance structures.

By taking all the above into consideration and with view to future research, the relationship of internal audit, audit committee and corporate governance could be further investigated. More specifically it could be interesting for researchers in the future to explore the impact of internal audit function and audit committees on the corporate governance. As it is mentioned above it is difficult to evaluate the effectiveness of these three concepts due to their intangible nature. For this reason, the way which is proposed in literature (Regoliosi and d'Eri, 2012) in order to evaluate the benefits resulted from these intangible concepts is to examine the input variables of these concept rather than the output variables. Thus, in such a research the internal audit function could be evaluated in terms of quality, considering the determinant factors of the quality, as it is analyzed in previous section and the audit committee could be evaluated in terms of effectiveness regarding also its critical factors (such as number of committee members, number of meetings annually or member's financial expertise).

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# The Effectiveness of Accounting Information Systems on Managerial and Firm's Financial Performance - Empirical Evidence from Greek SMEs in Hotel Industry

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## Abstract

The necessity of exploring and the difficulty of measuring Information Systems (IS) effectiveness led many researches to find out a quite corresponding surrogate. User satisfaction was used at large extent by researchers in order to capture the effectiveness of IS while the construction of an adequate measurement has been developed by many studies. Accounting Information Systems (AIS), considered as a valuable tool for managers in order to optimize their decision making and for firms with a view to obtain competitiveness and profitability, have to be effective. In hotel industry where competition intensity is severe and the need for exploitation of high quality financial information is demanded, effective AIS can be crucial for achieving enhanced individual and organizational performance. The purpose of this study is to fill this gap in literature, exploring the significance of AIS effectiveness in relation to managerial and financial performance, combining particularities of accounting information with IS literature under the specificities of Small and Medium Enterprises (SMEs) in a too competitive environment, as is Greek hotel industry. The results show that effective AIS strongly suggests positive impacts on managerial and financial performance while the longer is the time period that AIS is implemented by a firm, the greater will be the benefits in individual and organizational level.

**Keywords:** Accounting Information Systems, User Satisfaction, Individual Impact, Organizational Performance, Hotels

## 1. Introduction

Information Technology (IT) emerged and induced in business environment, resulting as an important tool for firms in order to achieve high competitiveness and thus, profitability. Serious investments in IT were made by firms aiming at achieving greater quality, accurate and timeless information for decision making, monitoring and lowering operations-related costs and increasing their financial performance. According to resource-based view theory, a firm can create a competitive advantage, exploiting its corporate resources which have to be valuable, rare, difficult to imitate, and non-

substitutable (Barney, 1991). IT can create this desired competitive advantage for firms if they transform their business into high information intensity establishments (Calderon, et al. 2001). The use of IT within organizations was extended and nowadays, the largest portion of them can not operate without the existence of Information Systems (IS). The objective of an IS is to accumulate, save, process and report data in order to provide the information necessary for managerial decision making, based on the definition given by Hicks (1993).

As far as IT has involved in business procedures, accounting was one of the first firm's functions that had been computerized. All the manual accounting activities, with the use of IT, were computerized and the adoption or the implementation of an Accounting Information System (AIS) was judged as necessary for a firm in order to survive in competitive environments. AIS can be characterized as a subsystem of a Management Information System (MIS). AIS, defined by Nicolaou (2000, p.91), is "a computer-based system that processes financial information and supports decision tasks in the context of coordination and control of organizational activities". Moreover, design and operation of AIS have to meet specific legal requirements in order to correspond to the needs of external and internal users (Stefanou, 2006). In general, AIS can be seen either as a conventional information system or as an Enterprise Resource Planning (ERP) financial subsystem. Although ERP systems contribute significantly to different business functions in relation to conventional AIS, both are highly beneficial in information generating and financial reporting (Spathis, 2006).

The adoption of AIS has changed all the typical accounting activities. In the past, an accountant used to make manual calculations and hand-write financial statements. With IT, there was a serious enhancement in accounting tasks and the process of closing accounts, reduction of errors and recovering quicker valuable information and a significant increase in staff efficiency related to the manual bookkeeping. The main objective of AIS is to provide all that useful information for the needs of financial managers in order to optimize decision making and control and so, improve their firm's financial performance. Information generated by AIS can be either financial or managerial. The first one concerns financial statements (balance sheets, income statement, statement of changes in equity and statement of cash flows) while the second one refers to cash and operating budgets, performance reports, cost management and reporting systems, responsibility and profitability reporting systems (Nikolaou, 1999). Direct and on-time information sharing to internal and external environment, computerization of the accounting procedures, standardization of financial statements, constant and direct feedback on firm's financial performance, reduction of operational expenses and more available working time for accountants can be gained from implementing AIS. At organizational level, AIS can improve functionality, increasing timeliness, accuracy of accounting information, and enable faster processing and better external reporting (Ghasemi, et al. 2011).

A large portion of literature made efforts to explore the success of implementing an IS, or in other words its effectiveness. According to Hosnavi and Ramezan (2010, p.30), effectiveness is defined as “outcomes, consequences and results, and represents a synonym for success, since being effective means achieving the outcomes and results initially planned for”. Although that it would be quite interesting to find a single dimension of measuring IS success, the difficulty of finding an objective one led to different approaches. Research on IS success, and thus effectiveness, has been focused mainly on two research theories, user satisfaction literature and technology acceptance model. A widely used surrogate of IS effectiveness is user satisfaction while its measurement was based mainly on the DeLone and McLean IS Success Model. Based on Aggelidis and Chatzoglou (2008), the success of an IS can be evaluated in terms of the quality of information provided to users, the impact of IS on users’ performance and the impact of IS on organizational costs and benefits. In case of AIS, except of certain studies which evaluated its effectiveness mainly in terms of its use, there is a gap in combining accounting information and information systems characteristics. Accounting information quality is examined widely in order to explore whether the needs of users (financial accountants and managers) are satisfied and its impacts on managers’ job performance.

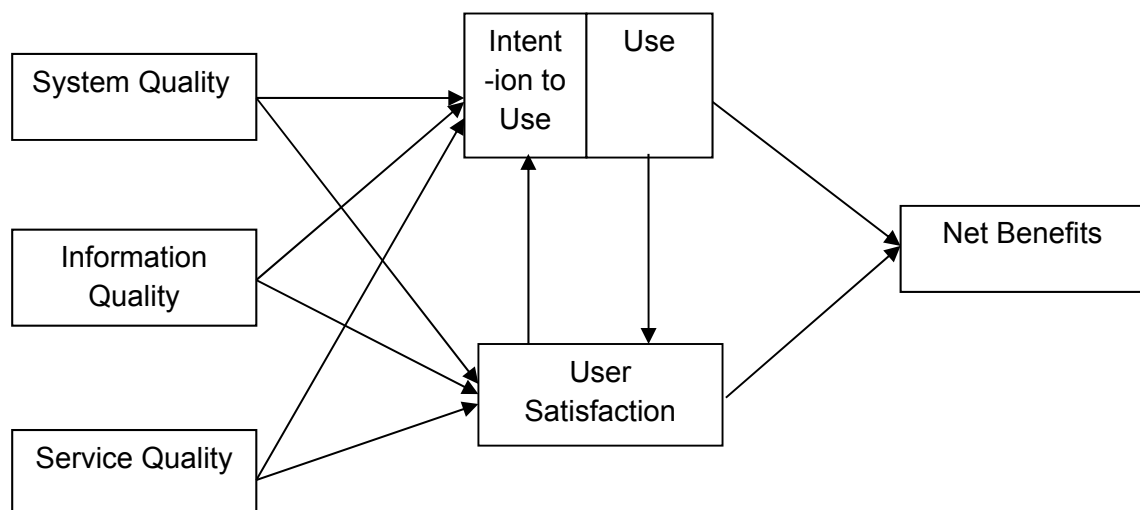
Wide range of empirical studies were undergone based on IS Success Model of DeLone and McLean examining whether user satisfaction is affected by system quality and information quality. However, little has been done in exploration of the organizational benefits that a firm can achieve under IS effectiveness or else user satisfaction. In the case of AIS, the majority of studies explored the gains under the use of these systems. Few researches made serious attempts in the field of AIS effectiveness, creating an unexplored ground for its impacts on individual and organizational level. The purpose of this study is to fill this gap in literature, exploring the significance of AIS effectiveness in relation to managerial and financial performance, combining particularities of accounting information with IS literature under the specificities of SMEs in a too competitive environment, as is Greek hotel industry. Our theoretical development and the construction of a reliable and valid instrument in order to measure our main variables were based mainly on the updated model of DeLone and McLean (2003) and the results of previous contributions in IS literature.

## **2. Literature Review**

### **2.1 Information System Success: Effectiveness, Individual Impact and Organizational Performance**

Since serious portion of resources have been spent in IT systems for achieving better financial results, firms want to achieve high IS effectiveness in order to support their operations, achieving their goals. In post

implementation period, user satisfaction of IS and its contribution to management and firm's performance have to be evaluated. Many authors tried to discover how success and effectiveness of an IS implementation can be measured. The DeLone and McLean IS Success Model, proposed in their study (DeLone and McLean, 1992), resulted to be one of the most valuable tools for researchers to undergo their approaches. They managed to classify IS success into six categories: system quality, information quality, use, user satisfaction, individual impact and organizational impact. These dimensions demonstrate that information produced by an IS is communicated to a recipient through its use or consumption, who may be influenced or not and thus, may affect organizational performance. System quality is referred to the characteristics of IS itself and information quality to the quality of product generated by the system. The typical measures of this field include system stability, acceptable response time, a user-friendly interface and ease of use (Wu and Wang, 2006). Information quality, or else data quality, represents measures of IS product. Usual measures include accuracy, precision, currency, timeliness and reliability of information provided (Pitt, et al. 1995). DeLone and McLean (2003) proposed, based on their literature reviews, an updated IS Success model (Figure 1). They suggested that a third dimension has to be added, service quality, to those affecting user satisfaction. Service quality can be evaluated at the extent of how well service is delivered to the user-customer and whether it meets the user's expectations. They also include another dimension, intention to use, measuring that way user attitude. Moreover, based on their review, they suggest that a positive experience with usage (level of utilization) will drive to higher user satisfaction. Finally, they collapsed individual and organizational impact into a construct named net benefits.



**Figure 1.** DeLone and McLean (2003) updated IS Success model

It is generally accepted that it is difficult to measure objectively IS success and so surrogates were widely used in order to approach it. The most common used are user satisfaction (Gatian, 1994; Seddon and Kiew, 1996), end-user computing satisfaction (Doll and Torkzadeh, 1988) or else user

information satisfaction (Nicolaou, 2000) which can be defined as “the extent to which users believe that the information system available to them meets their information requirement” (Ives, et al. 1983, p. 785). In any case, all of them demonstrate that the success of an IS is based on the satisfaction of IS user. However, there are criticisms about this establishment. Melone (1990) noticed that an IS can be effective even if there is no satisfaction from user, whose job is directly linked with the system. Al-Maskari and Sanderson (2010) emphasized that there is a complexity around the definition of user satisfaction mainly because of its subjectivity. In their study, they suggested that several factors such as system effectiveness, user effectiveness, user effort and user characteristics may affect user satisfaction.

Several researchers tried to construct a representative instrument in order to measure user satisfaction. Etezadi-Amoli and Farhoomand (1996) noticed that even this IS success surrogate present difficulties in measuring because of the confusion between the beliefs about characteristics of a system and the attitudes towards a system or towards using it. Because of this difficulty, numerous studies appeared using technical characteristics such as system accuracy, system timeliness, volume of output, information accuracy and relevance, presentation format and service quality in order to construct a reliable user satisfaction measure (Au, et al. 2002). Though, they mentioned that this assumption could be a limitation on measuring user satisfaction because it cannot evaluate the psychological reasons of user's satisfaction or dissatisfaction with an IS. This approach is consistent with the view of Tessier, et al. (1977, p.384) who suggest that user satisfaction is a concept that may be “may be both intellectual and emotional”. Although it would be easier to measure user satisfaction with a single-item rating scale (Vlahos and Ferratt, 1995), this can be characterized as unreliable due to the fact that it can not provide evaluation for the specific characteristics of the system with which users are satisfied or not (Ives, et al. 1983). Thus, the largest portion of studies tried to construct a reliable multidimensional measure of user satisfaction. However, the study of Seddon and Kiew (1996) confirmed that information quality, system quality and usefulness are indicators of user satisfaction while McGill, et al. (2003) reconfirmed that the first two dimensions can explain a large proportion of its variance. Guimaraes and Igbaria (1997) measured user satisfaction based on a ten-item instrument in terms of information characteristics and system quality. Hosnavi and Ramezan (2010), in order to overcome the difficulty of measuring user satisfaction, examined IS effectiveness, exploring the satisfaction of users on information quality, system quality and system use. Doll and Torkzadeh (1988) measured user satisfaction based on five factors, using questions about information and system quality: information content, accuracy, format, ease of use, and timeliness. Their twelve-item instrument was the basis for other researchers (Igbaria and Tan, 1997; Gelderman, 1998).

DeLone and McLean IS Success Model suggested that user satisfaction affects individual impact. Gelderman (1998) denoted that user satisfaction can

influence managerial performance if information generated by the system meet the requirements of managers. Individual impact is an indicator of user's better understand of decision framework, improvement of decision-making, change in user's job or change of decision-maker's perception of IS usefulness (DeLone and McLean, 1992). Hou (2012) suggested a more comprehensive approach, suggesting that individual performance impact refers to the actual performance of an individual using an IS. Based on review of DeLone and McLean (2003), individual impact was evaluated in relationship with user satisfaction mainly in terms of job and decision-making performance. Williams and Hazer (1986) described job satisfaction as employee's emotions and responses to the attributes of his job. Igbaria and Tan (1997) measured individual impact by decision making quality, performance, productivity and effectiveness of the job. Finally, the majority of researches supported that user satisfaction has a strong positive effect on individual impact (Igbaria and Tan, 1997; Guimaraes and Igbaria, 1997; Etezadi-Amoli and Farhoomand, 1996; Jurison, 1996; Torkzadeh and Doll, 1999; McGill, et al. 2003; Gatian, 1994; Hou, 2012).

The main goal that a firm has to focus on is to achieve high performance in financial terms. Based on the updated DeLone and McLean IS Success Model (DeLone and McLean, 2003), user satisfaction may lead to net benefits. Using this term, both individual and organizational performance can be included. DeLone and McLean (1992, p.74) define organizational impact as "the effect of information on organizational performance". Organizational impact represents the effect of information in terms of contribution to achieving goals, cost/benefit ratio, overall productivity gains and service effectiveness (Ismail, 2009). Due to the impact of external factors on firm's performance, perception of IS users on the impacts of system on firm's financial state was used by studies in this field (Chatzoglou, et al. 2011; Kivijirvi and Saarinen, 1995) in order to avoid potential undesirable effects. Gelderman (1998) included in his instrument two financial measures, revenues and profit while Udo (1992) examined the impact of the use of a decision support system on productivity and production cost reduction. Chatzoglou, et al. (2011) measured financial performance on four financial items: return on assets, sales growth, profitability and liquidity. Researches of Gelderman (1998), Kivijirvi and Saarinen (1995), Jurison (1996) and Yoon, et al. (1998) confirmed with their studies that user satisfaction can lead to improvement of organizational performance and procedures. Finally, the study of Gounaris, et al. (2007) exploring MkIS effectiveness proved that there is a positive impact both on employees' job performance and organizational effectiveness. On the contrary, the research of Udo (1992) suggested that usage is negatively correlated with effectiveness in terms of productivity and cost reduction.



## 2.2 Dealing with AIS Effectiveness and its Impacts

AIS provides planning and management information for an effective firm strategy, aiming at reviewing objectives' consistency (Rushinek and Rushinek, 1985). AIS have to generate information about external factors, provide timely comparative information about problematic trends, create a profit objectives system for each firm's department or operation, provide market value statements in order to enable managers to make predictions about firm's potential and capture future changes in the organizational environment of business (Gordon and Miller, 1976). Based on literature, AIS, like any other IS, has to meet the needs of users, or in other words to be effective. A firm, in order to acquire all the benefits mentioned before, has to achieve high AIS performance, evaluating AIS management supporting role (Niu, 2010). AIS adopters are interested more in enhanced decision making rather than management control based on the review of Granlund (2011). Firms in order to adopt successfully AIS have to deal with its effectiveness. Nicolaou (2000) suggests that AIS effectiveness is defined "in terms of the perceptions of decision-makers that the output information available to them through transaction processing, management reporting, and budgeting systems meets their requirements for organizational coordination and control". In the same notion, AIS effectiveness depicts the extent of AIS' contribution to achieving firm's objectives (Raymond, 1990). A high level of AIS effectiveness will improve firm's operations effectiveness, work performance and decision making processes, give a competitive advantage and as a consequence, firm's performance will be enhanced. According to the research of Ismail (2009), manager's accounting knowledge, vendor's effectiveness and accounting firm's effectiveness may influence AIS effectiveness. Gordon and Miller (1976) present all the key characteristics of decision making that can be influenced by effective AIS. In-depth analysis, long term prospect of managers' decisions, enhanced multiplex decision making, adaptability to external factors and internal demands, proactivity in order to be "ahead of competitors" and consciousness of strategies can be affected and facilitate by the effectiveness of AIS. Rushinek and Rushinek (1985) concluded that AIS is the best mean of providing the demanded short and long-term decision making information, enhancing development of goals, planning and control.

Salehi, et al. (2010) suggest that perceiving an AIS implementation as successful, means that AIS have to be profitably applied to area of major concern to the organization, be widely used by one or more satisfied users and improve the quality of their performance. They considered AIS effectiveness as "successful use of system, which ensures user's need". According to Davis, et al. (1989), perceived usefulness refers to the user's perception of the degree to which using the system will improve his or her job performance. On that basis, AIS usefulness can be described as perceived usefulness of information. The research of Seddon and Kiew (1996) suggested that system quality, information quality and usefulness (instead of usage) can explain user satisfaction in a system like AIS. However, the

majority of studies in AIS research has explored AIS in means of information characteristics produced by the system. Chenhall and Morris (1986) suggested that four dimensions of information characteristics have to be used in order to measure perceived usefulness of Management Accounting Systems (MAS): scope, timeliness, aggregation and integration. A lot of researches were undergone based on this information dimensions (Soobaroyen and Poorundersing, 2008; Sharma, et al. 2006; Lal and Hassel, 1998; Sajady, et al. 2008). According to Chenhall and Morris (1986), scope refers to the dimensions of focus, quantification and time horizon. Timeliness refers to the ability of MAS to provide information on request. Aggregation of information provides summarized information in periods of time or diverse management areas of interest. Integration is needed in order to put together data. Choe and Lee (1993), based on their review, used in their research the following accounting information characteristics: focus, aggregation, orientation, time horizon, financial-nonfinancial and quantitative-qualitative, while Xu, et al. (2003) conclude that accuracy, timeliness, completeness and consistency are the most commonly used in information quality literature.

In AIS, the quality of the information generated is essential for the success of the system. Nicolaou (2000) combined quality of information and satisfaction of system in order to create a representative measure of AIS effectiveness. Accounting information may help managers to understand their duties more clearly and reduce uncertainty before decision-making (Chong, 1996). Especially in business environments where the uncertainty is quite high, accounting information will lead managers to perform better and react effectively in problems aroused (Gul, 1991). Naranjo-Gil (2004) suggested that AIS adoption enhance performance, especially in the case that uncertainty is very low or non-existent. Firms which consume financial resources in AIS have to explore whether these systems satisfy the need of managers in terms of information quality and characteristics for their tasks. Managers are interested in high quality and up-to-date information in order to take better decisions and react to any given problem while reducing uncertainty. When a manager takes advantage of all generated information, then decision making capacity will be improved, its quality will be increased, demanded time will be reduced and so, firm will obtain a competitive advantage (Andrei-Coman and Uta, 2011). However, if there is an overload of information provided by AIS, then managers will not act effectively. In this case, information characteristics play an important role since the quality of output produced by the system is considered of great importance. Full and on-time information sharing to internal and external environment, computerization of the accounting procedures, standardization of financial statements, ongoing and direct information to financial managers, reduction of operational expenses and more available working time for accountants are serious benefits gained from implementing of AIS.

Many authors tried to explore AIS effectiveness in terms of use of the system and its impacts on firm performance. The use of AIS may provide competitive

advantage, increasing the quality and reducing the costs of products and services, increasing productivity and decision making through constant, correct and accurate information and sharing information and expertise (Allahverdi, 2011). The majority of studies proved that the benefits of implementing and using AIS in the core business provide significant gains in financial and organizational terms. Onaolapo and Odetayo (2012) support that that AIS affect positively organizational effectiveness. Grande, et al. (2011) found that AIS implementation by Spanish SMEs improved significantly their financial performance. Moreover, Soudani (2012) proved that the use of AIS can improve financial performance and even more organizational performance in terms of inventory management, employees' contribution, social responsibility, employee morale and customer satisfaction. The results of the research of Sajady, et al. (2008) suggested that the effectiveness of AIS may improve decision-making by managers and the quality of financial reports, may lead to more effective internal control systems and facilitate financial transaction processes. Based on DeLone and McLean model, the research of Daoud and Triki (2013) proved that information quality and system quality cannot influence directly firm's performance but only through user satisfaction. However, in their review it is noticed that AIS can prevent managers from overload information, which can lead to incorrect decisions on strategy and firm's objectives.

### **2.3 The case of Hotel Industry and the Specificity of SMEs**

The nature of the hotel industry, where high competition exists, is characterized by the need of coordinating different departments and operations. Hotel industry can be characterized as information intensive (Law and Jogaratnam, 2005). According to Rushinek and Rushinek (1985), an AIS should consider the needs of all firm's departments. However, it has to be noticed that there is a considerable amount of hotel organizations that have outsourced their accounting and financial activities to an external provider, which is consistent with the study of Burgess (2006). As competitiveness is increasing, hotel owners and managers realized that only if they exploit constant and accurate financial information sharing, then their firm will obtain a competitive advantage. This is also supported by the study of Espino-Rodríguez and Gil-Padilla (2005), which proposed that hotels will not outsource IT activity that will add value and give competitive advantage to the firm.

Hotels demand accurate information provided by AIS for a cognitive decision making in order to meet their financial objectives. In the case of hotel industry, there is a need of identifying and optimizing revenues and expenditures in different fields of operations, as lodging, food, beverage and other services. All these can be considered as profit and costs centers, enabling managers to take the right decisions in terms of pricing, offering a new service or discontinuing some other and calculating overhead costs with accuracy. Hotels, as service related firms, pay much more emphasis on well developed

pricing strategies and tactics (Harris and Brown, 1998). Hence, AIS may provide hotel managers with all the appropriate information so as to enhance the effectiveness of sales promotion, to maximize room rates and thus, improve their profitability (Lokman and Patiar, 2001). Analytical, cost centers, sales, control and financial and accounting data reports generated by AIS can support managerial decisions, improve control operations and enable managers to face arousing problems (Kasavana, 1982). Furthermore, since the main objective of a hotel is the satisfaction of its customers, manager's performance plays the most important role, as one of his duties is to provide high quality services to customers (Winata and Mia, 2005). The research of Ham, et al. (2005) suggested that a back-office IS, such as AIS, can positively affect hotel performance. In terms of effectiveness, user satisfaction is considered too important in the services sector. Due to the fact that IS have been widely induced in services and especially in hotel industry for reasons of productivity and competitiveness, it is crucial that users will be satisfied with an IS in order to perform better, providing better service quality and thus increasing profitability (Au, et al. 2002).

The adoption and implementation of IS by firms in order to achieve higher competitiveness depends on their size. The control of size's impact on the use of IT and its benefits has been of great research in literature. The reason is that there are significant differences between Small and Medium Enterprises (SMEs) and large firms; causes for implementing and kind of IS adopted, implementation strategies and level of its customization. SMEs operate under a high level of uncertainty, are especially centralized with regard to structure and have low human and financial resources. Under these circumstances, there are a lot of firms that do not invest in IT and simply survive or maintain their position in the market (Blili and Raymond, 1993). Moreover, willingness in terms of reactions throughout firm and inability concerning skills and training of personnel may affect the success of IS (Whitaker, 1987). All the above constraints are generally aroused in the results of the study of Main (1995) conducted on hotel enterprises. Findings of this research show that IT usage in small firms is lower due to cost of implementation and the need of keeping pace with technology development which require specific skills from personnel.

Because of their low financial resources, SMEs' managers need assurance that they will acquire relevant and reliable information at the right time with a reasonable cost (Saira, et al. 2010). AIS adoption enables SMEs to face short-term problems concerning costs, expenses and cash flows, generating the required financial information for monitoring and control and operate with long-term plans (Ismail, 2009). Users exploiting AIS can meet the demands and needs on financial information in terms of budgeting and cost management, crucial for sized firms. Annual financial statement information, as a product of AIS, can be provided constantly and more quickly, be segmented by product line or customer and be presented in a simple and explanative manner for SMEs managers (Marriott and Marriott, 2000).

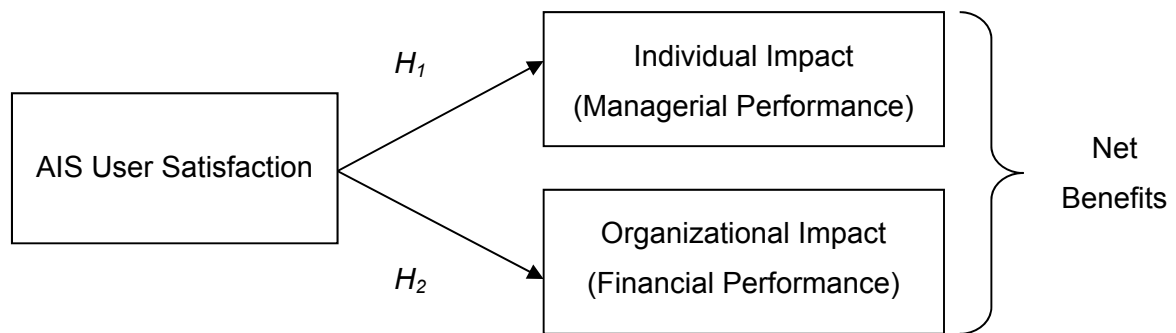
According to Grande, et al. (2011), AIS lead to better management transactions and higher competitiveness while improve administrative management, enabling firms to be more adaptive to a continuously changing environment like this in which hotel SMEs operate.

### 3. Research Methodology

Aiming at exploring the AIS effectiveness and its impacts and based on updated IS Success model of DeLone and McLean (2003), we make the following hypotheses (Figure 2):

$H_1$ : AIS User Satisfaction has a positive impact on Managerial Performance.

$H_2$ : AIS User Satisfaction has a positive impact on Firm's Financial Performance.



**Figure 2.** Research Model

These hypotheses are going to be examined using construct variables based on our literature review. Structured questionnaire will be the tool for collecting data from our sample. The instrument with items of each variable is presented in the Appendix. Finally, statistical analysis will undergo for accessing the validity and reliability of instrument and supporting or not the above hypotheses.

#### 3.1 Measurement of Variables

##### 3.1.1. AIS User Satisfaction

As our literature review proved, the effectiveness of an IS is widely measured under user satisfaction. Moreover, it has to be measured using a multidimensional instrument since a single-item instrument may be characterized unreliable as it cannot depict whether user is satisfied with every attribute of the system. In order to measure user satisfaction, it is assumed that managers understand their own demands on information (Gelderman, 1998). Ives, et al. (1983) suggested that there are two types of measures in user satisfaction. The first concentrates on IS output, in terms of content of the IS and the way in which the information is presented. The



second one of includes organizational support in developing and maintaining the IS.

In our study, we are going to measure AIS effectiveness with the surrogate of user satisfaction. The DeLone and McLean IS Success Model was the main driver for our instrument. We approach AIS user satisfaction as an overall user's evaluation of the system attributes, which is consistent with the study of Ong, et al. (2009). Since the use of AIS can be characterized as mandatory and not voluntary, we replaced usage by usefulness, based on the empirical results of Seddon and Kiew (1996). However, it has to be pointed out that according to the study of DeLone and McLean (1992, p68), "usage, either perceived or actual, is only pertinent when such use is voluntary". Addition to this, Wu and Wang (2006, p.730) stated that "system use is necessary but not sufficient to create system benefits". Moreover, we exclude service quality based on the results of Petter and McLean (2009) with a view to construct a well representative measure of user satisfaction. In their meta-analysis research, service quality found to have no positive statistical significant relationship with user satisfaction. Furthermore, use and user satisfaction have positive but weak relationship. Trying to overcome the difficulty of measuring user satisfaction and achieving also great reliability, our instrument is a multidimensional one, included three factors that affect and interpret it at a great extent: information quality, system quality and usefulness. Therefore, we are going to explore whether users of AIS are satisfied with the above three dimensions. Moreover, we have to bear in mind that our research is being conducted in SMEs sector. According to Raymond (1987), the instrument of measuring user satisfaction for small firms has to be short and easy to answer.

Constructing the instrument, we include three groups of questions evaluating the satisfaction of users in each of item, based on our review. Based on the study of Chenhall and Morris (1986) and Chang, et al. (2003), information quality is measured using a total list of nine items, based on the dimensions of scope (external information, nonfinancial information, future-oriented information), timeliness (frequency of reporting, speed of reporting), aggregation (information on the different firm's sections, information for the effect of different sections' activities on summary reports) and integration (information on specific targets, information on the impact of decision making). The specific instrument was modified in wording in order to examine satisfaction as opposed to usefulness. This alteration is consistent to the amendments of other studies (Soobaroyen and Poorundersing, 2008). Although the majority of IS studies were concentrated on items like accuracy, timeliness, completeness and consistency, we selected to evaluate information quality from a financial and managerial accounting perspective due to the nature of AIS. The system quality measures have to focus on performance characteristics of the evaluated system. We adopted items used by Wu and Wang (2006) which include system stability, acceptable response time, a user-friendly interface and ease of use. In this case, a total of four



items were included to capture the satisfaction of users on system quality. In order to examine usefulness, we used six items developed by Davis (1989). Thus, an instrument of nineteen items is introduced in order to capture satisfaction of an AIS user while negative wording was avoided, consistent with other researches (Gounaris, et al. 2007). Each item of AIS User Satisfaction (AISUS) is measured on a 7-point Likert scale ranging from (1) 'strongly disagree' to (7) 'strongly agree' (Appendix).

### 3.1.2. Managerial Performance

Managerial performance can be objectively measured when the result of performance is measured physically or managerial work can be characterized by routine but also subjectively measured when managerial tasks involve changing daily activities (Winata and Mia, 2005). In IS literature, managerial performance is mainly measured based on a perceptual manner (Igbaria and Tan, 1997; Hou, 2012; Gatian, 1994; Etezadi-Amoli and Farhoomand, 1996). According to an old and criticized for weak empirical foundations (Florén, 2006) theory but widely used, Fayol (1949) suggested that planning, organizing, commanding, coordinating and controlling are the main perspectives of managerial work. Mahoney, et al. (1963) suggested that managerial functions include planning, investigating, coordinating, evaluating, supervising, staffing, negotiating and representing. Power (2002) based on his review, concluded that there are four types of decisions regarding to managerial actions: strategic planning, management control, operational control and operational performance. Especially in accounting field, planning and controlling are too critical and so, effective managers must give emphasis and develop techniques on this sections in order to improve performance (Acton and Kleiner, 1991). In the field of SMEs, managerial work can be both organizational and managerial, according to the aroused need of firm (Florén, 2006).

The managerial supporting role of AIS was measured with four items by Niu (2010), mainly examining the impact of AIS on managerial work, evaluation, planning and information usefulness. Torkzadeh and Doll (1999) examined the impact on managerial work in terms of task productivity, task innovation, customer satisfaction and management control. Teo and Wong (1998) examined managerial satisfaction in relation to software, hardware, vendor support and consultants. Mia and Chenhall (1994) examined managerial performance evaluating the degree to which managerial roles are accomplished in one item scale. The study of Gul (1991), Sharma, et al. (2006) and Soobaroyen and Poorundersing (2008) used eight-item scale based on the study of Mahoney, et al. (1963) and ninth dimension for overall evaluation as a personal performance evaluation measure.

In our research, in order to capture managerial performance in the hotel industry, we use self-rating to assess the performance of managers-respondents on an instrument adopted by Mahoney, et al. (1963) which is

widely used by many studies. It is a subjective measure but hotel manager work is not a routine one and so we cannot use a physically measured instrument. Moreover, based on the review of Winata and Mia (2005), using a self-rating performance instrument, we can overcome 'halo effect', achieving also reliable results when the instrument is characterized by anonymity. Managerial performance (MP) was measured in terms of a nine item self-rating scale that required participants to evaluate the positive impact of AIS on their performance in a seven point Likert type scale from (1) 'strongly disagree' to (7) 'strongly agree'. This instrument includes eight managerial dimensions: planning, investigation, coordinating, evaluating, supervising, staffing, negotiating and representing (Appendix). The specific instrument was modified to the particularities of SMEs sector.

### 3.1.3. *Firm's Financial Performance*

In IS success literature, the largest portion of studies examined organizational performance based on the managers' perceptions (Kivijirvi and Saarinen, 1995; Yoon, et al. 1998; Terziovski, et al. 2003; Ham, et al. 2005; Ismail and King, 2005). It would be desirable to use publicity financial ratios but they may be affected by intangible impacts and environmental conditions (Wu and Wang, 2006) and also can be too aggregated, short-term emphasized with a past performance view (Duh, et al. 2006). On the contrast, Chatzoglou, et al. (2011) suggest that non-financial performance measures may be difficult to capture firm performance in an accurate, efficient and timely way. They also proposed based on their review, that evaluation of financial performance by managers-owners in the case of small firms would be the proper instrument. In their study, Li and Ye (1999) measured financial performance as a multidimensional construct based on their literature review.

The majority of AIS studies examined mainly the effects of its use on financial performance in terms of profitability. However, AIS, as our review suggest, can improve operational control and managerial decisions, affecting positively cost reduction. Based on all the above, in this study we capture financial performance due to AIS in a perceptual view. We asked from respondents to indicate their agreement or disagreement with six items dealing with whether or not AIS have a positive impact on terms of profitability, Return On Assets (ROA), sales growth, liquidity, adopted by the study of Chatzoglou, et al. (2011) and Return On Equity (ROE) and cost reduction. ROA, depicting firm's profitability and management efficiency, has to be used when financial performance is examined in the hotel sector (Lee and Kim, 2009). Sales growth demonstrates the effectiveness of a firm to expand in new or existing markets (Zhang, 2005). ROE, represents firm's profitability by measuring management's ability to use shareholders' money, can be a reliable tool for capturing financial performance when financial data are not available (Madan, 2007). Each item of financial performance (FP) is measured on a 7-point Likert scale ranging from (1) 'strongly disagree' to (7) 'strongly agree' (Appendix).

#### 3.1.4. Control Variable

In order to examine our hypotheses and achieve greater explanation of the effect of AIS user satisfaction on both managerial and firm's financial performance, we control for variable that have the potential to influence them. According to Brynjolfsson (1993), it may take several years in order for the benefits of an IT investment to be perceived by a firm. IS impacts have to be examined with a time lag since firms have to go through different post-implementation stages in order to obtain benefits. The costs of IS implementation creating increased short term costs and the time that is needed for managerial work to be adapted are significant factors for this time lag. In the research of Brynjolfsson and Hitt (1998), an increase in productivity has resulted three years after IT investment while Liu, et al. (2007) found positive abnormal changes of ROA three years after the implementation of the system. Moreover, Jurison (1996) suggested that the IS impacts on individual performance can be observed after six to eight months and on organizational level at least one year after. According to review of Hou (2012), users in firms who have implemented a system for more years than others will be more satisfied for these systems and his research revealed that the longer the time of using business intelligence system the greater individual performance is noticed. However, in our study we use system years (SY) as control variable. This variable is calculated as the length of time since the implementation of AIS.

### 3.2 Sample and Data Collection

Greek economy depends heavily to the industry of tourism. According to SETE (2012), tourism contributes around 16.5% of Gross Domestic Product (GDP) and 18.4% of total employment. Moreover, a state of hard competitiveness exists in Greek hotel industry, where the necessity for effective AIS can be considered crucial. The investment in IT systems and especially on AIS seems to be necessary for hotels in order to improve their decision making process and improve their financial performance. We have selected to examine Small and Medium Enterprises (SMEs) as they prevail in the Greek tourism market and because of their specificities that was referred above concerning to the adoption of IS. Following the criteria of the European Union, our sample should include small firms (from 10-49 employees, and turnover  $\leq$ €10m or balance sheet total  $\leq$ €10m) and medium firms (from 50-249 employees, and turnover  $\leq$ €50m or balance sheet total  $\leq$ €43m).

Initially, questionnaires were sent out to 195 small and medium hotels, randomly selected by Hellastat database. After sending via email and contacted with managers of these firms, our initial sample was consisted of 105 firms which fully completed and returned our questionnaires. Thus, the response rate of our survey is 54% which can be considered quite high. The second stage of determining our sample was to examine these questionnaires and identify which firms had implemented AIS in their core business. Out of

105 firms that returned a fully completed questionnaire, 78 firms (approximately 74%) have implemented an AIS.

**Table I.** Descriptive Statistics of Sample Firms

Size	Initial sample	AIS adopters	Percentage
Small	44	27	61.3
Medium	61	51	83.6
Total	105	78	74.3

Our initial sample consisted of 44 small and 61 medium-sized hotels. Out of 44 small hotels, only 27 firms (61.3%) have implemented AIS while 51 out of 61 medium (83.6) have adopted it (Table I). This finding especially in the case of small hotels is almost inconsistent with the literature review, according to the fact that due to their specificities, they are prohibited for investing and implementing AIS. Summing up, our initial sample was reduced to 78 firms.

Descriptive statistics of the respondents profile were summarized in the Table II. Among 78 managers-respondents, 47 managers (60.3%) were male and 31 were female (39.7%). Our sample is mainly managed by young aged employees. Around 60% of our respondents are below 40 years old. One-tenth of managers were more than 51 years old. Finally, concerning the education, we may support that the managers of our sample are highly educated. 60% of them hold a bachelor degree while another 18% has finished their postgraduate studies.

**Table II.** Respondents Profile

Variable	Frequency	Percentage
<i>Gender</i>		
Male	47	60.3
Female	31	39.7
<i>Age</i>		
18-30	16	20.5
31-40	31	39.7
41-50	24	30.8
51 or above	7	9.0
<i>Education</i>		
High School degree	18	23.1
Bachelor degree	46	59.0
Postgraduate degree	14	17.9

### 3.3 Data Analysis

In this study, before data collection stage, our instrument was checked in terms of content validity by conducting an extensive literature review in the field of IS effectiveness and AIS field. The questionnaire was then evaluated and reviewed by academics and practitioners.

In order to examine construct validity of our instrument, factor analysis was applied using principal component analysis for user satisfaction, as well as managerial performance and financial performance constructs. In factor analysis, we did not include system years since it is a single item construct. In order to proceed to factor analysis, we had to evaluate whether this study is sufficient for this analysis. In all three construct variables, values of KMO are higher than 0.5 (Hinton, et al. 2004) and results of Bartlett's test of sphericity are significant (Table III), and thus we proceed to factor analysis. Items with factor loadings less than 0.60, due to our sample size (Hair, et al. 2009) or with factor loadings greater than 0.3 on two or more factors (Yoon, et al. 1998) were deleted from the scale in order to improve the validity of the instrument, despite the fact that these high loadings in two or more components may depict the importance of item for the measurement of each variable. We established these rules since they are common practices for achieving higher unidimensionality and construct validity (Doll and Torkzadeh, 1988; Ong, et al. 2009; Yoon, et al. 1998). As a result, three items of AIS user satisfaction construct (US2, US7, US12), two items of managerial performance construct (MP4, MP7) and one item of financial performance construct (FP2) were eliminated from the analysis. After the elimination of these items, results confirmed that each of three variable constructs can be treated as single measures, ended up with just one component.

**Table III.** Tests for Factor Analysis

<b>Construct variable</b>	<b>Number of items</b>	<b>KMO</b>	<b>Bartlett's test of sphericity</b>
AIS User satisfaction	19	0.917	Significant ( $p < 0.001$ )
Managerial Performance	8	0.742	Significant ( $p < 0.001$ )
Financial Performance	6	0.861	Significant ( $p < 0.001$ )

It is important to examine our variables in terms of reliability. In this case, reliability analysis was conducted in order to test the internal consistency of each construct variable using Cronbach's alpha, the most widely used measure for multi-item scales. We anticipate high values of Cronbach's coefficient alpha because in other case, it will indicate that the items which measure each construct variable do not belong together. According the Hair, et al. (2009), the generally lower limit is 0.60. Cronbach's alpha for user satisfaction is 0.968, for managerial performance is 0.830 and for financial performance is 0.894. All three coefficients are well above the lower limit,

depicting a great internal consistency for the three variables. At this point, concerning construct variable of AIS user satisfaction, we have to notice that its high value of Cronbach's alpha ( $>0.90$ ) may be an excellent result for the developed scale although that it could get shortened (DeVellis, 1991).

Table IV reports the descriptive statistics of the variables, after the elimination of items which did not properly load on components, and their Cronbach's coefficients alpha. The descriptive statistics of our sample users reveal that they are moderately satisfied with AIS since the mean of variable is 3.735. In summary, after our analysis and techniques established based on our review, our instrument can be characterized of validity and reliability, and thus we can proceed to the examination of our hypotheses.

**Table IV.** Descriptive Statistics and Reliability Coefficients

Construct variable	Number of items	Mean	Std	Cronbach's alpha
AIS User satisfaction	16	3.735	1.012	0.968
Managerial Performance	6	3.675	0.972	0.830
Financial Performance	5	4.123	0.971	0.894

### 3.4 Results

In order to test our hypotheses, the arithmetic averages of each manager's ratings on the three construct variables were calculated.

Taking into consideration all above mentioned details, our primary hypotheses are tested based on the following models:

$$MP = b_0 + b_1AISUS + b_2SY + e \quad (1)$$

$$FP = b_0 + b_1AISUS + b_2SY + e \quad (2)$$

where *MP* is managerial performance, *FP* is financial performance, *AISUS* is AIS user satisfaction, *SY* is system years and *e* is the error term.

Our first hypothesis ( $H_1$ ) predicted a positive impact of AIS user satisfaction on managerial performance. Thus, in order to support our hypothesis the coefficient  $b_1$  of equation (1) has to be significant and positive. The second hypothesis suggests a positive impact of AIS user satisfaction on financial performance. So, the coefficient  $b_1$  of equation (2) has to be significant and positive.



**Table V.** Correlation Matrix

	MP	FP	AISUS	SY
MP	1			
FP	0.081	1		
AISUS	0.349**	0.318**	1	
SY	0.218*	0.457**	0.358**	1

\*\* . Correlation is significant at the 0.01 level

\* . Correlation is significant at the 0.10 level

Since we use multiple regression, according to Hair, et al. (2009), our variables have to satisfy the following assumptions: linearity, constant variance and normality. Scatterplots, Levene's test and Shapiro-Wilk test were undertaken respectively and no serious problems were indicated. Moreover, we have to investigate whether multicollinearity is a problem for our regression analysis in terms of estimation and explanation. The simplest way to examine if independent variables are highly correlated is with correlation matrix. Table V presents the Pearson's  $r$  correlation matrix for the dependent and independent variables. It is obvious that the correlation between our independent variable does not exceed the limit of 0.90 (Hair, et al. 2009). Furthermore, as we may see, there is a significant and positive correlation ( $r=0.349$ ) between managerial performance and AIS user satisfaction at  $p<0.01$  and also a significant and positive correlation ( $r=0.318$ ) between financial performance and AIS user satisfaction at  $p<0.01$ . It is also observed that our dependent variables are also positively correlated but not significant. Moreover, our control variable, system years, has a positive significant correlation with managerial performance ( $r=0.218$ ,  $p<0.10$ ) and financial performance ( $r=0.457$ ,  $p<0.01$ ), which is consistent with our review.

In order to test  $H_1$  and  $H_2$ , regression analysis was conducted to test the significance of AIS user satisfaction on managerial and financial performance respectively. The results of regression for model 1 are contained in the Table VI. There is a positive and significant relationship between AIS user satisfaction and managerial performance ( $b_1=0.251$ ,  $p=0.011$ ), thus  $H_1$  is strongly supported. Moreover, our model explained over 27% ( $R^2=0.274$ ,  $p<0.01$ ) of variance in managerial performance. In case of our control variable, system years, has a positive and significant relationship with managerial performance ( $b_2=0.119$ ,  $p=0.000$ ).

**Table VI.** Regression Analysis for Model 1

Variables	Coeff.	Value	S.E.	t	p-value
Y = MP					
Constant	$b_0$	1.564	0.425	3.683	0.000
AISUS	$b_1$	0.251	0.097	2.595	0.011
SY	$b_2$	0.119	0.030	3.972	0.000
$R^2=0.274$ ; Adjusted $R^2=0.255$ ; $F=14.170$ ; $p=0.000$					

In Table VII, a summary of regression results for the model 2 are presented. AIS user satisfaction appears to have a positive and significant relationship with financial performance ( $b_1=0.241$ ,  $p=0.021$ ). In this case,  $H_2$  is strongly supported. Moreover, our model explained almost 17% ( $R^2=0.188$ ,  $p<0.01$ ) of variance in financial performance. Besides, system years have a strong positive relationship with financial performance at  $p=0.006$  level.

**Table VII.** Regression Analysis for Model 2

Variables	Coeff.	Value	S.E.	t	p-value
Y = FP					
Constant	$b_0$	2.335	0.449	5.206	0.000
AISUS	$b_1$	0.241	0.102	2.360	0.021
SY	$b_3$	0.090	0.032	2.843	0.006
$R^2=0.188$ ; Adjusted $R^2=0.167$ ; $F=8.699$ ; $p=0.000$					

Finally, our previous findings for multicollinearity are reassured by examining variance inflation factor (VIF) values. According to Hair, et al. (2009), VIF values have to be lower than ten. In our research, the value of VIF for both independent variables is 1.050.

#### 4. Conclusions and Managerial Implications

The penetration of IT in business environment led many firms to invest in Information Systems (IS) in order to obtain competitiveness and improve firm's performance. Accounting Information Systems (AIS) provide high quality financial information, timelessly and accurately, thus, enabling managers to proceed in a successful and optimized decision making. However, except of adopting and implementing an IS, a firm has to ensure that the system will be effective, or in other words to be able to enhance their operations and business practices having as an ultimate target the improvement in decision making and its profitability. The purpose of this study is to examine whether an effective Accounting Information System (AIS) may have significantly positive impacts on individual and organizational level. Research was conducted in an intensive information industry such as the hotel sector, investigating potential effects of AIS effectiveness in Small and Medium Enterprises (SMEs) where uncertainty and competitiveness are high. Based on IS literature, user satisfaction is a well proved measure for the effectiveness of a system. Using a structured questionnaire, we examine the satisfaction of AIS users-managers and their perceptions on the extent of improvement of both personal and firms' financial performance using AIS. We attempt to comprise significant system characteristics based on IS literature with the nature of AIS information, in order to achieve a thoroughly reliable and valid conception of AIS user satisfaction.

In the descriptive statistics for our sample firms, it is interesting to notice that 61% of small sized firms has adopted AIS while 83.6% of medium sized firms

has not outsourced their financial and accounting activities. These findings reveal that SMEs, especially those which act in the hotel industry, have recognized the potential benefits of implementing AIS despite their limited financial resources and a series of other constraints due to their specificities. Moreover, our construct variables proved to be reliable enough and valid. Especially, in the case of AIS user satisfaction, information quality, system quality and perceive usefulness have been compromised perfectly with a set of questions, depicting the significant characteristics of an AIS. In the core of study, the results of our research supported our both hypotheses. Consistent with the findings of the majority of studies in IS literature, AIS effectiveness has a significantly positive relationship with managerial performance and financial performance at  $p < 0.05$  level. Moreover, it is noticed that individual performance is related with AIS user satisfaction in a greater extent and in statistical significance than organizational performance. Moreover, according to our regression analysis, we control for the time period that managers are using AIS. System years as our control variable, affect in a positive way both managerial and financial performance, while in the first case, it appears that they have a more statistical significant impact.

In conclusion, this study reveals that firms have to ensure that AIS users will be well enough satisfied with the system. The results of our research, consistent with previous studies, indicate that if the system provide high information quality, system quality and perceived usefulness for users, then both managerial and firm's financial performance will be increased. As far as our models are concerned, we used a control variable which worked both ways; to capture the impact of time needed for benefits to be obtained and the length of time that the system is used, since we did not include the dimension of usage in the construct variable of user satisfaction, due to the mandatory nature of AIS. The findings of the regression analysis show that the longer is the time period that AIS is implemented by a firm, the greater will be the benefits in individual and organizational level.

Based on the above results, SMEs managers have to be convinced of the importance of not outsourcing their financial and accounting activities. Many studies have explored the positive impact of implementing and using AIS inside business in firm's financial performance. This study, except of confirming the above finding, directs firm's attention to take into consideration AIS user satisfaction when its financial resources will be spent in implementing such a system. If manager-user of AIS is satisfied with terms of information quality, system quality and perceived usefulness at a great extent, then his and firm's financial performance will be benefited. Furthermore, managers and users of an effective AIS have to be patient with acquiring benefits since just like our study proves, the longer the using time period, the better for managerial performance and more the gains in financial terms are.

## 5. Limitations and Further Research

In this study a raw of limitations exists. First, constructing the variable of AIS user satisfaction, we did not include items regarding the dimension of service quality, based on results of a meta-analysis. Second, since the research was undergone in Greek hotel industry and particularly in SMEs, the results of this study may not have an identical response to those in other countries as well as in other large-sized firms. This is because of the financial crisis that has emerged in the country during the last years and its effects on financial performance. In our research, protecting our financial data from this effect, we used managers' perceptions in order to capture the impacts of AIS effectiveness on firm's financial state. However, it remains for sure a suspending factor for firms' profitability and thus, it cannot be omitted. Another limitation in our research is the exclusion of items in our construct variables. Items with high loadings in two components were eliminated for reasons of unidimensionality and construct validity despite the fact that they depict their importance for the variables. Furthermore, the fact that our models explain at low percentages the variance of our dependent variables indicates that more factors are at work. Another limitation of research is the size of sample. In this case, an increased sample of respondents could enhance the precision of factor analysis and findings.

Apart from sample size, this research would be interesting to be conducted in other business sectors and especially in manufacturing industry where logistics and production demand effective AIS. According to the variable of user satisfaction, characteristics of service quality could be included but with caution in case of examining user satisfaction in relation to net benefits, since a great portion of studies has found no statistical significance. High values for internal consistency, else reliability, may lead to a conclusion that some items could be eliminated. However, this remains to be proved with the use of a confirmatory factor analysis. Moreover, a future study could add appropriate variables either as control variables or as moderators in the linkage between effectiveness and financial performance. Furthermore, managerial performance was measured using a too examined and reconfirmed by many studies instrument. Regarding hotel industry, a construct variable could be used in a more service oriented way due to the nature of business. Finally, since all our construct variables have been based on the managers' perceptions, a longitudinal approach to this study could be applied because the needs and the beliefs of users possibly change during the time.

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## Appendix – Construct Measures

### *AIS User Satisfaction (AISUS)*

- US1: I am satisfied with external information provided by AIS.
- US2: I am satisfied with nonfinancial information provided by AIS.
- US3: I am satisfied with information provided by AIS which relates to possible future events.
- US4: I am satisfied with reports provided by AIS frequently on a systematic, regular basis.
- US5: I am satisfied with requested information provided by AIS arriving immediately upon request
- US6: I am satisfied with information provided by AIS on the different sections or functional areas in your organization
- US7: I am satisfied with information provided by AIS on the effect of different sections' activities on summary reports
- US8: I am satisfied with information provided by AIS on the impact that your decision will have throughout firm and firm performance
- US9: I am satisfied with precise targets provided by AIS for the activities of all operations in firm.
- US10: I am satisfied with the easy to use of AIS
- US11: I am satisfied with the user friendliness of AIS.
- US12: I am satisfied with the stability of AIS.
- US13: I am satisfied with the response time of AIS.
- US14: Using AIS in my job would enable me to accomplish tasks more quickly.
- US15: Using AIS would improve my job performance.
- US16: Using AIS in my job would increase my productivity.
- US17: Using AIS would enhance my effectiveness on the job.
- US18: Using AIS would make it easier to do my job.
- US19: I would find AIS useful in my job.

### *Managerial Performance (MP)*

- MP1: AIS improved my performance in Planning (determining goals and policies, work scheduling, budgeting)
- MP2: AIS improved my performance in Investigating (collecting and preparing information, usually in the form of records, reports, and accounts, inventorying, measuring output, preparing financial statements, recordkeeping)
- MP3: AIS improved my performance in Coordinating (exchanging information with people in the organization in order to relate and adjust programs, arranging meetings)
- MP4: AIS improved my performance in Evaluating (assessment and appraisal of observed performance, employee appraisals, judging output records, judging financial reports, judging proposals and suggestions)
- MP5: AIS improved my performance in Supervising (directing, leading, and developing subordinates, counselling subordinates, training subordinates, explaining work rules, assigning work, disciplining, handling complaints of subordinates)
- MP6: AIS improved my performance in Staffing (maintaining the work force of firm,





employment interviewing, selecting employees, placing employees, promoting employees)

MP7: AIS improved my performance in Negotiating (purchasing, selling, or contracting for goods or services, tax negotiations, contacting suppliers, dealing with sales representatives, advertising products, collective bargaining, selling to dealers or customers)

MP8: AIS improved my performance in Representing (advancing general organizational interests through speeches, consultation, and contacts with individuals or groups outside the organization, speeches, community drives, news releases, attending conventions, business club meetings)

### ***Financial Performance (FP)***

FP1: AIS improved Profitability

FP2: AIS improved ROA

FP3: AIS improved Sales Growth

FP4: AIS improved Liquidity

FP5: AIS improved ROE

FP6: AIS improved Cost Reduction

# The effect of ERP systems on the level of internal control - empirical evidence from Finnish medium-sized entities

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## Abstract

Research evidence from publicly held companies indicates that firms having implemented enterprise resource planning (ERP) systems are less likely to report internal control weaknesses than a matched control sample of non-ERP-implementing firms. While public companies have to report on their internal control, little is known about non-public companies with no reporting requirements on internal control. Adopting a survey approach, this study aims to investigate what effect, if any, integrated information systems such ERP systems are perceived to have on the level of internal control in Finnish medium-sized non-public entities. The initial results suggest that the respondents perceive an ERP system to have a modest impact on the firm's internal control. The effect was perceived to be the strongest on information and communication as well as control activities and the weakest on the control environment. Further, the results of a multiple regression analysis indicate that ERP use and firm size (significant at  $p < 0.05$  level) explain the variance in the level of internal control, whereas firm profitability, firm age and audit firm do not.

**Keywords:** enterprise resource planning, ERP, internal control, COSO, non-SOX environment

## 1. Introduction

In the last decade the focus on corporate internal control has increased, triggered among others by corporate scandals and subsequent Sarbanes-Oxley Act of 2002. According to the SOX legislation, publicly held companies are required to report on the effectiveness of their internal controls over financial reporting as part of an overall effort to reduce fraud and restore integrity to the financial reporting process (Morris, 2011). In the effort to comply with SOX, management has realized the importance of assessing, developing and maintaining an effective and efficient internal control system and researchers have emphasized the role of information technology (IT) therefore (e. g., Byington and Christensen, 2005; Cannon and Growe, 2004; Morris, 2011). In this wake, software vendors have started advertising

enterprise resource planning (ERP) systems as systems that cannot only detect and prevent fraudulent activity, but also offer protection to the resources in the organization. Further, the built-in controls and other features of the ERPs would help firms improve their internal control (Cannon and Growe, 2004). ERP systems integrate all of the major core levels of the company operations to effectively provide real-time and integrated data and information for corporate decision-making (Davenport, 2000). More recently, also specific internal control monitoring software has emerged, and been found to enhance the strength of the internal control systems (Masli et al., 2010)

While ERP systems have been found to have significant implications for internal control in general (Elmes et al., 2004) and controls related to accounting and auditing in particular (e.g., Granlund and Mouritsen, 2003; Rikhardsson et al., 2006; Spathis and Constantinides, 2004), prior studies have also, in particular during the earlier years of ERP implementations, associated IT with more control problems (Bell et al., 1998; Wright and Wright, 2002). For example Messier et al. (2004), examining a sample of firms in various stages of computerization, found that missing controls, poorly designed controls and overworked accounting personnel were more likely the source of misstatements in computerized business processes compared to non-computerized business processes. Also Solomon (2005) reports that inadequate system controls have been cited in SEC filings as a chief source of material weaknesses related to internal control. Thus, it remains somewhat unclear whether the implementation of various type of IT yields the intended effects on internal control.

Further, prior studies have mainly examined firms that have to comply with SOX and Morris (2011) maintains that it is likely that results for smaller, non-SOX-compliant firms initially may be different. Researchers examining disclosures of material weaknesses in internal control of SOX-complying firms have reported that weak internal controls are associated with smaller, younger, and financially weaker firms with insufficient investment of resources in accounting controls, overall inadequate resources and organizational complexity (e.g., Ge and McVay, 2005; Doyle et al., 2007). Despite the importance of investigating this type of firms, prior studies appear to be scarce, perhaps due to the lack of public data.

Adopting a combination of survey and archival approach, this study aims to investigate what effect, if any, ERP systems have had on the level of companies' internal control. The study focuses on medium-sized companies for three reasons to contribute to contemporary research. First, while the implementation of ERP systems took place over ten years ago in most large Finnish companies, it is expected that medium-sized Finnish companies would have implemented ERPs more recently. A recent implementation is considered more relevant because the implemented software packages would likely include new features, and the adopting firms would more easily

remember possible changes occurring in the internal control. Second, while prior studies (e.g., Masli et al., 2010; Morris, 2011) have focused on large SOX-complying companies, much less research efforts have been devoted to studying non-listed and more resource-constrained companies such as small and medium-sized entities (SMEs). Still the SMEs represent the majority (some 97 per cent) of all entities within the European Union, and they are a recent market for the software vendors. Third, while large, listed companies have to report internal control weaknesses, not much information is available about the level of the internal control in other types of entities, as these entities are excluded from the reporting requirements. Thus, this study may also provide valuable knowledge about the state-of-the art of internal control in this type of companies.

As data collection is still partly ongoing, the reported results are preliminary. The initial results suggest that the respondents perceive an ERP system to have a modest impact on the firm's internal control. Based on mean values, the effect was perceived to be the strongest on information and communication as well as control activities and the weakest on the control environment. Further, the results of a multiple regression analysis indicate that ERP use and firm size (significant at  $p < 0.05$  level) explain the variance in the level of internal control, whereas firm profitability, firm age and audit firm do not.

The remainder of the paper is structured as follows. Chapter 2 provides the background and hypotheses. Chapter 3 describes the research method. Chapter 4 presents the results and Chapter 5 concludes with a brief discussion of the results, their implications and the limitations of the study.

## 2. Literature Review

In 1992, the Committee of the Sponsoring Organizations of the Treadway Commission (COSO) issued its report "Internal Control-Integrated Framework", which was aimed as a systematic framework for internal control (COSO, 1992), and has been commonly adopted among publicly held companies worldwide. Also the American SEC has specifically stated that the COSO Framework satisfies the SEC criteria and "may be used as an evaluation framework for purposes of management's annual internal control evaluation and disclosure requirement" by companies listed on U.S. stock exchanges (Gupta and Thomson, 2006, p. 28; Morris, 2011). According to the COSO framework, internal control is "a process, effected by an entity's board of directors, management and other personnel, designed to provide reasonable assurance regarding the achievement of objectives in the following categories: effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations" (COSO, 1992, p. 1). Further, the framework emphasizes that internal controls are most effective when they are "built into" the entity's infrastructure (COSO, 1992, p. 1).

The enactment of the Sabanes-Oxley Act (SOX) in 2002 and the reporting requirements of Sections 302 and 404 have increased information about the publicly held companies' internal control procedures, something that also has significantly increased the empirical/archival research on internal control-related issues in recent years. Control studies using SOX data have primarily investigated the characteristics of firms that report material weaknesses and the effect of the internal control reports on market conditions. Findings on firm characteristics indicate that firms reporting material weaknesses are smaller, younger, riskier, more complex, and financially weaker (e.g., Ge and McVay, 2005; Doyle et al., 2007).

Further, prior studies have investigated the importance of IT in facilitating the monitoring process related to internal control. For example ERP systems include features that facilitate implementation and enforcement of internal controls to ensure the accuracy of financial information being reported. Therefore, it is expected that companies implementing ERP systems would use those built-in control features of the system to enhance their internal control procedures and try to minimize internal control weaknesses. Prior studies also indicate support for IT in enhancing internal control. For example Morris (2011) examined SOX Section 404 compliance data for a sample of firms that had implemented ERP systems between 1994 and 2003. The results indicated that ERP-implementing firms were less likely to report internal control weaknesses compared to a matched control sample of non-ERP implementing firms. Also Spathis and Constantinides (2004) found, when studying a sample of 26 Greek firms, that the ERP system improved the effectiveness of internal control. Masli et al. (2010) reported that the implementation of a specific internal control monitoring technology was associated with lower likelihood of material weaknesses.

In contrast to those studies, prior research conducted during early ERP implementations reports that the reengineering of business process and organizational changes brought about by the adoption of the new ERP system may also lead to changes in the control requirements of a company (Chang and Gable, 2002), and cause increased risks and control problems. For example Bell et al. (1998, p. 14) found that incorrect application of internal controls and inadequate internal controls were more likely to be sources of problems when information systems were computerized.

Today, information systems such as ERP systems are the backbones of many companies and a necessity for COSO to be effective (ITGI, 2004, p. 27). The principal contribution of the ERP systems includes the management of risks through the monitoring of a firm's internal controls (Masli et al., 2010). When evaluating the level of the internal control in accordance with the COSO framework and the possible impact of IT, five inter-related components - control environment, risk assessment, control activities, information and communication, and monitoring - are assessed.

Song et al. (2011) studied the effects of ERP systems on each of the five components. They emphasize among others the change that the ERP systems bring to the organizational structure, enterprise culture and internal environment, which allows the level of internal control to be reduced and control efficiency to be improved. The ERP systems can also monitor risks in real-time and risk control can be embedded in the daily management, thus risk management can become part of enterprise management. Although the ERP system itself does not guarantee the separation of duties, the system will increase the content of the physical control, through management of documents and data. Further, the ERP system should provide companies with an effective platform to achieve information sharing and communication. Increased understanding of business processes and control systems among staff will also improve the timeliness of internal monitoring. Klamm and Watson (2009) found in their study that firms with IT-related weak COSO components reported more material weaknesses and misstatements than firms without IT-related weak components, providing evidence on the pervasive negative impact of weak IT controls, especially in control environment, risk assessment, and monitoring.

Drawing on these prior studies, although conducted among publicly held companies, it is proposed that the use of an ERP system among non-publicly held, medium-sized companies would be positively associated with the level of their internal control.

### **3. Research Methods**

#### **3.1 Data and data collection**

The investigation of the level of internal control was conducted as an electronic online survey using the Webropol software. E-mail addresses to medium-sized company executives were received through the Profinder database, which is a Finnish database including contact information to corporate executives. The targeted population was unlisted medium- sized and large companies and their executives at the managerial level, working in accounting or finance. A total of 1000 emails were collected and used for survey distribution. The receivers were asked to forward the questionnaire to the person within the company who would be most familiar with the issues asked, if the receiver was the wrong person. While it is recognized from prior research that the internal auditor would have been an appropriate executive to approach as he would have extensive knowledge about the company's control environment, business operational process and the weakness present in the internal control system (Grabski, 1986), the preliminary search indicated that these executives were few in the examined sample.

Multi-item indicators based on previous research were used whenever possible. Items reflecting perceptions of the level of internal control were measured using a five point Likert-type scale ranging from totally disagree (1)



to totally agree (5). It is recognized that these items reflect the respondent's subjective perception of the level of internal control of the firm. While the degree to which subjective self-ratings correspond to objective measures is debatable, evidence from prior research within the accounting field has shown that for example respondents' subjective self-ratings of performance and objective measures are highly correlated (see e.g., Shields et al., 2000). Demographic variables of the respondents regarding their position, experience, information about the ERP system in use and so on were included in the background section of the survey and ascertained using single-item questions. The survey data was matched against archival data for the enterprises, derived from the Voitto+ database, a commercial database containing financial data on Finnish companies. Thus, data for the variables firm age, firm size, type of audit firm (Big4 or not) and profitability in the regression analysis are adopted from this database.

It turned out that about 150 email addresses were either incorrect or "out of office" for longer time periods (due to mother leave, illness and so on). Thus, the final sample size was 854. After two reminders, 97 usable responses were received, generating a response rate of 11.5 per cent, which is considered acceptable and consistent with response rates of other contemporary web-based surveys.

### 3.2 Model Specification and Measurement

The data analysis of this study involves a regression analysis. At this initial stage, a total of five independent variables are included in the model to predict the level of internal control as a discrete outcome (InternalControl).

The following regression equation is tested:

$$IC = \alpha + B1(ERPse) + B2(FirmSize) + B3(FirmAge) + B4 (Big4) + B5(Prof)$$

The dependent variable measure in the regression equation is:

*InternalControl:* An aggregated measure of 19 indicators on a five-point Likert scale ranging from 1 = totally disagree to 5 = totally agree on 19 statements reflecting the level of perceived internal control with regard to 1) control environment, 2) risk analysis and assessment, 3) control activities, 4) information and communication, and 5) monitoring of the COSO framework. A higher sum is expected to represent higher perceived internal control.

The independent variable measures are:

*ERPUse:* An aggregated measure of 11 indicators on a four-point scale ranging from 1 = 0-25% to 4 = 75-100% reflecting the level of use of a number of the most common modules of ERP system, such as Purchases, Sales,

Production, Finance, Controlling, and so on. A higher sum is expected to represent higher system use.

*Firm Size:* A measure indicating firm size, measured as the logarithm of firm turnover (of year 2010, which was available in the database Voitto+).

*Firm Age:* A measure indicating firm age, measured based on the year of company establishment (available in the database Voitto+).

*Big4:* Auditor type, a dummy variable reflecting whether the company is audited by a Big Four auditor or not. This data was also derived from the Voitto+ database.

*Prof:* Profitability was measured using ROA (income before extraordinary items divided by total assets) for year 2010. The ratio was derived from archival data. The ROA ratio has frequently been applied in contemporary research as a measure of profitability (e.g. Guerreiro et al., 2008).

## 4. Findings

### 4.1 Descriptive Data

The respondents were CEOs (15 %), CFOs (58 %), controllers (16 %) and IT managers (10 %), with long working experience (36 % reported 11-20 years, 32 % 21-30 years and 15 % 31-40 years), and thus considered having the relevant knowledge to respond to the questionnaire. The enterprises represent a variety of industries, but the majority (about half) operates in the manufacturing industry. All companies of the current sample have implemented an ERP system; about 26 % within the last 3 years, about one third within the last 4-6 years, 20 per cent within the last 7-10 years and another 20 % over ten years ago. No significant differences with regard to early and late responses were identified in the data, providing some support for the absence of a non-response bias. As all responded companies had implemented an ERP system, a second survey has been sent out to receive a control group of companies that do not use an ERP system.

The initial findings indicate that not many (only 11 %) of the medium-sized entities report information about their internal control to the public, but about half (44 %) report within the company. About 20 per cent argued that reporting on internal control added little value. Overall, regarding the respondents' perceptions about the level of the corporate internal control, investigated through 19 statements based on the COSO framework on a Likert scale 1-5 (where 1 indicated no agreement and 5 in total agreement), the mean in many statements indicated a perception of fairly good level. Further, the ERP system was seen to have had modest impact on the internal control. On a scale 1-5 (where 1 indicated no impact and 5 very strong impact), the effect was perceived to be the strongest on information and communication (mean 3.36)

and control activities (mean 3.30), and the weakest on the control environment (mean 3.0). The variation in mean values between the various COSO components is, however, very small, and all mean values are about 3, which would indicate modest impact based on the scale used.

**Table 1.** Correlations between variables in the regression model

	Int.Control	ERP_effect	Firm size	Firm Age	Big 4	Prof
InternalControl	1					
ERP_effect	.357**	1				
Firm size	.282**	.017	1			
Firm age	-.138	-.249*	.108	1		
Big 4	.206*	.054	.325**	.133	1	
Profitability	.125	-.074	.210*	.055	-.006	1

Pearson Correlation, Sig. (2-tailed), N =97

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

Before the conduction of the regression analysis, a test of the bivariate correlations between the variables in the regression model was conducted. The test statistics, shown in Table 1 give some evidence of significant correlations, but no multicollinearity problems.

## 4.2 Regression Analysis

Finally, a multiple regression analysis was performed on the data to assess the perceived impact of the ERP system on the perceived level of corporate internal control (Table 2). Other variables in the regression analysis were: firm size, firm age, audit firm (Big 4 or not) and profitability (measured as ROA). Additional data was extracted from a financial database and matched with the sample. The model was tested in SPSS and assessed by F statistics. The results indicate that ERP use and firm size (both significant at  $p < 0.05$  level) explain the variance in the level of internal control, whereas firm age, audit firm and profitability do not. The negative association between FirmAge and level of internal control was unexpected and needs further investigation.

**Table 2.** Results of regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.797	17.210		.279	.781
ERP_effect	.296	.090	.316	3.297	.001
Firm Size	9.922	4.093	.243	2.424	.017
Firm Age	-3.612	3.052	-.114	-1.184	.240
Big 4	3.752	2.934	.126	1.279	.204
Profitability	.037	.034	.105	1.104	.272

Dependent Variable: InternalControl

R Square 0.240; Adjusted R Square 0.197; F-statistics 5.672, sig. .000

The initial findings provide some support that the use of ERP systems also in this business environment is perceived to enhance the internal control of the firm. The research evidence also suggests that the level of internal control in unlisted companies is not only a matter of ERP systems, but other factors such as firm size would also explain the level of internal control.

## 5. Conclusions

This article set out to increase the understanding of the effect of ERP systems on the level of internal control. It was proposed that the use of an ERP system would have a positive effect on the firm's level of internal control, perceived by the respondents. More specifically, it was predicted that the level of internal control would be influenced by the use of an ERP system as well as firm characteristics, such as firm size, age, type of audit firm, and profitability. In support of the proposition, evidence was found that indicates that the level of use of ERP systems and firm size may significantly influence the level of internal control. No support was, however, found for firm age, audit firm type and profitability. Overall, the results show that the majority of the respondents perceive that the ERP system has rather moderate effect on the five inter-related internal control components of the COSO framework.

The findings of this study contribute to the contemporary, still limited research on internal control in privately held entities, as indicated in the introductory section. First, this study extends and strengthens the results of prior studies with empirical data among medium-sized, private firms. These results are believed to be important and useful for standards setters in further developing regulation for this type of companies. Second, this study extends prior studies by investigating the effect of the level of ERP system use (scope) through the level of the use of a number of ERP modules, in contrast to prior studies

where the use of ERP systems have been measured as a dichotomous variable (e.g., Morris, 2011).

Some limitations should, however, be taken into account. Some limitations are inherent to the survey method, such as the use of perceptual measures and the potential for common-method bias. Thus, the findings may be biased and relate to problems of human judgement. Further, many constructs were measured with only one item indicator. Although the single-item scales in this study showed adequate validity and reliability, it has been argued that multi-item scales have demonstrated greater reliability and validity overall. Furthermore, the sample size is small, which should be considered when trying to generalize the findings.

In summary, despite the belief that this study provides valuable insights, future research is needed to confirm these findings in different settings and using different methods. This rather exploratory analysis could, however, provide a basis for subsequent research. Future research could also identify other characteristics that can add to the prediction of internal control within SMEs. Further, the measure of level of internal control was a subjective one, and further studies could to develop the measurement of internal control or suggest a relevant proxy for this field where self-reported internal control weaknesses are almost non-existent.

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# Towards Key Concepts for Process Audits – A Multi-Method Research Approach

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## Abstract

In the audit domain it is agreed that a comprehensive understanding of the clients' business processes is crucial for effective and efficient internal and external audits. However, little attention has been paid to domain-specific concepts relevant to business process audits. Especially, few empirical research studies have been devoted to concepts, facilitating a comprehensive understanding of business processes from an audit perspective. To close this gap we conducted 17 semi-structured expert interviews in order to reconstruct key concepts of the audit domain and their relationships particularly focusing on process audits. As these expert interviews only formed a first step in our research endeavor to determine the information needs of process auditors, this paper presents the results of an extensive online survey. With the answers of 370 internal and external auditors we gained new insights to verify and complement the results of the expert interviews. A comparison of the results reveals that the relevance of identified audit concepts is confirmed whereas the classification of relationships between concepts is rather heterogeneous. Both results are jointly illustrated in a concept map. This map provides a useful starting point for the construction of an audit domain specific model.

**Keywords:** Audit Domain, Process Audits, Information Requirements, Survey

## 1. Introduction

It is widely acknowledged that auditors play a crucial role in preventing accounting scandals like Enron 2001, MCI WorldCom 2002, Parmalat 2003, Satyam 2009, or Olympus 2011. Inadequately conducted audits can result in corporate fraud and exceptional business turbulences. A crucial capability of auditors is the ability to process and assess information. In order to cope with increasing information respectively data volumes, auditors nowadays focus on business processes (Bell, 1997; Ruhnke, 2006). This approach is based on the assumption that well-controlled business processes lead to correct preparation, presentation and disclosure of financial statements. By now, the concept of process audits is also embedded in

international audit standards like ISA 315.81: “The auditor should obtain an understanding of the information system, including the related business processes, relevant to financial reporting (...)” (International Federation of Accountants (IFAC) 2010). Doing so, auditors are confronted with the steadily increasing complexity of today’s organizations and their business operation. They need to collect and process a huge amount of information from diverse sources in a short period of time. Moreover, they have to cope with complex and ambiguous domain-specific constructs like controls (Maijoor, 2000) and address the needs of various stakeholders (e.g. process owner, risk manager) with rather varying perspectives on audit tasks (Spira and Page, 2003).

Under these circumstances the creation of reliable audit results poses an increasing challenge. Therefore, the attention on the appropriate support for process auditors has picked up rapidly not only in practice but also in academia over recent years resulting in diverse research activities. Researchers from different areas aim at developing models, methods and information systems (IS) to effectively and efficiently support auditors. Thereby, various foci are set, ranging from automated tool support (e.g. computer-assisted audit tools (CAAT) (Ahmi, 2013), continuous auditing (Kuhn and Sutton, 2010), compliance checking (Becker *et al.*, 2012)) to domain-specific modeling languages (Strecker *et al.*, 2011). Although the potentials of conceptual models and process models are recognized in the audit domain (Bradford *et al.*, 2007), generic modeling approaches do not provide a full set of adequate constructs for relevant domain-specific concepts (Carnaghan, 2006; Strecker *et al.*, 2011). Notably, only few research attempts have been made to establish an in-depth understanding of concepts relevant to auditors when conducting process audits. Particularly, little effort has been devoted to empirically grounded studies on this topic. Most publications dealing with the information needs of auditors are dedicated to requirements derived from abstract audit standards or resulted from a discourse with single experts. The paper at hand addresses this research gap and presents the results of an online survey conducted among internal and external auditors especially focusing on process audits.

The work presented in this paper constitutes a second step in an ongoing research project that aims at developing effective support for auditors with an explicit focus on audits of accounting-related business processes. As a first exploratory step we conducted 17 expert interviews (Schultz *et al.*, 2012) to develop an initial empirically grounded understanding of relevant concepts for process audits. As a result, 12 audit concepts and their relations have been derived and combined in a concept map. A concept map consists of concepts and their relations and is a tool to organize and graphically represent information (Siau and Tan, 2008; Novak and Cañas, 2008; Zaniibbi, 2011). To validate and extend these results we have conducted the online survey mentioned before.

In this regard, the contribution of this paper is twofold: firstly, with the online survey we validate the results of the expert interviews regarding completeness of identified audit concepts and their relations. Secondly, we extend the results based on newly

gained insights: a relevance assessment of each concept and its relations regarding relevance is presented. Moreover, the different perspectives of internal and external auditors are outlined and the influence of auditor's working experience on the perception of audit concepts is elaborated. As a summary we present an enhanced concept map incorporating the survey results.

These results form a rigorous, empirically grounded basis for an information model for process audits. By involving main stakeholders in the construction of an information model we follow the approach for constructing an empirically grounded information model proposed by Ahlemann and Gastl (2007). An information model helps to reduce the complexity of the domain, fosters communication among stakeholders, and improves transparency regarding the concepts to be considered (Strecker *et al.*, 2011). It also facilitates the development of information systems (Wand and Weber, 2002) for effective and efficient support of process audits that is currently lacking (Racz *et al.*, 2010).

The next section describes related research. In *Section 3* the applied research method is outlined by explaining the three main elements of the survey: specification of the population and the sampling procedure, survey design, and data collection (Pinsonneault and Kraemer, 1993). *Section 4* presents research findings and limitations. In summary, a concept map illustrates the results graphically. The paper ends with a conclusion and implications for future research work.

## 2. Background and Related Research

This section presents the results of the literature review that is based on the approach of Cooper (1998) and considers the guidelines of Webster and Watson (2002) and Rowley and Slack (2004). It should be noted that the section only presents the most relevant literature – the focus is set on existing research results regarding audit-relevant concepts in the context of business process modeling.

On the one hand, audit firms consider process audits as an integral part of their audit approaches (Stuart, 2012) (Bell, 1997), not least because audit standards demand an in-depth understanding of the auditee's business processes (International Auditing and Assurance Standards Board (IAASB) 2009). On the other hand, existing enterprise modeling approaches include not only commonly accepted modeling concepts (e.g. data) but also domain-specific concepts as for instance controls. Literature focusing on business process modeling predominantly discusses audit-related modeling concepts from a risk or compliance perspective. Rosemann and zur Muehlen (2005) are among the first to consider the concept of risk in the business process modeling context. In doing so, they present a taxonomy of process-related risks and discuss how this taxonomy can be applied in the analysis and documentation of business processes. In an analogous procedure, Karagiannis (2008) describes a conceptual approach for integrating compliance management and business process management by using meta-modeling concepts. He also presents a business process-based solution to the SOx compliance problem. The proposed

solution aims at supporting SOx reporting requirements based on core business processes and a continuous improvement of the company's adopted business processes (Karagiannis, Mylopoulos, and Schwab 2007). Strecker et al. (2011) adopt a somewhat similar approach for the support of audit risk assessment. With their domain model for internal controls Namiri and Stojanovic (2007) also introduce similar concepts. The proposed approach is based on the formal modeling of internal controls in the validation process. For this reason, a semantic layer is introduced in which the process instances are interpreted according to a predefined set of controls. Moreover, they introduce recovery action and specific controls like IS general controls and application controls. With a strong focus on compliance, Sadiq *et al.* (2007) present a modeling approach for control objectives using a specialized modal logic and a corresponding process model annotation. Three publications in unison provide related approaches to test or measure the compliance of a business process model against a set of regulations and rules (Lu *et al.*, 2008; Governatori *et al.*, 2006; Governatori *et al.*, 2009). Earlier approaches use petri nets to formally model and evaluate controls within business processes for audit purposes (Pitthan and Philipp, 1997; Chen and Lee, 2003). Many more examples could be given. The integration of financial accounts into enterprise models has been discussed in literature (Vom Brocke *et al.*, 2011). However, this approach remains on an abstract level, incorporating the concept of accounts into a combined meta-model of ARIS and REA. Based on a review of auditing literature and corresponding standards, Carnaghan (2006) identified concepts relevant to process level audit risk assessment like process objectives, risks, controls and financial statement line items (accounts), to name only a few.

However, there are two factual points of criticism which the literature described before have in common. First, a comprehensive assessment of all possible concepts has not been undertaken by any of the afore-mentioned literature sources. As a matter of fact, research predominantly focuses on single aspects of the domain, rather than creating a full picture. This results in a motley landscape of individual work, inappropriate as a basis to the construction of a domain-specific information model. Second, up to now all research work is based on requirements derived primarily from reviews of relevant literature, standards and frameworks (e.g. COSO). Domain experts or stakeholders are not comprehensively involved. This neglects the general demand to integrate stakeholders into research.

In order to close this gap, expert interviews conducted beforehand identified 12 audit concepts. Thereby, an audit concept constitutes information about real world objects relevant for process audits. The online survey provides a short description for each audit concept, to ensure a mutual understanding among participants (see *Table 1*). Again, these short descriptions are derived from expert statements.

**Table 1.** Overview of Audit Concepts

Audit Concept	Short Description provided to Participants
Controls	Procedure that aims at preventing/ detecting an undesirable event or result, e.g. manual/ automated controls, key controls, application controls, preventative/ detective controls, IT general controls.
Process Flow	Sequence of interdependent or linked activities e.g. purchase-to-pay, warehousing, order-to-cash.
Risks	A threat of an event with negative effects, e.g. system breakdown, misstatement, fraud.
Data	Any type of electronic or paper-based input or output of a process activity, e.g. invoices, vouchers, contracts, reports.
Information Systems	Any combination of information technology and people's activities that support operations, management and decision making, e.g. ERP-Systems (SAP, JD Edwards, Microsoft Dynamics AX, etc.), accounting software (Lexware, Data Becker, etc.).
Audit Objectives	Overarching goal of an audit. It can be broken down into more detailed assertions or control objectives, e.g. reliability of financial statements, compliance of a process.
Organization	Any organizational unit, e.g. department, role, employee.
Standards& Regulations	Legislative rules or commonly excepted standards providing requirements/ guidelines for processes or their results, e.g. GAAP, SOx, COSO.
Audit Results	Result of a performed audit. It refers to a process and/ or individual controls and comprises assessments of design and operating effectiveness.
Materiality	"Information is material if its omission or misstatement could influence the economic decisions of users taken on the basis of the financial statements" ISA 320 (International Federation of Accountants (IFAC), 2010).
Financial Statements	Reports about an organization's financial results and conditions like balance sheet and income statement. On a detailed level the reports consist of accounts, e.g. assets, accounts payable.
Business Objectives	A specific result that an organization aims to achieve within a time frame and with available resources, e.g. profit.

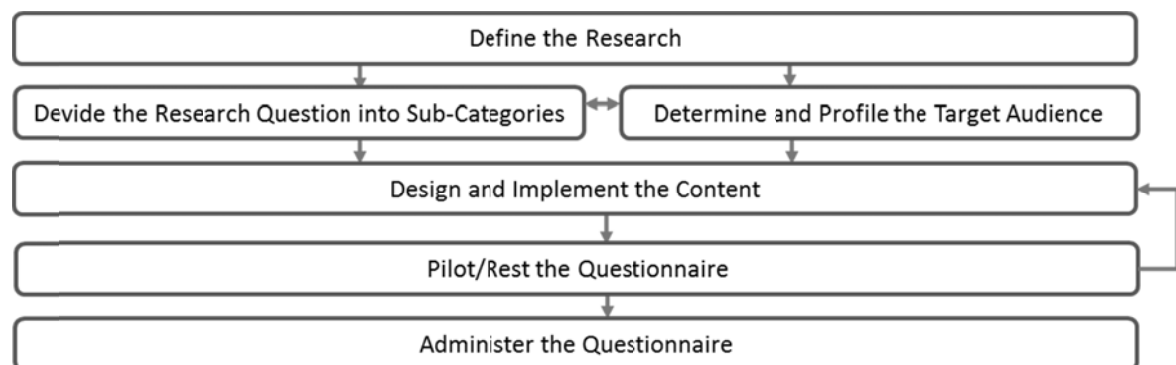


### 3. Research Method

Ahlemann and Gastl emphasize the early integration of empirical evidence in the process of constructing an information model. All propositions should be scrutinized with regard to their acceptance by a group of subject-matter professionals (Ahlemann and Gastl, 2007). Following this recommendation, the paper at hand applies a quantitative research method as it collects and analyses data from an online survey focusing on internal and external auditors with expertise in process audits. This work forms the second step of an ongoing research project. It complements initial empirical results regarding relevant audit concepts and their relations gathered through semi-structured expert interviews (anonymous). Combining different research methods (multi-method research) is meaningful for the complex topic under research as the “(...) collection of different kinds of data by different methods from different sources provides a wider range of coverage that may result in a fuller picture (...)” (Kaplan and Duchon, 1988, p. 575). In doing so, this paper validates the results of the expert interviews, reveals further relevant relations among audit concepts, and presents new insights into the audit domain.

#### 3.1. Survey Content

Surveys are a well-established and widely used method for data collection not, only in information systems research (Palvia *et al.*, 2004). The general approach for this online survey follows the process proposed by Lumsden and Morgan (2005)(Figure 1).



**Figure 1.** Design Process for Online-Questionnaires (Lumsden and Morgan, 2005)

The survey is primarily of a descriptive nature. The purpose of a descriptive survey is to find out what situations, events, attitudes or opinions occur in a population (Pinsonneault and Kraemer, 1993). However, the questionnaire has also explorative aspects as it seeks for additional audit concepts and relations (for a classification of explorative, descriptive, and explanatory surveys see (Pinsonneault and Kraemer, 1993)).

The survey divides the overall research question “*What are information requirements of internal and external auditors in the context of business process audits?*” into two subcategories:

1. What are relevant audit concepts for process audits?
2. What kinds of relations do exist between these audit concepts?

The survey is divided into three parts: the first part contains general questions concerning the respondents’ organization (size, field of business, number of employees dealing with process audits), the respondent’s work experience and his role in the organization. Part two asks the respondents to assess the relevance of audit concepts in context of a process audit. The given list of audit concepts is derived from the expert interviews (see *Table 1*) (anonymous). This part also provides an option to add additional audit concepts. Part three analyzes the relations between audit concepts. *Table 2* lists the three parts of the questionnaire.

**Table 2.** Questionnaire Structure

Part	Topic	Questions
<b>1</b>	<b>Respondent’s organization, role, work experience</b>	Q1-Q5
	1. Which sector is your company operating in?	
	2. How many employees work at your company?	
	3. How many employees primarily work in the department for process audits?	
	4. What is your job description?	
	5. How many years of experience do you have in process auditing?	
<b>2</b>	<b>Relevance of audit concepts</b>	Q6, Q7
	6. Please assess the relevance of the following audit concepts in order to obtain a comprehensive audit result of a business process audit?	
	7. Are there any other concepts to be considered when conducting a process audit?	
<b>3</b>	<b>Relations between audit concepts</b>	Q8, Q9
	8. Which audit concepts are directly related to each other?	
	9. Please describe the relation in your own words?	

The answer possibility of question six is a Likert-Scale ranging from “very relevant” to “very irrelevant”. Liker-Scales are frequently used for measuring constructs as they are easy to construct and administer (Baker, 2003). The questionnaire uses a seven-option scale. Research has shown that response-scales with five or seven options are the method of choice. This questionnaire utilizes a seven-option response scale as it is more reliable (Cronbach, 1951) and allows for greater differentiation (Finn,

1972) (Masters, 1974). Along with a seven- options Likert-Scale comes a “Middle Option” increasing the reliability and validity of results (Lietz, 2010), p. 206). Moreover, a “Don’t Know” option is provided for this question as there is a significant difference between participants actually not knowing an answer or forgetting to give one. Question eight offers a matrix with check-box answer possibilities. Each of these check boxes represents a possible relation between two audit concepts. Many sources dissuade from using matrix questions. However, the particular nature of the participants allows us to use them. Morrison et al. (2008) state that “(...) *a matrix may be useful when inter-relationships among data items must be preserved, and when respondents’ familiarity with tables has been well established*”. Question seven and nine asks the participants to fill in a free-text field. The visible input field highly influences the length of a given answer. To foster short and concise answers the text field in the questionnaire contains a maximum of 40 visible letters.

### 3.2. Survey Design

Many researchers publish guidelines on the design of online questionnaires. Morrison et al. (2008) outlines one of the most comprehensive guidelines for the construction of questionnaires based on a wide range of preliminary work. Those guidelines were published and applied by the Economic Directorate of the United States of America and represent a sound foundation. Moreover, the questionnaire considers the recommendations for online surveys from Lumsden and Morgan (2005). The following paragraphs present general design decisions based on these two guidelines. They are clustered in three categories: technical, design, and language.

**Technical requirements** include the support of multiple platforms and browsers. The questionnaire satisfies this requirement by only relaying on standard HTML and the minimal use of java script. As demanded by Smith (1997), it is possible to interrupt and reenter the survey. Furthermore, the online questionnaire randomly sorts all answer possibilities. By doing so, the influence of the order of answer possibilities does not affect the overall result (Lietz, 2010; Galesic and Bosnjak, 2009; Baker, 2003).

Besides the guidelines of Morrison et al. and Lumsden, the **design** of the questionnaire was based on further recommendations. The questionnaire starts with an invitation text that explains the nature of the survey, demonstrates third-party trustworthiness, and defines an incentive (a free copy of research results) (Andrews et al., 2003; Schonlau et al., 2002). Following the advice of Andrews et al. (2003), the questionnaire starts with personal questions, presenting them at the end of a questionnaire partially results in drop-outs. In order to prevent drop-outs we included a “Don’t Know” option in all questions (Schonlau et al., 2002).

The last class of requirements took different language-related aspects into account ranging from the length of questions (the length should not exceed 16 to 20 words (Brislin, 1986; Oppenheim, 2000; Payne and Payne, 1951)) over the type of

questions (no double-barreled questions as well as no negative questions should be used due to the level of complexity (Andrews *et al.*, 2003)), and to the wording of a question (formulated in a simple way (Dillman *et al.*, 1998), and use simple grammar (Lietz, 2010)).

### **3.3. Population, Sampling and Data Collection**

The target population of this survey comprises individuals with working experience as internal or external auditors in the subject area of process audits. In a first step, the survey is limited to German-speaking countries. This restriction is not likely to have an influence on the representativeness of the results since international audit standards force auditors to use similar approaches worldwide, e.g. (International Federation of Accountants (IFAC), 2010). Moreover, the addressed respondents mostly work for globally operating companies and are confronted with diverse regulatory and internal requirements of all important markets and regions world-wide. The survey includes the operational (auditors conducting process-audit field work) as well as the management perspective (senior auditors responsible for audit planning and supervision).

By utilizing social and professional networks (e.g. XING), large auditor associations (e.g. DIIR, ISACA) and online forums auditors get invited. Additionally, the Top 25 German audit companies<sup>1</sup> were contacted (based on (Lünendonk, 2012)) and we invited the internal audit departments of the Top 100 German companies to participate.

The approach described above uses a non-probabilistic method to select respondents (survey type: unrestricted self-selected survey) (Couper, 2000). Considering this fact, the analysis in *Section 4* especially pays respect to the generalizability of findings. However, in our opinion the survey results reflect a mutual understanding regarding information requirements for process audits of the target population. The purposeful distribution of invitations covers the targeted population comprehensively. The approach does not systematically exclude any sub-group resulting in a low coverage error (mismatch between the target population and the sample frame) (Couper, 2000). By carefully applying pertinent guidelines for (web-) survey design the survey reduces the measurement error to a minimum (deviation of the answers of respondents from their true values on the measure) (Couper, 2000).

As demanded by several authors, a pilot test was carried out (Gräf, 2002; Lumsden and Morgan, 2005; Baker, 2003). The pilot test followed the procedure defined by Andrews *et al.* (Andrews *et al.*, 2003). In total, the pilot test trialed eight participants. Based on the results of the pilot tests adjustments were made especially regarding a more precise wording of the questions.

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<sup>1</sup> including Deloitte, E&Y, KPMG, PwC, and BDO

The questionnaire was placed online for two months starting from October 15th until December 15th, 2012. A total of 463 respondents, 370 of which completed all three question parts, participated.<sup>2</sup>

## 4. Analysis and Research Findings

### 4.1. Descriptive Statistics of Respondents

Table 2 and Table 3 present descriptive statistics of the participants and their organizations. In the course of the research Section 4 builds groups based upon the information presented here. Therefore, an understanding of the distribution of single variables is beneficial. The variables sector and number of employees is especially noteworthy because of their unequal distribution. For later presented research, the distribution of sectors and job position are of particular interest.

**Table 3.** Characteristics of Respondent's Organization

Aspect	Values	# of respondents	percentage
Sector	Audit company	263	0.71
	Consulting	8	0.02
	Service Sector	69	0.19
	Production sector	30	0.08
number of employees	< 250	17	0.05
	250 - 1,000	21	0.06
	> 1,000	332	0.89
Size of process audit department (number of employees)	< 10	65	0.17
	10 - 30	28	0.08
	> 30	277	0.75

**Table 4.** Respondent's Characteristics

Aspect	Values	# of respondents	percentage
Job position	Auditor	160	0.43
	Senior Auditor	147	0.40

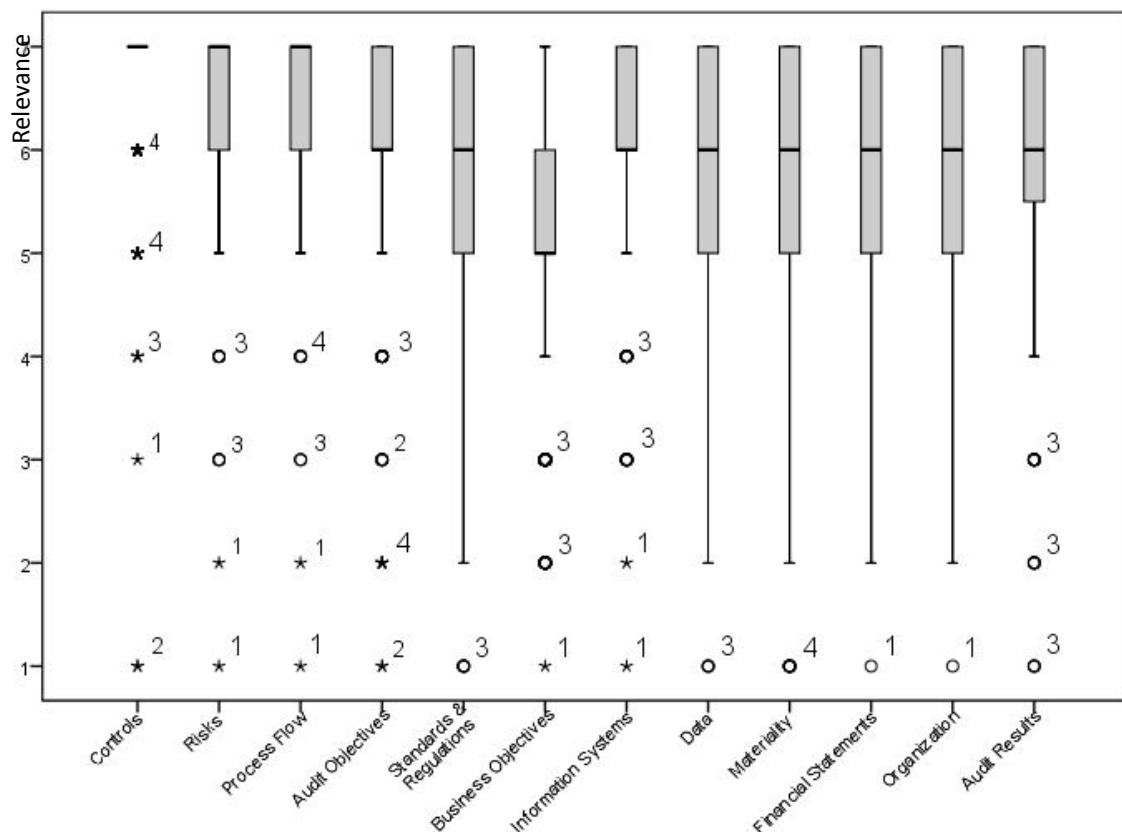
<sup>2</sup> For comparison only, this number of respondents clearly exceeds the minimum sample size for a population of 10,000 individuals (Bartlett, Kotrlik, and Higgins 2001).

	Head Internal Audit/ Partner	57	0.15
	Internal Controls responsible	6	0.02
Process audit experience (in years)	< 2	93	0.25
	2 - 4	95	0.26
	5 - 10	115	0.31
	> 10	67	0.18

## 4.2. Concepts

Part two of the questionnaire focuses on the audit concepts and their relevance in the context of a process audit. The respondents assess each of the 12 audit concepts on a seven-option Likert-Scale ranging from “very relevant” (7) to “very irrelevant” (1). Based on these data, the median 0.25-Quartile and 0.75-Quartile for each audit concept are depicted in Figure 2 as a boxplot. The majority of respondents rated 11 out of 12 audit concepts as “very relevant” (median = 7) or “relevant” (median = 6). Only the concept “business objectives” was ranked as “rather relevant” (median = 5). Moreover, for all concepts the analysis reveals a small interquartile range (maximum two scales). When considering outliers (depicted by an asterisk or circle) separately, the analysis reveals rather small ranges within the responses for five out of 12 audit concepts (from 5 – “rather relevant” to 7 – “very relevant”). In contrast, the range for the remaining concepts is larger (from 2 – “irrelevant” to 7 – “very relevant”) indicating a more varying assessment of relevance among the respondents. However, as the number of outliers in Figure 2 indicates, respondents rarely chose the answer options “very irrelevant” and “irrelevant” (less than 2%).





**Figure 2.** Relevance of Audit Concepts

The analysis utilizes the Cramer V and Chi-Square Test ( $\alpha = 0.05$  and degree of freedom ( $df$ ) = 6)<sup>3</sup> in order to analyze whether the frequency of responses significantly differs depending on sector or process audit experience of the respondents. For a sector analysis all respondents are grouped: external auditors are respondents from audit companies, whereas internal auditors are all remaining respondents. The analysis shows significant but weak dependencies for the concepts Financial Statements ( $\chi^2 = 35.55$ ; Cramer-V = 0.31), Materiality ( $\chi^2 = 20.56$ ; Cramer-V = 0.237), and Business Objectives ( $\chi^2 = 12.81$ ; Cramer-V = 0.186). Although the median for financial statements and materiality is 6 in both groups, the corresponding interquartile ranges indicate that external auditors consider both concepts as more relevant than internal auditors (Financial Statements: range from 6 to 7 for external and from 4 to 6 for internal auditors; Materiality: range from 5 to 7 for external and from 5 to 6 for internal auditors). In contrast, internal auditors assess the concept Business Objectives as more relevant (median = 6) compared to external auditors (median = 5).

Regarding respondents' process audit experience the analysis (Chi-Square Test at  $\alpha = 0.05$  and  $df = 18$ ) reveals significant but weak dependencies for the concepts Process Flow ( $\chi^2 = 33.81$ ; Cramer-V = 0.303) and Materiality ( $\chi^2 = 31.5$ ; Cramer-V = 0.169). Auditors with less than 2 years of process audit experience consider the

<sup>3</sup> IBM SPSS Statistics Version 21.0.0.0 is used as analysis software.

concept Process Flow as less relevant (median = 6) than more experienced auditors (median = 7). For the concept Materiality the median is 6 and the interquartile range is 2 in all experience categories (from 5 – “rather relevant” to 7 – “very relevant”) except for auditors with an experience from 2 to 4 years. For this category the interquartile range is 3 (from 4 – “neither nor” to 7 – “very relevant”).

Part two of the questionnaire also provides an option to add new concepts. Only a minority of respondents used this optional step in the questionnaire (11 respondents, 0.03% of all respondents). Table 5 lists all concepts that are additionally mentioned by respondents. Based on the previously given understanding of audit concepts all of these could be subsumed under existing concepts.

**Table 5.** Mapping of additional Concepts added by Respondents

Audit Concept	Additionally mentioned concepts (# of respondents)
Process Flow	Process Interfaces (1), Process Maturity Level (1)
Standards and Regulations	Internal guidelines (3), good/best practices (1), Process Instructions (1), Data Security (1)
Data	Resources (1), Input/ Output (1), Supporting Documentation/ Vouchers (1), Quantity Structure (1)
Business Objective	Process Goals (1), Target Values (1), Efficiency, Costs, budget (1), Measurements (1)
Organization	Roles (1)
Risks	Sources of Error (1)

Overall, the results of the online survey coincide with findings of the expert interviews. As the survey does not reveal additional concepts we conclude that there are particular concepts that are commonly considered by auditors when conducting a process audit. These should be taken into account when constructing information models for the audit domain or developing corresponding IS. Furthermore, the respondents share the experts' view on the degree of relevance: Process Flow, Risks, and Controls are more relevant, whereas Business Objectives are assessed as less relevant. The small interquartile range (maximum two scales) for all audit concepts underlines a rather consistent comprehension among the respondents regarding the relevance of concepts. These results can be used to derive appropriate *levels of detail* of audit-relevant information in information models and IS. However, significance tests on the survey data reveal noteworthy differences between internal and external auditors. External auditors consider Financial Statements and Materiality as more relevant whereas internal auditors emphasize the concept Business Objectives. This again corresponds to the results of the expert interviews where a shift away from Financial Statements to Business Objectives was identified for internal auditors. These results call for considering the *particular perspectives of internal and external auditors* in information models and IS. The determined

differences in the relevance assessment depending on the experience of auditors underline that IS aiming to support process audits should consider different level of user experience.

### 4.3. *Relations*

Survey part three asks the participants to externalize their comprehension regarding the relations between the afore-mentioned audit concepts. In a first step, they indicate whether a relation between two particular concepts exists or not. The median for the number of relations per respondent was 23. In comparison with this, the experts median was 14 relations. Looking at the complete list of identified relations over all respondents the audit concepts Controls, Risks, Process Flow, Information Systems, and Financial Statements were mostly linked to other concepts (above-average). This corresponds to the results in *Section 4.2*: these concepts are among the ones with the highest relevance rating.

All possible relations have been indicated as relevant by at least 32 respondents. As shown in *Figure 3* the percentage of respondents that indicate a relation as important ranges from 10.6% to 78.4%. The analysis reveals 17 relations that were marked by a majority of respondents. Again, concepts rated as most relevant (Controls, Risks, Process Flow, Information Systems, Data) are more frequently included in these relations. Five out of the 17 relations were not previously derived as a result of the expert interviews: Standards&Regulations <> Financial Statements, Financial Statements <> Data, Audit Objectives <> Audit Results, Risk <> Materiality and Business Objectives <> Organization. On the contrary, there are 14 relations that were derived from the expert interviews but are not marked as relevant by the majority of survey respondents. 15 relations are only mentioned by less than 25% of the respondents. These relations were not included in the results of the expert interviews.

Overall, there is a broad variety regarding the assessment of relations between audit concepts. Therefore we subdivide the relations into three groups for further analysis:

- *Relations with high empirical support*: All relations are supported by the majority of the online survey respondents and included in the results of the expert interviews (12 relations – highlighted in black)
- *Relations with medium empirical support*: All remaining relations that are supported by the majority of the online survey respondents or included in the results of the expert interviews (additional 5 relations from the survey – highlighted with horizontal stripes; 14 relations from the expert interviews – highlighted with cross strips)
- *Relations with low empirical support*: All remaining relations (35 relations)

These three groups are depicted in *Figure 3*, whereby the first number in this figure represents the percentage of survey participants and the second number the count of experts indicating a relationship between two concepts during the interviews.

	Risks	Process Flow	Audit Objectives	Standards & Regulations	Business Objectives	Information Systems	Data	Materiality	Financial Statements	Organization	Audit Results
Controls	0,78 / 16	0,77 / 16	0,43 / 12	0,44 / 4	0,30 / 0	0,63 / 10	0,42 / 9	0,37 / 0	0,47 / 0	0,53 / 10	0,47 / 11
Risks		0,68 / 13	0,50 / 8	0,39 / 0	0,55 / 4	0,48 / 8	0,30 / 0	0,56 / 0	0,47 / 15	0,45 / 0	0,48 / 0
Process Flow			0,36 / 0	0,37 / 5	0,45 / 4	0,63 / 15	0,45 / 8	0,25 / 0	0,43 / 15	0,65 / 15	0,34 / 4
Audit Objectives				0,48 / 0	0,28 / 0	0,16 / 0	0,19 / 13	0,46 / 0	0,41 / 9	0,19 / 0	0,55 / 0
Standards & Regulations					0,28 / 0	0,27 / 0	0,18 / 0	0,27 / 0	0,62 / 0	0,31 / 0	0,44 / 0
Business Objectives						0,25 / 0	0,15 / 0	0,17 / 0	0,27 / 0	0,59 / 0	0,21 / 0
Information Systems							0,70 / 10	0,15 / 0	0,54 / 3	0,43 / 0	0,22 / 0
Data								0,28 / 0	0,61 / 0	0,19 / 0	0,33 / 13
Materiality									0,54 / 11	0,11 / 0	0,49 / 0
Financial Statements										0,19 / 0	0,39 / 0
Organization											0,22 / 0

**Figure 3.** Relations between Audit Concepts

The following paragraphs focus on relations with high or medium empirical support (in total 31 relations) in order to present only important results.

For these 31 relations the analysis utilizes the Cramer V and Chi-Square Test ( $\alpha = 0.05$  and  $df = 1$ ) in order to assess whether the frequency of responses significantly differs depending on respondents' sector or process audit experience. The analysis reveals significant but weak dependencies for eight relations. Internal auditors more frequently indicate a relation between: Process Flow <> Standards&Regulations and Business Objectives; Controls <> Standards&Regulations and Information Systems; Risks <> Business Objectives and Information Systems. In contrast, external auditors significantly emphasize the relation between Audit Objectives and Financial Statements.

Regarding respondents' process audit experience the analysis (Chi-Square Test at  $\alpha=0.05$  and  $df=3$ ) shows that auditors with more working experience select relations among the concepts Process Flow, Controls, and Risks significantly more frequently. Moreover, it is apparent that the relations including the concept Process Flow are more important for auditors with higher experience. In total, the relations between Process Flow and nine other concepts (Controls, Risks, Standards&Regulations, Business Objectives, Information Systems, Data, Financial Statements, Organization, Audit Results) are significantly more frequently selected by these auditors. They also highlight the relations of Audit Objectives and Business Objectives <> Risk significantly more often.

In conclusion, the analysis regarding the relations between audit concepts supports the results from the expert interviews. Firstly, a rather high number of relations exists between audit concepts which are considered as relevant. Secondly, there is a rather heterogeneous perception of relevance for each relation by the experts and survey respondents. This is an indicator for the complexity of process audits and corresponding information requirements. The results of the survey may help to tackle

this complexity. The three levels of empirical support can be used to prioritize the concepts and relations for an information model or corresponding IS and defines appropriate *levels of details*. Moreover, significance tests on the survey data reveal noteworthy differences between internal and external auditors as well as variances depending on the working experience of an auditor. As internal auditors emphasize the influence of Standards&Regulations and Business Objectives on Process Flow, Risks and Controls, these aspects should be particularly taken into account when designing IS for this user group. The same applies to external auditors and their focus on the relation between Audit Objectives and Financial Statements. The results regarding working experience call for a dedicated support for different experience levels. The analysis reveals that more experienced auditors have a more integrated view on the concepts Process Flow, Risks and Controls and their relations among each other. Furthermore, experienced auditors' perspective is more process-oriented. Analysis results show that the Process Flow is the focal concept linked to most other concepts. Both aspects should be considered in corresponding IS to appropriately support audits on different experience levels.

In the last section of the survey the participants are asked to name resp. label the relations they have identified in their own words. For each relation an analysis with the help of MAXQDA<sup>4</sup> (version 10) determines the frequency of words in the answers given. Depending on the word frequency the concept map either uses the most or the two most- mentioned verbs. As an example, the word-frequencies analysis derived "minimize" and "reduce" as labels for the relation between controls and risks.

As the relations are displayed in random order during the survey to avoid the influence of the sorting, a direction of the relation could not be derived from the labels. Therefore, the direction derived from the expert interviews is kept for the concept map presented in the next section.

#### **4.4. Concept Map**

Starting from the concept map derived from the expert interviews, this section incorporates the results gained by the survey. Figure 4 depicts the updated concept map. It displays the following old information:

- Gray-shaded boxes depicting the 12 concepts
- The first number in each box lists the number of experts considering the concept as relevant
- The first number under each relation depicting the number of experts considering the relation as relevant

In addition, the map presents new information based on the survey:

- The second number in brackets in each concept box depicts the median of the relevance assessment (*Section 4.2*)

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<sup>4</sup> MAXQDA is software for qualitative text and content analysis. For further information please refer to <http://www.maxqda.com/>

- Five new relations are supported by more than 50% of the survey respondents (Standards&Regulations <> Financial Statements; Financial statements <> Data; Risk <> Materiality; Audit Objectives <> Audit Results; Data <> Financial Statements; Business Objectives <> Organization) (Section 4.3)
- Labels of all relations between concepts according to the performed word-frequency analysis (Section 4.3)
- The second number under each relation label adding the percentage of respondents considering this relation as relevant (Section 4.3)

Figure 4 depicts the resulting concept map including 12 audit concepts and 31 relations. Each node of the map includes following information: <Name of the Audit Concept><number of experts mentioned the concept><median of relevance assessment>. Each link contains the following information: <label of relation><number of experts mentioned relation><percentage of respondents mentioned relation>.

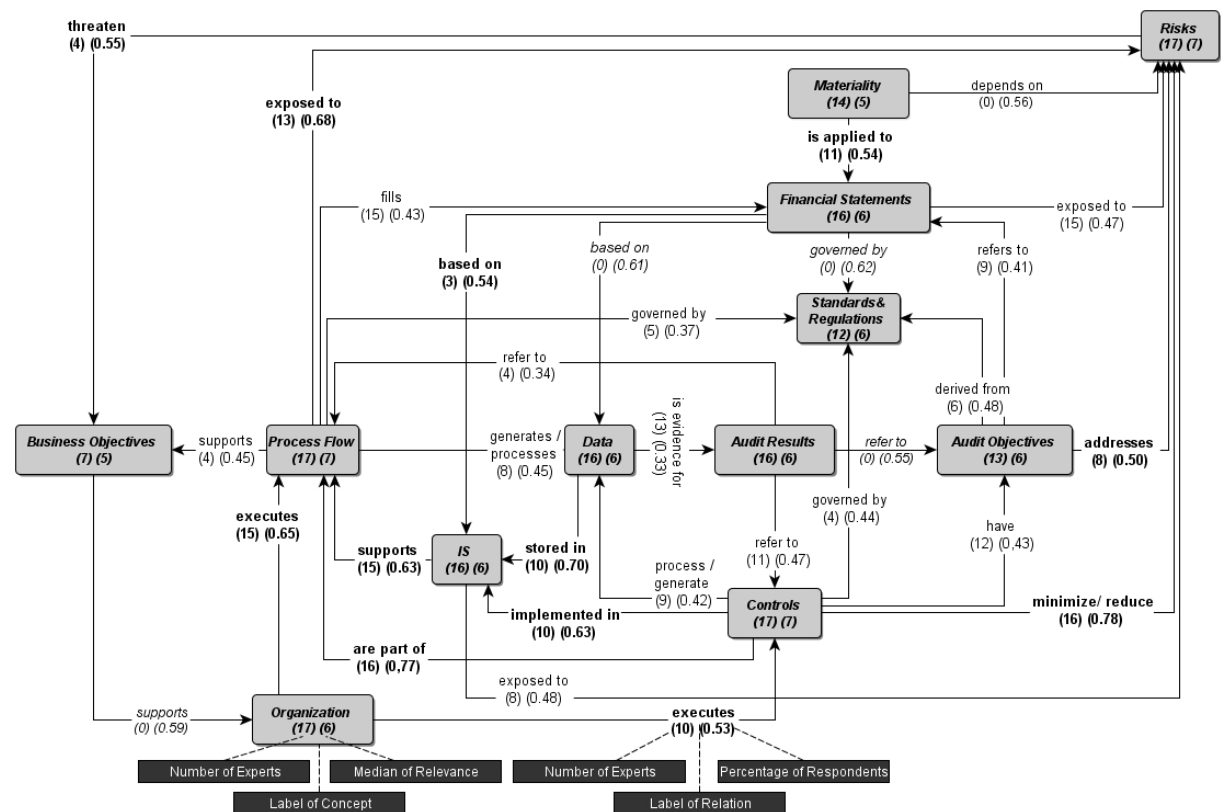


Figure 4. Concept Map for Process Audits

## 4.5. Limitations

This paper proposes opportunities for further development which have not been included in its scope for different reasons. However, it is important to point them out in order to facilitate future research and allow for an independent evaluation of the presented results. One aspect could be the expansion of the survey population. Until now, only respondents from German speaking countries could participate. The



expansion to other languages, as for instance English, would significantly extend the basis population. Furthermore, the survey presented in this paper primarily covers participants from companies with more than 1,000 employees (see *Table 3*). Changing this circumstance would also widen the population and therefore give a more complete picture as it allows for a comparison of small and large companies.

From a statistical perspective, the non-probabilistic method used to select respondents does not allow to generalize the presented results for the targeted population. However, by covering the targeted population comprehensively through purposefully distributed survey invitations and applying pertinent guidelines for survey design, we believe that the results portray a common understanding of the domain.

Another aspect is the complexity of identified relations between audit concepts. Up to now each respondent labels the relations in their own words resulting in a vast number of different labels for every relation. Moreover, cardinalities as well as the directions of relations have not yet been explicitly surveyed. In order to build a domain-specific model this seems to be a necessary next step.

## 5. Conclusion and Future Research

We conducted an online survey among internal and external auditors in order to determine their information needs, especially in the context of process audits. The 370 respondents originate from a wide range of different organizations ranging from the Top 25 audit companies in Germany to the internal audit departments of organizations operating in diverse sectors.

This online survey formed a seconded step in a larger research project. The aim of the survey was to verify and complement the results derived from expert interviews on a quantitative basis. Regarding the audit concepts the analysis revealed that a mutual understanding of the experts and respondents exists. 12 audit concepts are derived which are regarded as relevant for process audits by the experts as well as by the survey respondents. Concerning the relations among these audit concepts the results are more widely spread. All possible relations were classified as relevant by at least 30 respondents but there are only a few relations classified as relevant by the majority (more than 50%) of the respondents. We derived similar results from the expert interviews. The findings suggest that attention has to be paid to specific relations when constructing an information model for process audits. Moreover, analyses of the survey data reveals noteworthy differences between internal and external auditors and different experience levels of auditors. External auditors consider the concepts Financial Statements and Materiality as more relevant, whereas internal auditors stress the concept of Business Objectives. Experienced auditors have a more integrated view on the concepts Process Flow, Risks and Controls and underline the importance of the concept Process Flow, as it provides a link to most of the other concepts. The here presented results form a rigorous, empirically grounded basis to design an information model and IS artifacts for

providing effective support to the audit domain that is currently lacking (Racz *et al.* 2010).

Against this background, future research needs to establish a comprehensive understanding of each identified relation. Moreover, in order to build a domain-specific information model, cardinalities as well as unambiguous labels for relations need to be defined. Future research might also further investigate different information needs of different stakeholders. As has been shown internal and external auditors differ in their requirements as well as experienced auditors compared to auditors with a relatively short work experience. A more detailed analysis would be necessary to fully understand these differences and how to address them in a comprehensive domain-specific information model. Last but not least, an expansion of the survey population to non-German-speaking countries seems meaningful. Even though international regulations and guidelines standardize audit work as far as possible, cultural difference cannot be fully neglected.

From a methodological point of view, the present study underlines that “(...) adopting a particular paradigm is like viewing the world through a particular instrument such as a telescope, and x-ray, machine, or an electron microscope. Each reveals different aspects but each is blind to others” (Mingers, 2001, p. 244). By combining expert interviews and an online survey we gained new insights leading to a more complete picture of information requirements for process audits.

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# Management Accounting Adaptability in an Integrated Information System Environment

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## Abstract

In this study, we explore the relationship between the qualities of the information system environment and management accounting adaptability. The information system environment refers to three distinct elements: the degree of information system integration, system flexibility, and shared knowledge between business unit managers and the IT function. We draw on the literature on integrated information systems (IIS) and management accounting change and propose a model to test the hypothesized relationships. The sample for this study consists of Australian companies from all industries.

## 1. Background

Support for management accounting is provided by solutions such as Enterprise Resource Planning Systems (ERPS) and budgeting software (Granlund and Malmi, 2002, Rom and Rohde, 2007). ERPS' provide easy and fast access to operational data which in turn affect the ability of management accounting to provide managerially relevant and usable information (Cooper and Kaplan, 1998). ERPS' are also known as IIS, since the software in itself or when used in conjunction with other software (e.g. business intelligence solutions) is *integrated* in the sense that data are stored in one place and computers can communicate with one another through a shared network (Rom and Rohde, 2007).

There exists a considerable amount of research on IIS which started to emerge in the late 90's, in parallel to large-scale software implementations in the industry. Much of this earlier research focused on the impact of ERPS on corporate performance (e.g. Poston and Grabski, 2000, Hunton et al., 2003, Nicolaou, 2004, Nicolaou and Bhattacharya, 2006). Although, the initial findings were not highly supportive in terms of the impact of ERPS on organizational financial performance, more recent studies found an indirect

relationship between the two through improvements in business processes (e.g. Wieder et al., 2006, Velcu, 2010).

Researchers have also looked at the relationship between IIS and management accounting or control (e.g. Granlund and Malmi, 2002, Scapens and Jazayeri, 2003, Rom and Rohde, 2007, Chapman and Kihn, 2009, Wagner et al., 2011). Often, this relationship is considered unidirectional, i.e. that IIS impacts management accounting (Rom and Rohde, 2007), as difficulties of changing ERPS forces companies to work with initial configurations and failures (Davenport, 1998, Dechow and Mouritsen, 2005). This would suggest that the adoption of new management accounting techniques would become difficult once a system is in place. On the other hand Rom and Rohde (2007) claim that there may be a bidirectional relationship between IIS and management accounting. Rom and Rohde (2007) argue that users can reconfigure the systems incrementally, leading to significant changes over time. Quattrone and Hopper (2006) illustrates a case where such reconfigurations lasted for four years, leading to a continuous state of drift. Wagner et al. (2011) also reports on a post-roll-out modification but in this case, the ERPS was reconfigured to match the functionality of the legacy systems for its grant accounting module. Overall, research focusing on the adoption of IIS found that ERPS implementations had no significant effect on management accounting techniques (Scapens and Jazayeri, 2003). In contrary, it is suggested that ERPS might have a stabilising effect on management accounting practice (Granlund and Malmi, 2002).

Despite the advent of IIS and its profound impact on the way processes are executed, an earlier study reported that companies continue to use separate spreadsheets or software for Balanced Scorecards (Kaplan and Norton, 1992) and Activity Based Costing (Cooper and Kaplan, 1991). These software programs are more user-friendly and flexible with regards to analysis and reporting (Granlund and Malmi, 2002).

ERPS' have significantly evolved since their inception with the development of new software paradigms such as Service-Oriented Architecture and Cloud Computing offering improved analytical capabilities than before. However the same question remains: once the software is implemented, how does it impact management accounting? Does it facilitate or hinder change?

Contingency theory suggests that management accounting practices in organizations reflect the idiosyncratic circumstances internal and external to the firm (Burns and Stalker, 1961, Lawrence and Lorsch, 1986). One of the earliest adopters of contingency theory in management accounting research is Hofstede (1967), who explained the functioning of the budgeting system through economic, technological, and sociological factors. Consistent with this theory, also management accounting change was found to be associated with global competition and changes in technology (Waweru et al., 2004), the performance gap (Jun Lin and Yu, 2002), organizational structure (Cavalluzzo and Ittner, 2004, Abernethy and Bouwens, 2005), top management support (Cavalluzzo and Ittner, 2004), and the influence of government (Lapsley and Wright, 2004). There is also evidence that the type of strategy may have an impact on the use of management accounting techniques. For example, with

the differentiation strategy, companies tend to use advanced management accounting practices such as quality improvement programs, benchmarking, and activity-based management (Baines and Langfield-Smith, 2003). Also Fullerton et al. (2012) report that companies with lean manufacturing strategies adopt different types of management accounting and control techniques. Given that contingent factors are likely to change over time, management accounting adaptability becomes critical to sustain the fit. However, barriers to change exist, with IIS being possibly one of them (Rom and Rohde, 2007).

Management accounting change may be supported (or limited) by the flexibility (inflexibility) of the information technology architecture of a company. Flexibility has been recognized as an important element of an organizations' IT infrastructure (Byrd and Turner, 2000). Davenport and Linder (1994) view IT infrastructure flexibility as a core competency and that IT infrastructure should enable change to be able to effectively respond to new market conditions. IT infrastructure as a concept can be divided into two related components: a technical IT infrastructure and a human IT infrastructure (Henderson and Venkatraman, 1992). The technical IT infrastructure entails the integration and interconnectedness of telecommunications, computers, software, and data so that all type of information can be expeditiously and effortlessly routed through the network and processes (Rockart et al., 1996). The human IT infrastructure refers to human and organizational skill, expertise, competencies, knowledge, commitments, values, norms, and organizational structures (Henderson and Venkatraman, 1992, Henderson and Venkatraman, 1993, Broadbent and Weill, 1997, Broadbent et al., 1999). Gebauer and Schober (2006) define information system flexibility in terms of the flexibility-to-use and the flexibility-to-change the system. Flexibility-to-use refers to the range of process requirements met without requiring a major change to the IS. On the other hand, flexibility-to-change refers to the degree to which a system can be changed in the future (Gebauer and Schober, 2006).

In-depth knowledge of technologies, processes, and people in and across diverse functional areas is recognized as drivers of organizational performance (Badaracco Jr, 1990). This is also true for the IS group's ability to effectively work with diverse functional groups (Rockart and Short, 1991). This relationship has only intensified over the recent years as business processes have become more embedded in technologies such as ERPS. Thus line management today is heavily dependent on the IS group for technical support and for changes required to the existing systems. This can only be accomplished through *shared knowledge*, which is defined as an understanding and appreciation among IS and line managers for the technologies and processes that affect their mutual performance (Nelson and Coopridier, 1996).

This study does not focus on change per se, as change is not the end but instead views *adaptability* as an important capability that can allow for changes to management accounting when necessary, i.e. when internal or external conditions change. For example, organizations might decide to

switch to Activity Based Costing or incorporate some additional key performance indicators into their scorecards/dashboards. Hence, the level of management accounting adaptability would determine the extent of such modifications. This could be considered a capability since it is known that companies capable of changing their management accounting practices are more likely to outperform companies that are more static (Baines and Langfield-Smith, 2003).

According to the Resource Based View of the firm, capabilities refer to an organization's ability to assemble, integrate, and deploy valued resources to achieve competitive advantage (Russo and Fouts, 1997). Resources include tangible, personnel-based, and intangible resources (Grant, 1991). Physical assets such as plant, equipment, and inventory are examples of tangible resources. Intangible resources refer to reputation, brand image, customers, and information systems. The focus of this paper is the information system and its characteristics (degree of integration and flexibility). Personnel-based resources include technical know-how, organizational culture, training, and loyalty. Shared knowledge as well as the skills and attitudes of the IT function fall under this category. The characteristics of the information systems with those of the personnel (personnel-based factors) make up the Information system environment.

An adaptable management accounting system can improve the effectiveness of the management accounting function. Adaptability is necessary since the environment in which organizations operate constantly change. It is known that changes in technologies, market conditions, organizational style, and strategy can lead to changes in management accounting practices (Baines and Langfield-Smith, 2003). A lack of adaptability in the light of such changes may result in management accounting systems that are no longer relevant. They may lack the capability to provide information for decision making and control. Hence, an adaptable management accounting system is likely to be more effective than a system which is relatively static. Finally, an effective management accounting system would lead to enhanced organizational performance.

## 2. Hypotheses Development

Integration is a key feature of modern information systems such as ERPS. Probably, the most defining characteristic of integration is the single database concept. Chapman and Kihn (2009) reported that integration in terms of a common data architecture improves performance through enabling repair, internal-, global transparency, and flexibility. These four design characteristics are derived from Adler and Borys (1996) and facilitate an *enabling* approach to management control. Repair refers to a situation where the user can deal with uncertainties to avoid a breakdown in the process. This may be supported by an IIS if the system allows for some user modifications to the reporting or if the users can drill down information (see operationalization in Chapman and Kihn, 2009). This design feature is desirable so that users can

better deal with unforeseen circumstances. This feature is related to flexibility since modifications to the interface or features need to be made to suit the specific work demands of individuals (Adler and Borys, 1996). An IIS can support this feature as it allows some configuration through constrained user options (Chapman and Kihn, 2009). Flexibility in this context refers to flexibility-to-use but not to flexibility-to-change (Gebauer and Schober, 2006). Flexibility-to-change the system is equally important and needs to be considered as not all required changes to management accounting can be made through user changes. Some changes might require intervention from the IT function, e.g. reprogramming. Given the importance of flexibility in facilitating change, we posit the following hypothesis.

H1: Information system flexibility is positively related to management accounting adaptability

The second design characteristic *internal transparency* refers to an IIS' ability to provide an "excellent platform for the development of a control system that can inform its users in detail concerning the inner workings it acts upon" (Chapman and Kihn, 2009 p. 155). This feature might also relate to management accounting adaptability in the sense that integration might on one hand increase complexity, making changes to system difficult but on the other hand support adaptability by highlighting weaknesses in current reporting practices. This leads to our second hypothesis.

H2: Information systems integration is related to management accounting adaptability.

Global transparency may also be supported by an IIS through its extensive process mapping and standardization efforts, allowing its users to see how local actions impact larger organizational goals and strategies, as well as by allowing interaction between previously distant individuals (Chapman and Kihn, 2009). When it comes to adaptability, we think that the interaction between the IT function and managers is critical. Major changes to the system can only be made through the support of the IT function. This leads to our third hypothesis.

H3: Shared knowledge between IT and accounting is positively related to management accounting adaptability.

We also hypothesise a negative relationship between IIS and flexibility as integration might increase complexity, making the system potentially more difficult and or costly to change. On the other hand, we argue there is a positive relation between IIS and shared knowledge between IT and managers since in an IIS environment, reliance on the IT function is likely to be more prominent because of the complexity and interconnectedness of the system.

H4: Information systems integration is negatively related to information system flexibility.

H5: Information systems integration is positively related to shared knowledge between IT and business unit managers.

We also posit that a highly adaptable management accounting system is more likely to provide a better fit, resulting in a more effective management accounting system than one that is less adaptable. Effectiveness relates to the adequacy of the management accounting system in providing the required decision relevant information to management. It would also facilitate the desired level of control by collecting and communicating the required information. This leads to Hypothesis 6.

H6: Management accounting adaptability is positively related to management accounting effectiveness.

Finally, we expect a more effective management accounting system to lead to better organizational performance as managers can improve planning and control through the access to better tools and more relevant information (Baines and Langfield-Smith, 2003, Chapman and Kihn, 2009). This leads to our final hypothesis.

H7: Management accounting effectiveness is positively related to organizational performance.

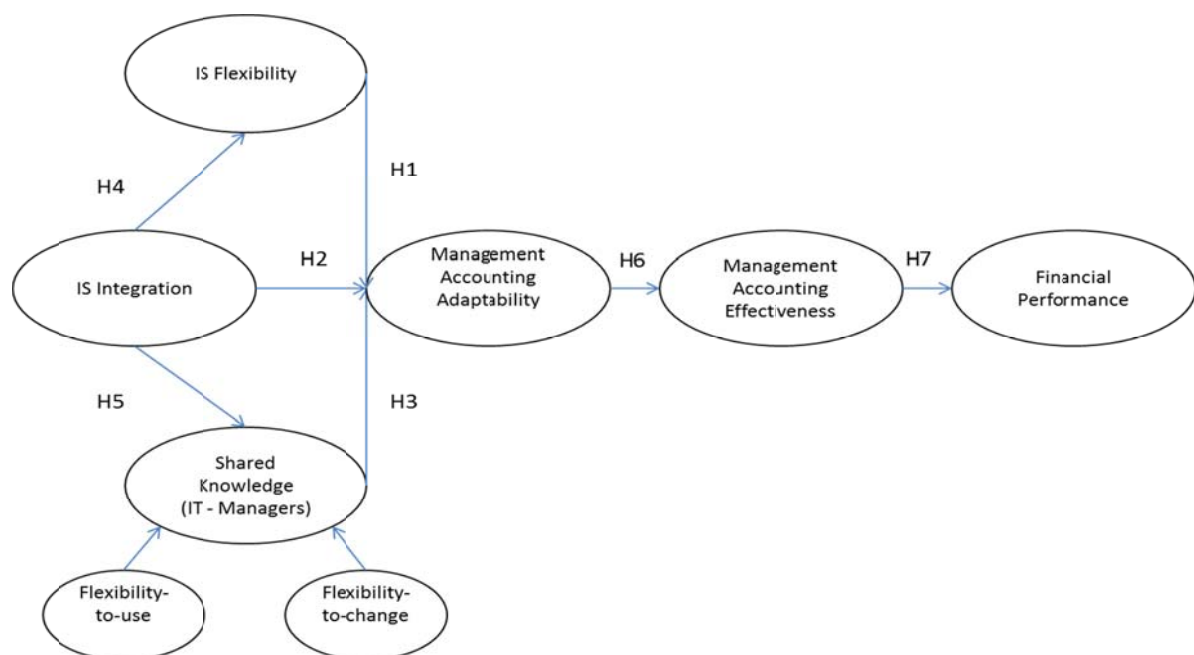


Figure 1: Research Model



### 3. Research Design

#### Data and Method

The sample for the survey will consist of Australian companies. We will not limit the sample to any particular industry or sector, although one constraint will apply to turnover (minimum \$1 million). The respondents will be business unit or line managers as in relevant studies (e.g. Baines and Langfield-Smith, 2003, Chapman and Kihn, 2009). The survey will be e-mailed to 4,000 respondents with an aim of receiving more than 200 valid responses. We will use factor analysis to test the internal consistency of the (reflective) constructs and correlation analysis and Partial Least Squares Modelling to test the hypothesised relationships between the constructs in the model.

#### Measures

All measures have a minimum of three indicators. The IS integration measure is based on Chapman and Kihn (2009) and focuses on the common database concept, the most prominent feature of the IIS. IS flexibility is a second order construct and captures both, flexibility-to-use (FTS) and flexibility-to/change (FTC) and is derived from Gebauer and Schober (2006). The two constructs (FTU and FTC) are considered to be formative in the sense that the items within each construct are not expected to correlate and therefore form rather than reflect the respective constructs. Shared knowledge between the IT function and management is based on Elbashir et al. (2011). Management accounting adaptability and management accounting effectiveness are measures developed by the authors. Finally, performance is based on Govindarajan (1984) and Govindarajan and Fisher (1990).

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# Business Rules Explication in Inland Shipping

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## Abstract

Planning of transport through inland shipping is complex, highly dynamic and very specific. Existing software support is focusing on road transport planning and/or is merely a visual representation of shipments to be manually assigned to particular vessels. As a result inland shipment planning is time-consuming and highly relies on the personal skills of the planner. In this paper we present a business rules based model that aims to further support inland shipping organizations in their shipment planning by identifying the characteristics and constraints that are of interest and the related explicated business rules. The model is derived from transport-related literature, explorative expert interviews and transport management software vendors. The usability and applicability of the model is subsequently successfully empirically tested using identified performance measures through a case study at a major European inland shipping broker.

**Keywords:** business rules, business rules management, logistics, inland shipping, transport planning.

## 1. Introduction

Until Autumn 2008, inland navigation grew steadily, however the economic crisis in Europe has decreased shipment over water since then by more than 10% per year in Europe (Serruys, 2010; Renthergem & Hart, 2009). Consequently, companies in this sector are looking for ways for decreasing costs, while at the same time increasing quality. At the same time the sector is confronted with increasing legislation and governmental rules regarding the environment and security. More than road transportation, climate change, visible through extreme high water levels or long periods of low water levels, increase transport costs over water. The inland shipping sector is facing major challenges.

The following PEST-analysis (for the technique see e.g. Ward & Peppard, 2003), inspired by an investigation from Price Waterhouse Coopers (PWC, 2012), provides an overview of major changes and trends in the sector

categorized by a political, economic, social and technology view. As can be seen, also some positive trends can be identified.

**Table 1.** PEST-analysis inland shipping (see also PWC, 2012)

Political	Economic	Social	Technology
Law and regulation regarding environment and security.	Financial European crisis hits inland shipping transport.	Environmental requirements pushes substitution of road transport by water transport.	Track & tracing technology for goods movements.
Government responsible for Infrastructure.	Increasing goods logistics implies growth of sector.	Climate change visible through extreme water levels (high and low).	Mobile network available (3G, 4G).  Mobile devices and mobile applications.

To remain profitable, organizations active in water transport planning and brokering should optimize their core planning process for efficiency and ability to deal with the complex and highly dynamic day-to-day business. Application of information technology would be a good road ahead, yet to our knowledge existing transport management systems (see e.g. [www.tmssystemen.nl/tms-software-overzicht.htm](http://www.tmssystemen.nl/tms-software-overzicht.htm)) do not provide explicit water transportation modules that deal with the unique variables of water transportation. As proper inland shipment planning is highly related to rules and regulation, to deal with the above issues, we define the following research question.

*How can business rules be explicated for planning of inland shipping transportation such that transport planning in inland shipping organizations is improved?*

In answering our research question we first look into business rules management literature. We further explore professional and scientific literature as for understanding inland shipping in general, and we undertake explorative interviews for more specifically identifying characteristics, protocols and constraints in shipment planning. Subsequently we build our model, by which inland shipping organizations can be supported for optimizing their shipment planning. This model is finally validated through a case study at a major inland shipment planning organization.

The described approach follows Hevner et al.'s (2004) design research method for information system research: our model is considered the artifact that has practical relevance for the sector, and is intended to be constructed rigorously. Finally the model is tested and evaluated through a case study.

## 2. Exploration

### 2.1 Business Rules and Business Rules Management

Spreeuwenberg (2010) defines business rules as a translation of business strategy, legislation and expertise into operational guidelines. The management of business rules is consequently the set of activities responsible for the coordination and management of business rules in order to support business continuity and agility (cf. Spreeuwenberg & Hoppenbrouwers 2009). Through business rules management organizations should be able to anticipate quickly to a changing environment; it also makes transparent what would otherwise remain complex business processes.

Business rules can be described in natural languages. Since computer processing of natural languages is difficult, structured rules languages are developed. Rulespeak (Ross, 1997) is a well-known example, but still is a very open standard. Zoet et al (2011) further normalizes rules by identifying mutually independent conditional variables leading to a single conclusion variable. This can be taken further by the consideration that business rules can be categorized as dealing with only two main objects.

Object X requires some characteristic or constraint from object Y.

We call this the business rules pattern. Within inland shipping for example a certain product to be transported (object A) demands double walled tanks (characteristic) in a ship (object B). As such business rules can be defined in the cells of a matrix with objects as its X- and Y-axis.

### 2.2 Inland shipping and planning

Goods transportation is crucial for the economy of a country and for the quality of life of its citizens (Siggerud, 2006). In Western Europe, a large part of goods transportation is done by inland shipping. Professional literature (e.g. Van Huizen, 2010) forecasts that by 2040 transport across water has five folded.

Planning of inland shipments is a complex and highly dynamic task. A first investigation from professional and scientific literature on transport planning in general, and transport planning across water in particular, provides us with the following recurring characteristics and constraints that have to be taken into account (see Table 2).



**Table 2:** First round identified characteristics and constraints for inland shipment planning

Characteristics and constraints	Source	Description
Draught	Krekt et al. (2011)	The draught at a certain weight is different per ship, and should be less than the water level of the itinerary
Freight weight	Luman & Bode (2011)	The freight weight determines the use of small or large ships. The ship should have equal or more capacity than the requested freight for transportation.
Product constraints	Luman & Bode (2011)	Each product requires certain ship types and characteristics. Ethanol for example should be transported in a double walled tanker.
Customer constraints	Bückmann (2008); Luman & Bode (2011)	Certain customers have unique demands for e.g. certain types of ships. E.g. single walled, double walled tankers, or with a certain quality system certification.
Route constraints	Knapen (2006); Krekt et al. (2011); <a href="http://www.bureauvoorlichtingbinnenvaart.nl">http://www.bureauvoorlichtingbinnenvaart.nl</a>	Each trajectory of transport has its own limitations, e.g. regarding water level, locks, bridges and current velocity.
Legislation and security constraints	Bückmann (2008); <a href="http://www.bureauvoorlichtingbinnenvaart.nl">http://www.bureauvoorlichtingbinnenvaart.nl</a> ; Luman & Bode (2011)	Legislation addresses technical requirements, quality requirements, educational requirements and more for crews; security instructions, environment related prescriptions and more.

In trying to make a planning optimization measurable we found the following indicators for transport planning in literature:

**Table 3:** Initially identified measurable performance indicators for inland shipment / transport planning

Indicator	Source	Unit of measure
Degree of loading	Van Groningen (2006)	Shipped cargo / loadcapacity of ship
Empty leg percentage	Technum (2001)	Hours of shipping with no cargo / Hours of cargo shipping
Speed of planning	Nisbet (2000)	Time needed (from request for shipping) to find (a) suitable ship(s)

### 2.3 Explorative interviews

Our goal with explorative interviews is to extend and categorize the already found characteristics and constraints in literature used for planning inland shipping. Specifically, with the respondents we first want to identify the objects that characteristics and constraints relate to in the context of inland shipment planning, and subsequently identify the cell content in the earlier proposed matrix (see the end of section 2.1), so that business rules patterns will be identified. Our approach included the following milestones:

1. Convenient sample of inland shipping planning experts found
2. Determination of the related objects with the planning experts
3. Identification and confirmation of characteristics and constraints per cell with the planning experts (formation of business rules patterns)
4. Explication of business rules from business rules patterns
5. Completion and justification of performance indicators

ad 1) In the east of the Netherlands we found one of the major cargo shipping companies of Western Europe willing to provide us with four of their six planners, who are responsible for all requests for inland cargo shipping of this particular company. The company has a fleet of 40 ships, and has about 100 employees.

ad 2) In a plenary session with the planners the goal of the overall interviewing was presented. Subsequently the planners were asked what kind of information a customer provides when requesting inland shipping. The four planners came up with the objects product, customer, loading location / unloading location, itinerary, and ship. This provided us with the following matrix for which, per cell, planning characteristics and planning constraints can be identified.

**Table 3:** Matrix providing a frame for planning characteristics and constraints

This column requires the other columns	Product	Customer	Ship	Loading and unloading location	Itinerary
Product					
Customer					
Ship					
Loading and unloading location					
Itinerary					

ad 3) In this phase we interviewed the respondents individually. We provided the responded with the initial list of planning factors from table 2. Each of the respondents considers this list too generic and sometimes not even valid.

Derivatives of the original factors were subsequently identified and positioned into the matrix by each respondent. Four matrices were produced and in a plenary session debated upon, resulting in an agreed upon set of characteristics constraints in a single matrix. This operationalized matrix inherits all possible business rules patterns. An example of a business rule pattern is consequently: a customer may require a certain maximum age of a ship.

ad 4) Following the identification of the agreed set of characteristics and constraints, and thus the business rules patterns, the respondents brought up their first idea of explicated business rules.

ad 5) The workshops also implicitly provided additional performance indicators, not yet identified from literature. Table 4 shows the extension of the performance indicators as agreed by the planners involved in the explorative interviews.

**Table 4:** Second round identified measurable performance indicators for inland shipment / transport planning

Indicator	Source	Unit of measure
Degree of loading	Van Groningen (2006)	Shipped cargo / loadcapacity of ship
Empty leg percentage	Technum (2001)	Hours of shipping with no cargo / Hours of cargo shipping
Speed of planning	Nisbet (2000)	Time needed (from request for shipping) to find (a) suitable ship(s)
Planning errors	Through explorative interviews	Percentage of errors in finding (a) suitable ship(s)
Over-valued shipping	Through explorative interviews	Percentage of ships assigned with over-capacity

### 3. Model

The agreed upon set of characteristics and constraints and explication of business rules lead to the following operationalization of our model.

**Table 5:** Model with planning characteristics and constraints

	Product	Customer	Ship	Loading and unloading location	Itinerary	Snapshot of explicated business rules
<b>Product</b>			Type ADN Type Type Tank Lining Type Tank heating Maximum tank load Type (un)loadingpomp Type separatie- en pipe system			“When transportating product Ethanol, ship needs to have double hull tanks.” “When transportating product Natronloog, ship needs to have Tank Heating” “When transportating product Ammoniak, ship may load the tanks till 95% of maximum tankcapacity.
<b>Customer</b>			Maximum age ship Type Tank Lining Kind tracing Single hull or double hull ship Clean status Vetting approval			“When transportating for Customer-X, ship age needs to be for up to 15 years”. “When transportating for Customer-X, ship needs to have an approved EBIS inspection vetting of aa maximum of 6 months in the past. “When transportating for Customer-X, ship needs to have RVS tank lining”
<b>Ship</b>						
<b>Loading and unloading location</b>			Type (un)loading pomp Manifold distance Maximum dimension Kind of rest			“When transportating to unloadinglocation X, ship needs to have (un)loading pumps with low noise level” “When transportating to unloadinglocation X, ship needs to be shorter then 82m in length” “When transportating to unloadinglocation X, ship needs to have a manifold distance of 1.20m”
<b>Itinerary</b>			Maximum dimension Maximum draught Maximum headway Cargo state			“When transportating over itiniry-X, ship needs to be shorter then 82m in length” “When transportating over itiniry-X, shipheadway needs to be shorter then 7m” “When transportating over itiniry-X, ship draught (with load) needs to be shorter then 5,5m”

Note that only characteristics and constraints for a *ship* (see column 'Ship') were identified, not initially as a surprise, as the request for transportation is to be translated in finding a *ship* meeting the characteristics and constraints. Column 'Snapshot of explicated business rules' shows some of the business rules for planning shipments. This model can therefore be leveraged by a planner in the search for a ship that is able to execute on the transportation requests from customers.

## 4. Case Study

Interstream Barging (ISB) is the largest inland shipping planner in Western Europe with HQ in the Netherlands and two satellite offices in Germany. Ships of ISB mainly navigate on rivers in the Netherlands, Belgium and Germany. This organization employs twelve planners (brokers) and has a fleet of almost 130 ships, including 25 'own' ships, and 105 charters. Total transporting capacity of these ships is 370.000.000 kilo. Next to a planning department, ISB has its own ship servicing department, crew for the ships, back-office department for operational tracking and tracing of transportation, a finance department, and a department for asset management.

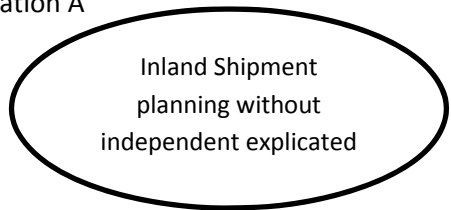
We found ISB available for validating our Table 4 framework. Given operational constraints at ISB we agreed to have the following efficient, yet multi-perspective, procedure:

1. The authors/researchers learn the inland shipping planning process from process descriptions.
2. Validation of the objects in the model and the characteristics and constraints through workshops with experienced planners.
3. Validation of the business rules in the context of planning through a a prototype simulation that includes identified business rules versus planning in the old situation.

Figure 1 shows the context of the third step in our validation procedure.

**Figure 1:** Method for measuring the impact of our framework on planning performance indicators

Situation A



IMPLICATED planrules



Degree of loading
Empty leg percentage
Speed of planning
Planning errors
Overvalued shipping

Situation B



Business Rules Model

En van	Voorwerp	Regelregel voorbeelden
Product	Bepaald ADR type, bepaald type tankbedekking, wel of geen verwarming, max vulhoogte, bepaald type pompsysteem, bepaald type separate- en ledingsysteem.	"Bij vervoer van het product Ethanol moet het schip uitgerust zijn met een dubbelwandige tankinstallatie." "Bij vervoer van het product azijn, moet het schip in de winter voorzien zijn van een ledingsverwarmingssysteem om ervoor te zorgen dat het product niet vast." "Bij het vervoer van het product Ammoniak, mogen de ledingslengtes van het schip maximaal 95% gevuld worden."
Klant	Bepaalde maximale leeftijd, bepaalde tankbedekking, wel of geen tracing, Duiden of enkelzijdig of dubbelzijdig, bepaalde schoon-eisen, verting apparatuur, niet geïsoleerd, aanwezigheid van slangen, wel of geen ledingsverwarming, bepaalde scheepsinspectie.	"Bij een vervoersopdracht van Klant A mag het schip niet ouder zijn dan 15 jaar". "Bij een vervoersopdracht van Bayer, moet de EBS inspectie van het schip maximaal 6 maanden geleden positief zijn uitgevallen." "Bij een vervoersopdracht van Shell, moet het schip zijn voorzien van een geïsoleerde tank." "Bij een vervoersopdracht van Klant A, moet het schip zijn voorzien van een ledingsverwarmingssysteem om het product op de gewenste temperatuur af te leveren."
Laad- en losplaats	Bepaald type Pompsysteem, bepaalde afstand van manfold, bepaalde maximale afmetingen, wel of geen draaitaak, niet geïsoleerd, aanwezigheid van slangen.	"Bij een vervoersopdracht naar Ingolstadt, moet het schip zijn voorzien van een stille pomp, vanwege geluidsoverlast." "Bij een vervoersopdracht naar Nieuw-Geschiedenberg, mag het schip geen draaitaak gebruiken." "Bij een vervoersopdracht naar Antwerpen-BIJZ, moet de afstand van de manfold 1.20m zijn."
Trageit	Bepaalde maximale afmetingen, bepaalde maximale diepgang, bepaalde maximale kruishoogte, verbod op bepaalde tankinhoud.	"De vaargebied van het schip bij het te laden gebied moet kleiner zijn dan de vaargebied van de kleinste brug op het te varen traject bij de gegeven waterstand." "De lengte van het schip moet kleiner zijn dan de lengte van de kortste sluis op het te varen traject."



Degree of loading
Empty leg percentage
Speed of planning
Planning errors
Overvalued shipping

Result





#### 4.1 The company's planning process

In Appendix A, a snapshot of the process associated with planning of inland shipping is described in Business Process Management Notation (BPMN; <http://www.omg.org/spec/BPMN/2.0/>). The visualization of the process confirms the complexity of inland shipping planning, as earlier mentioned. There is much communication and late changes involved in shipping planning, which results in extra steps and/or exceptions.

The process is characterized by multiple stakeholders: customers, ship-owners, captains, ISB's planning department, ISB's back-office department. There are also three triggers resulting in three sub-processes: 1) the request for an ad-hoc shipment planning, 2) the request for a contract-based shipment planning request, and 3) continuous (daily) planning, during which the dynamics in inland shipping are being dealt with (e.g. due to the low water level, an anticipated ship (for shipment of the customer's request) does not arrive on time for loading the product. For all three associated sub-processes business rules may help out particularly in the red-circled steps in Appendix A's visualized process.

#### 4.2 Validation of objects, characteristics and constraints through workshops

Four experienced planners took part in three two-hour workshops over 1 month time (November 2012). The first workshop was dedicated to presenting Table 4 and asking the planners whether they found the model complete, correct and usable. It soon became clear that the planners found the dimensioning of the model incomplete, as there were additional characteristics and constraints within ISBs planning process that could not be positioned in the matrix of Table 4. With this the authors added an extra column, 'Planning', to position the suggested extra characteristics and constraints. The column Planning provided an additional step: first Ships were possibly filtered for a shipment (see column 'Ship'), then the particular Planning-column provided extra criteria for further filtering possible shipments. In the second and third workshop the new model was debated and finally agreed upon, including additional characteristics and constraints. Table 6 shows the updated model, for spacing reasons not displaying the explicated business rules column.

**Table 6:** Revised operationalized matrix with planning characteristics and constraints

1st column requires from other columns	Ship	Planning
<b>Product</b>	Type ADN Type Type Tank Lining Type Tank heating Maximum tank load Type (un)loadingpomp	Possibility of loading with another transportorder Not allowed earlier loadings

	Type separatie- en pipe system Kind safety equipment crew	
<b>Customer</b>	Maximum age ship Type Tank Lining Kind tracing Single hull or double hull ship Clean status Vetting approval Non blocked (un)loading hoses Type Tank heating	Possibility of loading with another transportorder Not allowed earlier loadings Time-window.
<b>Loading and unloading location</b>	Type (un)loading pump Manifold distance Maximum dimension Kind of rest Non blocked (un)loading hoses Cargo state	Possibility of loading with another transportorder Not allowed earlier loadings Time-window. Vapor retour pipe possibility
<b>Itinerary</b>	Maximum dimension Maximum draught Maximum headway Cargo state Permit / license.	

The updated model was used in the next step.

#### 4.3 Validation through planning scenarios and prototype

Through planning scenarios, using a developed prototype including the business rules for planning, we tested whether the use of the model has impact on the identified performance indicators, using the earlier identified planning performance measures. Three experienced planners (also involved in the in section 4.2 described workshops, so that they were all up-to-speed on the research) acted as respondents. Specifically the following was included in the prototype, taking advantage of the during testing running database in ISB:

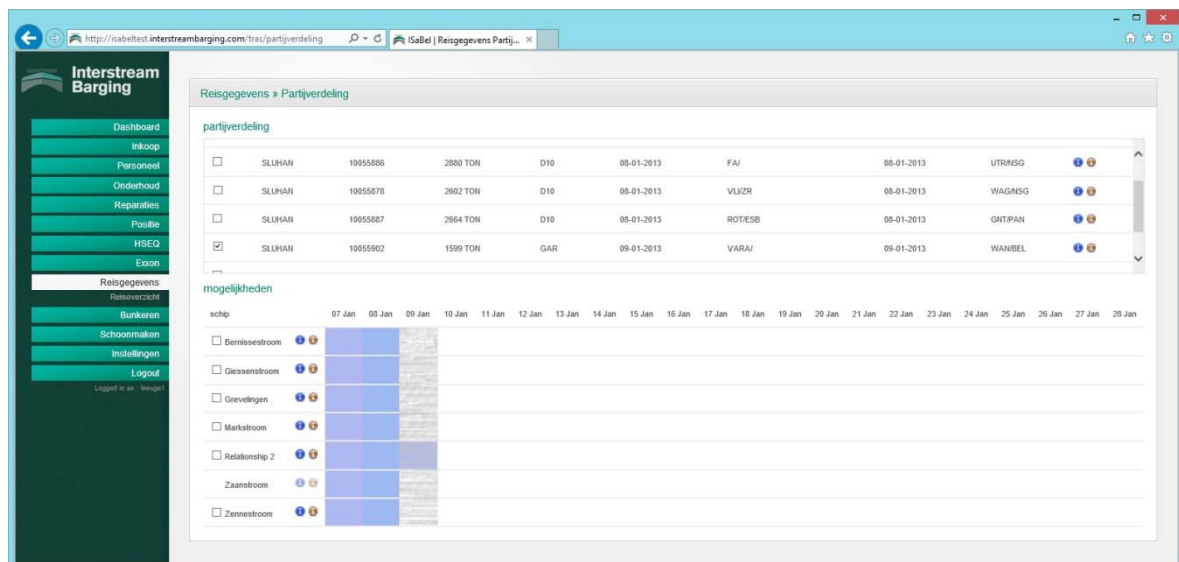
- all ships of ISB
- all customers of ISB
- all terminals and harbors/ports
- all possible products
- existing planned ships in a planboard
- existing requests for planning of shipments
- newly created table with business rules

The following business rule patterns were explicitly included, as they were part of the scenario, and the respondents identified them as frequently occurring:

- product requires from ship a certain type of tank wall
- customer requires from ship whether it is non-blocked (for navigation)
- customer requires from ship certain maximum age
- loading and unloading location requires certain type of pump from ship
- loading and unloading location requires from ship certain maximum distance

Find the scenario in Appendix B, with respondents' comments and perceived respondents' performance values included. Find below two screen dumps of the prototype that were used during scenario execution by the respondent.

**Figure 2:** Prototype screen: filtering ships for certain request for shipping



In the top of the screen four rows are visible representing four requests for planning. The fourth row is selected (and corresponds to the request for planning from within the scenario) and determines that the ship represented by the sixth row in the bottom of the screen is not suitable for the requested shipment, due to application of the explicated business rules.

**Figure 3:** Prototype screen: explanation why a certain ship is not able for transporting the request for shipping, in terms of violating business rule

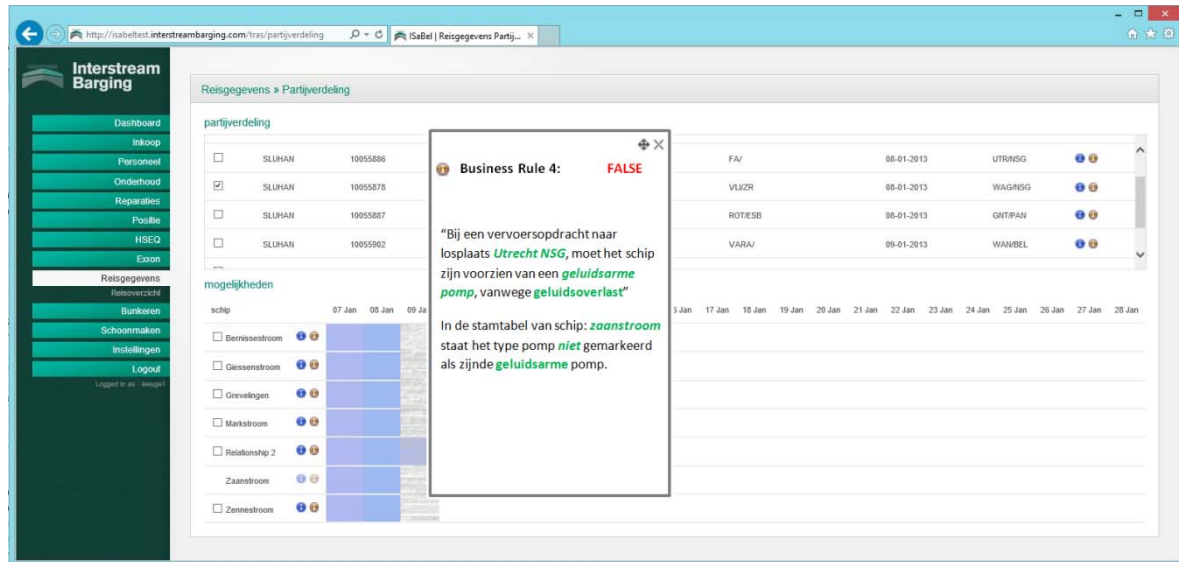


Figure 3 shows which business rule is violated, and why the greyed-out row (representing a ship) is not able to fulfill the request for shipment from the customer.

Table 7 shows the cumulated perception of the planners towards the planning process as supported by the model following the scenario. In this table the following legenda is used (note that the values in the table are all relative values: the new situation with explicited business rules in a prototype versus the old situation without explicated business rules):

- << using the prototype the performance has dramatically decreased
- < using the prototype the performance has decreased
- = using the prototype the performance remains the same
- > using the prototype the performance has increased
- >> using the prototype the performance has dramatically increased

**Table 7:** Performance indicator scoring of prototype-supported planning process compared to the traditionally used information system

	Degree of loading	Empty percentage	Planning errors	Speed of planning	Over-valued shipping
Minimum value	=	=	>	>	<
Maximum value	>>	>	>>	>>	=
Mean value	>	=	>>	>>	=

Specifically the respondents perceive less errors and increased planning speed when using the prototype. And also regarding the degree of loading the respondents are positive. Yet over-valued shipping seems not to be improved:

"I think that the prototype shows potential ships for transportation that are just too good, in the sense of having over-capacity", as one the respondents commented. A likewise argument is brought up by the respondents for empty percentage shipping. A possible explanation for both performance lagging behind could be that the used business rules in the prototype are not so much controlling real optimization of transportation, but much more focusing on whether a ship is capable in transportation.

## 5. Conclusions

In this research we found an answer to the question "how business rules can be explicated for planning of inland shipping transportation such that transport planning in inland shipping organizations is improved". We developed a model, consisting of business rules that were derived from identified inland shipping transportation characteristics and constraints. Within the context of the performed validation we see an improvement of specifically performance indicators 'degree of loading', 'empty percentage' in transportation, and 'planning errors', when business rules concerning the inland shipment planning process are being explicated.

Testing validity through a prototype provides an in-depth experience of the use of business rules, however limiting the scope of usage. For further validity, the model should be additionally applied and tested in the inland shipping sector. We think that also application of the model in road transportation could be possible, as also road transportation is subject to many planning dynamics. Yet the model may be differently operationalized because different explicated business rules coming from different characteristics.

The authors found the method of scenario-based prototyping, resembling usability testing as described by Nielsen (1994), as a very valuable validation technique: the respondents/testers really have an opinion on how the application of a model would benefit their business.

Finally, the model could be included in the roadmap of inland shipment planning software providers.

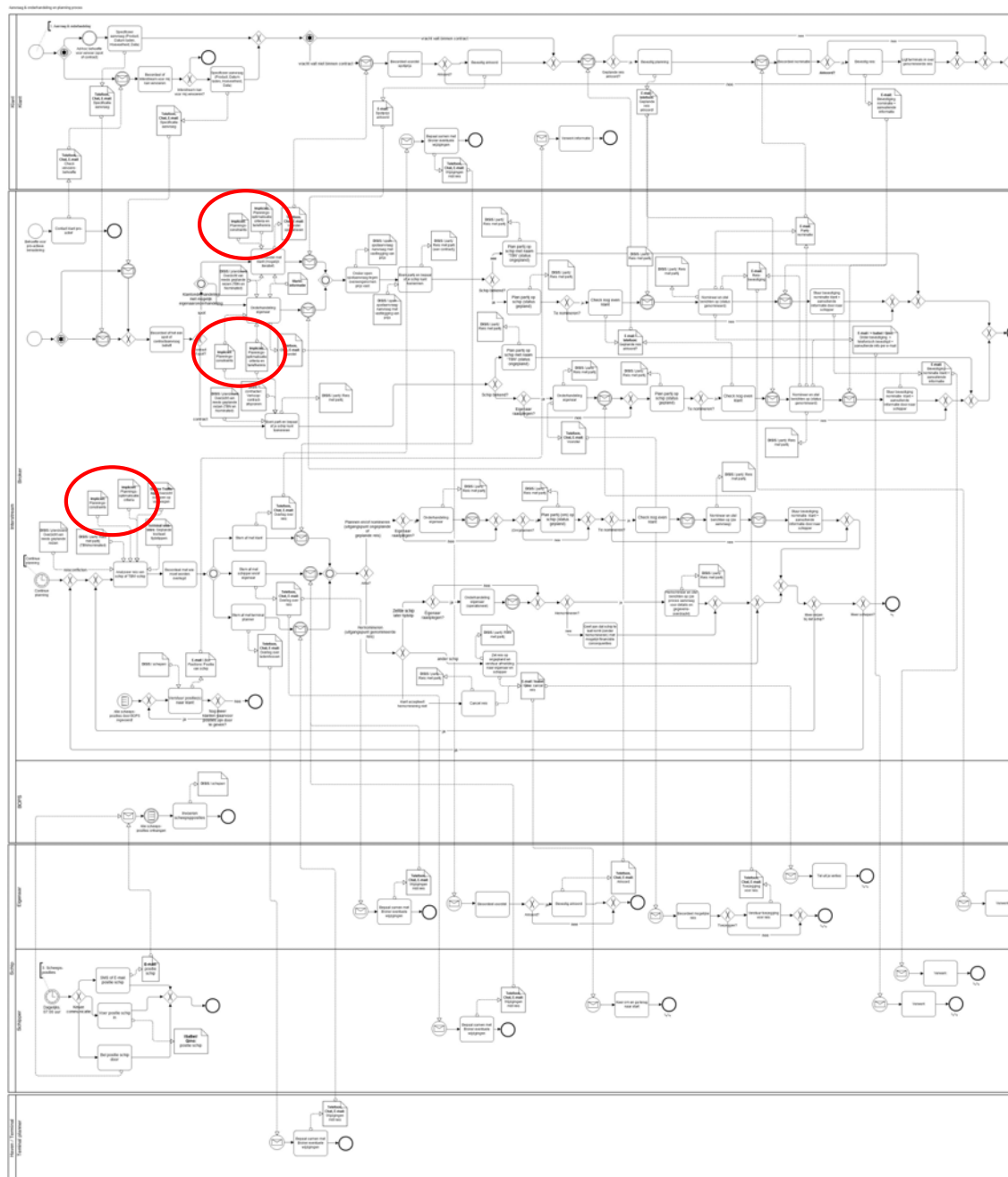
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## Appendix A: Inland Shipping Planning Process



## Appendix B: Planning scenario using explicated business rules, with respondent comments and planner perceived performance values

Dear planner, welcome at this prototype session.

Please follow each step of your plan process (explained down under), first in the system you are using every day, then answer question A; Second in the new prototype plan system, then answer question B.

Question 4 and 6, also have a question C, in which we want you to fill in your judgment about the different systems.

Use the following measure criterion for answering that question C.

- << using the prototype the performance has dramatically decreased
- < using the prototype the performance has decreased
- = using the prototype the performance remains the same
- > using the prototype the performance has increased
- >> using the prototype the performance has dramatically increased

**Scenario: Known customer BLAI2, with contract, calls you for a transport order; 800TON Phenol (type 144) from Antwerp Terminal 4, to Rotterdam Terminal 8, loading date 'the day after tomorrow'.**

### 1. Filter available ships on the basis of characteristics and constraints on solid data

Think about the ships that will be available for transporting this order, based on the solid technical and functional data / information of the barges.

#### a. First, do the job in your daily used information system.

Respondent 1:

I know all the characteristics and constraint about the barges fort his transportation order. I know that the Product Phenol 114 needs RVS tank lining. I know the barges who has these tank lining. I know everything about the sailing route between Antwerp and Rotterdam. I know there are only eight barges available for this order.

Respondent 2:

I don't need an information system for choosing the right ship. I's a senior planner, and you need to know such things in this function.

Respondent 3:

I search in the information system to trips in the past, with the same product, and the same loading and unloading terminal. Then I know which barges are possible to choose. I always asked my college, senior planner, when I don't know what to do. Or I will call my colleges at the Fleet Management Department.

#### b. Second, do the job in the new prototype plan system.

Respondent 1:

The list of selectable barges are much more smaller when I select the transportation order. Instead we are going from 130 barges to 10! Seems that I didn't know the possibilities of four barges, and that I saw two barges which are not capable of doing

this order. When I click the orange Information-button, I see that the two barges don't have noise-silent pumps, so that's why they are not capable for unloading at Terminal 8 in Rotterdam.

Respondent 2:

The plan system is filtering the list of barges when I select the transport order above in the screen.

Respondent 3:

When I select the transport order, down under at the screen I only see ten barges which I can select for this order. With the orange Information button, I can open the explanation of why the barges are selectable or not. With this system, there is no possibility to make mistakes!

**c. Third: Judge the differences in quality between A and B.**

Fill in the matrix with you judgments.

Process step 4	Degree of loading	Empty percentage	Planning errors	Speed of planning	Over-valued shipping
Respondent 1	=	=	>>	>>	<
Respondent 2	=	=	>	>>	=
Respondent 3	=	=	>>	>>	=

**2. Filter available ships on the basis of characteristics and constraints on variable data (based on-, and dependent from planning and historical orders).**

Now you know the variable information, it's time to filter the technical and functional available ships based on their planning and historical orders.

At this step, you will take the following constraints into account.

Possibility of loading with another transport order Not allowed earlier loadings Vapor retour pipe possibility Customer time-window
--

**a. First, do the job in your daily used information system.**

Respondent 1:

When transport orders can be transported at the same time, the search for possibilities based on characteristics and constraints is an immense process. Our daily used information system don't help us with this.

Respondent 2:

Our daily used information system doesn't support this filtering. Knowledge to do so, is in my mind.

Respondent 3:

Our daily used information system does not give me that kind of information. I leave Together loadings to my senior colleagues.

**b. Second, do the job in the new prototype plan system.**

Respondent 1:

Your story tells me that a Business Rules Based plan system will consider all the possibilities to show a filtered list of available ships.

Respondent 2:

That prototype plan system, should already take all the characteristics and constraints into consideration to filter the list of barges, to a list of available barges.

When that Rules-based plan system will also take together loadings into consideration, I am sure that will give us an enormous improvement. For sure, I don't know everything ;-). I'm only concerned about the barges which will come into selectable area, from which we don't want them to execute the order because off the transportation costs of High end ships, for low-end transport-orders.

Respondent 3:

Wow, then there is a possibility that I (with less experience) should also be able to plan complicates and combined transport-orders.

**c. Third: Judge the differences in quality between A and B.**

Fill in the matrix with you judgments.

Process step 6	Degree of loading	Empty percentage	Planning errors	Speed of planning	Over-valued shipping
Respondent 1	>>	>	>>	>>	<
Respondent 2	>	=	>	>	<
Respondent 3	>	=	>>	>>	=

# Measures of Motivating Females to Establish an Enterprise in Peripheral and Marginal Regions: An Ordered Logit Analysis

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## Abstract

Promoting small business ventures in peripheral and marginal regions by increasing motivation among females toward establishing an enterprise can reduce not only the gender gap in entrepreneurship but also can address unemployment and migration problems. Extended and indepth understanding of barriers and conditions to establish an enterprise in such regions may help identify key measures to address those problems. This article investigates barriers and conditions in establishing an enterprise in peripheral and marginal regions with data obtained from an entrepreneurship and career choice survey among female students at secondary level in Sogn og Fjordane County in Norway. The results obtained from the use of an ordered logit model indicate that major factors in explaining or correlating with the motivation of establishing an enterprise were social and cultural capital, personal characteristics like proactive personality, and career anchors.

**Keywords:** entrepreneurship, antecedents, enterprise, measures, ordered logit, peripheral and marginal areas

## 1. Introduction

It is well documented that women in general are less oriented toward entrepreneurship than their male counterparts (cf., e.g., Brun, 1998; Mazzarol et al., 1999; Blanchflower, 2004; Minniti et al., 2005; Fueglistaller et al., 2009; Bullvåg et al., 2009, 2010; Nesse, 2010; Shinnar et al., 2012; Hughes et al., 2012, Kelly et al., 2011). Obviously, men and women do not have similar interests toward establishing an enterprise and entrepreneurship, denoted as choosing entrepreneurship as a career (EC) here. However, motivating females toward entrepreneurship not only can decrease the gender gap but also can contribute to increase the supply of entrepreneurs.

The Global Entrepreneurship Monitor (GEM) provides the most recent global overview of female entrepreneurship (Roland Xavier et al., 2013). Total early-stage entrepreneurial activity (TEA) rate is higher for male than for female as

a whole in the world. But the gender gap is not equal in all regions probably due to differences in cultures and gender roles. There is the smallest gap in Sub-Saharan Africa and Latin America, while we can observe bigger gaps in the Middle East, North Africa, and the EU. We can also find significant differences between the countries in the same region. It is important to point out that the female TEA rate is slightly higher in Ecuador, Panama, Ghana, Nigeria, and Thailand. On the other hand, there is extremely low women entrepreneurship in Egypt, Palestine, Republic of Korea, and Pakistan. Norway is among the countries with relatively low female TEA rate. According to the Global University Entrepreneurial Spirit Students' Survey, entrepreneurial intentions (EI) was generally higher among male than female students with some variations among the countries (Fueglistaller et al., 2009). The countries with the smallest difference between genders were Switzerland, South Africa and France.

In Norway, the GEM report shows that the TEA rate among females is quite low which is significantly less than the national goal of 40% (Alsos et al., 2012). The TEA rate varies between 25 and 30 from 2000 to 2011. The TEA rate among women was 29% in 2011, an increase from 2008. It indicates that the possibility of reaching the national goal of 40 % female entrepreneurship in near future is not attainable. Perceived "mental barriers", i.e., women in a lesser degree than men think they have the competence needed for entrepreneurship, might be one of the main reasons underlying the situation (Alsos et al., 2012). The percentage of female entrepreneurship is significantly low, in fact below 10 % (Bullvåg et al., 2011), in Sogn og Fjordane County, where we have collected our data. The relatively low entrepreneurial activity among Norwegian women is astounding<sup>5</sup> since Norway has been among the countries with the lowest gender gaps in the World Economic Forum's ranking (Hausmann et al., 2012).

Although most of the international investigations show that men are more entrepreneurial than women, the variation between the countries do not indicate any generally acceptable results. It is therefore interesting to investigate barriers to, and possible drivers for, female entrepreneurship in areas where female entrepreneurship is significantly low. Using data collected through a survey among youths from areas with different entrepreneurial climates in Norway<sup>6</sup>, Nesse (2010) identifies that boys have several driving forces for and fewer barriers to entrepreneurship than girls. For example, the desire for independence was an important driver for entrepreneurship among boys, but not among girls. The preference for a secured future was a major barrier to girls' entrepreneurship, but not for boys'. This may indicate that young females in Norway suffer from some kind of "mental barriers" among that prevent them from starting their own businesses. To further explain,

<sup>5</sup> Astonishing in the sense that there is very less gender gap overall but significantly much gender gap in entrepreneurship!

<sup>6</sup> Data from two secondary schools in Sogn og Fjordane County and two secondary schools in a more entrepreneurial region of Sunnmøre in Møre og Romsdal County.



supplement and contrast the results by Nesse (2010), we have collected new data from all the girl students who were studying in the last year in all the secondary schools in Sogn og Fjordane County. Our purpose is to gain more insight about motivation for and barriers against choosing entrepreneurship as a career (EC) among girls in a peripheral area with little female entrepreneurship so as to identify measures that could motivate young females toward EC through removal of some of the barriers.

After the completion of the study at higher secondary level, students generally have three options, viz., continue studying, become an entrepreneur or work as an employee. They are at the crossroads of their careers. They probably discuss the future with family and friends, so investigating their preferences at this stage could result in more valid outcomes. It is less likely that people change their career as an employee or entrepreneur after one is in that career, so it is better to investigate preferences before they make their first decision. Krueger et al. (2000) also point out that students face an immediate career choice and starting a business could be a realistic option for them. To this end, our sample is appropriate to investigate the preferences toward EC.

Shapero (1975, 1985) argues that we need to better understand how opportunities manifest themselves if we are to better understand entrepreneurial process. We believe that opportunities manifest in innate “entrepreneurial ability” (Lucas 1978) and individual preferences. Investigating antecedents underlying individual preferences in choosing EC is therefore the goal of this article. Because entrepreneurship is one of the options that an individual person could pursue as a career, we can model entrepreneurship as an occupational choice problem.

Perhaps there are easier paths than becoming an entrepreneur. This is particularly true in Norway because probability of being unemployed is very low and the wage level is high in Norway. One is entitled to get unemployment benefits even if s/he is unemployed. The same situation prevails in countries having generous social welfare policies.

In generating a richer and more robust understanding of female entrepreneurship, we should identify the root cause why female entrepreneurship is low using a robust method, appropriate statistical tool and appropriate theory. We utilize an ordered logit (OL) model which is a suitable statistical tool that would help to build and improve upon the rigor and credibility of empirical research. This is another purpose of this article. In the paper, we first develop and argue the relationships to be tested. As our model focuses on peripheral and marginal regions, we build a theory since EC in such regions has not attracted much attention from researchers. In addition, the results in the paper does have a methodological contribution to entrepreneurship research because the literature is too sparse using the same theory and model, at least in entrepreneurship research.

The results of the article will help predict types of individuals who are likely to choose EC and why EC choice exists at all. Our article is based on the results of rigorous scholarly research that develops/extends a theory in the field of entrepreneurship. We have theoretical sophistication and methodological rigor. The paper tests a model of EC utilizing a more appropriate statistical technique than the more commonly used OLS models. This approach helps to gain new insights and substantial additional information.

We have organized the remainder of the article as follows. We discuss the relevant literature in Section 2. We explain the data, model and methods in Section 3. We present the results and discuss them in Section 4. We conclude the article in Section 5.

## 2. Prior Research

It is an established fact that men are more entrepreneurial than women worldwide. There is an extensive research about this topic, for example, differences of the business start-ups by gender (Alsos and Ljunggren, 1998), about self-employment (Blanchflower, 2004), international comparison of entrepreneurship among students (Fueglistaller et al., 2009), entrepreneurship in Norway (Spilling, 1998; Bullvåg et al., 2009, 2010; Alsos et al., 2012), GEM (Minniti et al., 2005; Bosma et al., 2009; Kelly et al., 2011; Roland Xavier et al., 2013), gender differences among youths' motivation in entrepreneurship (Nesse, 2010), the role of gender and culture in entrepreneurial perceptions and intentions (Shinnar et al., 2012), extending women's entrepreneurship research in new directions (Hughes et al., 2012), to name just a few. Parker (2009) also provides a relatively brief but lucid discussion of the issue in a chapter of his book. Most of the studies have attempted to investigate the explanations underlying the gap between male- and female entrepreneurship. The studies also identify key measures to overcome the barriers and/or to augment favorable conditions for promoting female entrepreneurship.

About 20% of the entrepreneurs were women in Spilling's (1998) investigation of 720 business start-ups in Norway. According to Brun's (1998) further analysis of the data, the proportion was 40% in the age group under 30 although there were only one-fifth women entrepreneurs as a whole. Brun therefore pointed out a possible tendency that younger women were more entrepreneurship-oriented than older ones. She hoped that female entrepreneurship would increase as a result of favorable effect in the younger cohorts of special policy measures for supporting female entrepreneurship. Brun also argued that women face many more barriers than men in establishing and running a business. Similarly, Alsos and Ljunggren (1998) investigated gender differences in business start-up processes using longitudinal data to get better understanding of factors that influence the success of new businesses. They found more similarities than differences between male and female nascent entrepreneurs. Their results also indicate that females write fewer business plans initially, use less external capital in

the startup process, and tend to hire fewer employees compared to male nascent entrepreneurs. According to the GEM report, the proportion of female entrepreneurs in Norway increased from about 25% in 2004 to around 30% by 2008 (Bullvåg et al., 2009) leading to some optimism about reaching the national goal of 40% within 2013. But the proportion declined again to about 25% in 2009 (Bullvåg et al., 2010). The proportion of female entrepreneurs in 2011 was about the same as in 2008 (Alsos et al., 2012).

Mazzarol et al. (1999) studied gender differences using a sample of actual and potential entrepreneurs from Australia. They explain the gender gap in entrepreneurship with women's traditional career choices and gender roles. They called for more female role models to increase female entrepreneurship. However, Aldrich (1999) believes that one of the most important barriers to women's entrepreneurship is that women are kept outside of men's business network. Renzulli et al. (2000) envisaged that this difference would disappear gradually as women go beyond family and establishes more heterogeneous networks. Statistics from the OECD countries also show that men have a higher probability than women of becoming self-employed (Blanchflower, 2004). One of the explanations for the gap between male- and female entrepreneurship is women's traditional career choice and their crucial role in the family. According to Kolvereid et al. (2005), "mental barriers" among women can largely explain the gender difference in entrepreneurial activity in Norway because women believe that they have less necessary competence for entrepreneurship than man do.

GEM's special report on women and entrepreneurship presented in 2005 (Minniti et al., 2005) shows that men were more involved in entrepreneurial activity than women in all of the 34 participating countries. The authors point out two main reasons why women participate less frequently than men in entrepreneurial activities: lack of self-confidence and lack of role models. Traditional measures to support female entrepreneurs are therefore insufficient: instead mentors and network building are necessary for promoting female entrepreneurship. The authors also recommend imparting better education to female, especially in engineering. In a later analysis of the same material, Minniti (2010) found more or less the same; the gender gap is explained by women's lower subjective self-confidence and higher fear of failure compared to men. She also found that the gender gap was bigger in middle-income countries than in low-income countries, probably because entrepreneurship in the latter are driven by necessity.

However, some studies show similarities between the genders. In a survey based on self-assessment among South African students, Louw et al. (2003) found significant differences between the genders in only four of fourteen "entrepreneurial traits": the boys scored higher on the factors such as taking initiative, using assistance from external resource persons, technical and business knowledge. Gender differences were greatest when it came to self-evaluation of technical knowledge, while there were no differences in terms of self-esteem. In an investigation among 265 business master students in USA,

Zhao et al. (2005) found that female students had significantly lower EI than their male counterparts. But they did not find any gender differences in entrepreneurial self-efficacy. Similarly, Ahl (2006) examined 81 studies of female and male entrepreneurs, mostly from the USA, and found that there were no major differences between female and male entrepreneurs. Women had smaller firms, perhaps because they had small loans due to low-value collateral, and/or they chose small businesses such as retail and service themselves. She concludes that research on women entrepreneurship needs new directions. Further, Shinnar et al. (2009) did not find any gender differences in their investigation of entrepreneurial attitudes among 317 university students. The authors see their finding as an opportunity for expanding entrepreneurship education by involving more women. Additionally, Ali et al. (2010) found no significant impact of gender on entrepreneurial attributes in their investigation among 520 Pakistani students.

Parker (2009, p. 197), on the other hand, opines that “A particularly important difference between men and women in entrepreneurship stems from the persistent tendency of women to spend more time in household production and child-rearing activities than men. Until and unless this situation changes, women will continue to opt for forms of entrepreneurship which result in lower average returns compared with men.” According to the analysis by Verheul et al. (2011) based on data obtained from telephone interviews with 8500 people in 29 countries (EU member countries, USA, Iceland, Liechtenstein and Norway), the pattern is still the same. Women were less motivated for self-employment than men because women were worried about the general economic situation, possible administrative difficulties, and the risks of starting a new company.

The research investigating the gap between male and female entrepreneurship is expanding. Women face different opportunities and constraints in entrepreneurship compared to men. On the whole, the researchers identify contextual and individual explanations behind the gap between male- and female entrepreneurship.

Numerous studies about women entrepreneurship including the ones cited above indicate that contextual factors such as social and cultural capital, and industrial structure, and individual explanations such as career anchor, personality and cognitive aspects are broadly the major categories of antecedents underlying entrepreneurial activities, behaviors, new venture creation or even attitude toward an enterprise of an individual. However, some researchers point out that research on creating a new enterprise is often characterized by deficits of methodological rigor (e.g., Aldrich & Baker, 1997; Shook, Priem & McGee, 2003; Krueger & Day, 2010) and of theoretical sophistication (Shane & Venkataraman, 2000). Similarly, Krueger & Day (2010) also calls for strong theory in entrepreneurship research. These deficits could have caused inconsistent findings of studies in entrepreneurship research.

The central shortcoming of the entrepreneurship research in general, which is well recognized by the researchers, is that entrepreneurship studies are mainly descriptive and lack methodological rigor (cf, e.g., Aldrich & Baker, 1997; Priem & McGee, 2003 Krueger & Day, 2010). For example, self-assessed ordinal scales such as a Likert scale are widely used to measure individuals' strength of entrepreneurial preference but researchers treat the ordinal scale as if it were a continuous variable in statistical analyses. Scholars investigate factors influencing and/or being correlated to entrepreneurship by using OLS models. However, it is well-known that OLS models are appropriate only when the dependent variables are continuous (cf., e.g., Haire et al., 2009; Gujarati, 2003). Using the OLS models to analyze ordinal variables is the most serious shortcoming of the studies in entrepreneurship research. Agresti (2007, p. xvi) remarks that: "...most of whom now realize that it is unnecessary and often inappropriate to use methods for continuous data with categories responses." Most of the studies emphasize on maximizing R-squared. However, this is one of the problems in entrepreneurship research according to Krueger & Day (2010). Technically speaking, OLS models estimate or predict the average value of dependent variable on the basis of the fixed values of explanatory variables and consequently do not take into account the inconsistent and non-transitive behavior of a person (cf., e.g., McFadden, 2001; Ben-Akiva & Lerman, 1985). Since the choice models generally and the ordered choice models such as ordered probit/logit particularly are probabilistic models, they can take into account random human behavior. Our literature review indicates that ordered choice models are rarely used in entrepreneurship research with Kuckertz & Wagner (2010) and Koellinger et al. (2013) as important exceptions.

Studies about female entrepreneurship are conducted in different situations for specific problems with different assumptions. Additionally, those studies focus on different variables and do not have consistent findings. Consequently, it is difficult to draw general conclusions. Moreover there is a little or no research that investigates female entrepreneurship from the career perspective with focus only on women, particularly girls, who are at the cross-roads of their career in rural and peripheral regions. The study in this paper investigates the issue by focusing only on girls who are at an important decision point in their careers. We also use the more appropriate method, which has not attracted much attention of researchers in entrepreneurial field, to investigate the issue.

### **3. Research Methodology**

#### **3.1 Data**

This study uses data obtained from an entrepreneurship development and career choice survey among all the last year students studying in all the secondary schools in Sogn og Fjordane County in Norway. The county, which is rich in natural resources, has a large share of youths, young women particularly, out-migrate (Gundersen and Sørli, 2009). It is also considered



one of the marginalized counties in Norway. The students were handed out a structured questionnaire. They were also given an orientation about the questions, required information and how to fill in the questionnaire. All the students filled in and handed in the questionnaire within the given time. The survey was undertaken as a part of a larger study to investigate obstacles and conditions for rural innovation funded by Sogn og Fjordane County and the Norwegian Research Council. The purpose of the study was identifying barriers and conditions for entrepreneurship development, status and/or attitudes regarding the present education system, the future professions and career choice among young students in rural Norway with an aim to suggest the policy measures that could address the present problems, equip the students with necessary skills and knowledge required by the employers in the country, and improve the present education system.

The data were entered by student assistants. We performed several screening and consistency checks of the data set. As part of this screening process, we discarded some observations that had many missing values. The final sample consists of 556 observations. However, some of the observations had missing information in some of the relevant variables. As a result, the number of observations is different in different models.

### 3.2 Model<sup>7</sup> and Hypotheses

Define  $y^*$  as a latent (unobserved) variable ranging from  $-\infty$  to  $\infty$  to represent the strength of preference toward EC. The structural model can be written as:

$$y_i^* = x_i' \beta + \varepsilon_i^*$$

where  $i$  denotes a respondent,  $x$  is the vector of the antecedents underlying EC, and  $\beta$  is the vector of the coefficients of the model (to be estimated). Since  $\varepsilon^*$  accounts for aggregate of unobserved and unobservable (by the analyst) idiosyncrasies (Greene and Hensher, 2010), we can treat  $\varepsilon^*$  as a random variable or disturbance or error term. The observed counterpart of the latent variable  $y^*$  is respondents' self-evaluation in a rating scale to a statement concerning an EC. We can reasonably assume that higher score in a rating scale is related to higher  $y^*$ . In consistent with the definitions used in the GEM studies (e.g., Bosma et al., 2009) and others (e.g., Krueger, 2009), we asked the respondents to "rate" their level of agreement (or disagreement) on the integer scale from 1 to 5 where 1 corresponds to strongly disagree and 5 corresponds to strongly agree<sup>8</sup> to the following statements:

<sup>7</sup> Model formulation draws on Greene and Hensher (2010), Long and Freese (2006), Ben-Akiva and Lerman (1985), McKelvey and Zavoina (1975), McFadden (2001), Bhatta (2011) and among others.

<sup>8</sup> The respondents were actually asked to rate the extent of their agreement/disagreement in a 5 point ordinal scale with strongly agree =1, agree =2, neutral =3, disagree =4 and strongly disagree =5 in the survey. Later we reversed the rating for analysis. It is obvious that we do not assume 2-1=3-2=4-3=5-4, that is, the intervals between the consecutive numbers are not the same. They were coded just as consecutive integers from 1 to 5. Perhaps this way of coding makes the researchers tempted to analyze the ordinal outcomes using the OLS models as if they were continuous variables (cf, e.g., Long and Freese, 2006; Greene and Hensher, 2010; Agresti, 2006). However, an ordinal dependent variable



- I will own business despite the potential risk of economic loss (EC1)
- I cannot think of establishing a business (EC2)
- My own business can give me the way of living that suits me (EC3)
- It is appropriate to establish my own company (EC4).

The observed response categories are linked to the latent variable by the following measurement model (Long and Freese, 2006, p. 139):

$$y = \begin{cases} 1 & \text{if } -\infty \leq y^* < \alpha_1 \\ 2 & \text{if } \alpha_1 \leq y^* < \alpha_2 \\ 3 & \text{if } \alpha_2 \leq y^* < \alpha_3 \\ 4 & \text{if } \alpha_3 \leq y^* < \alpha_4 \\ 5 & \text{if } \alpha_4 \leq y^* < \infty \end{cases}$$

where  $\alpha_1, \alpha_2$  and so on are the threshold parameters or cut-off points that define the changes among ordinal categories. Now we can derive the probability associated with an observed outcome for a given value of  $x$  as (ibid, p. 139):

$$\text{Prob}[y_i=j|x] = \text{Prob}[\alpha_{j-1} \leq y^* < \alpha_j] = F[\alpha_j - x_i'\beta] - F[\alpha_{j-1} - x_i'\beta], j=0,1,\dots,J.$$

where  $F$  is the cumulative distribution function of the random error  $\varepsilon$ . The resulting model is ordered probit if  $\varepsilon$  are normally distributed while the model is ordered logit if  $\varepsilon$  follow the logistic distribution. Not to mention, the ordered choice models are nonlinear models which are estimated by maximum likelihood. Here we emphasize that the ordered choice models<sup>9</sup> predict the probability of observing an outcome, not the average value of the outcome variable as in the OLS models, which depends on the distribution of  $\varepsilon$  in addition to the variables included in the model representing  $x$ . This is the basic difference between the ordered choice and the OLS models. Interpretation of a coefficient estimate is quite different in a nonlinear model compared to that of the OLS models because the effect of a change in a

violates the assumptions of the OLS models resulting in biased and inconsistent estimates and possibly leading to ambiguous conclusions (McKelvey and Zavoina, 1975; Gujarati, 2003; Long and Freese, 2006).

<sup>9</sup>There is a large body of literature in many fields that apply ordered logit/probit models, for example, calculus attainment and grades received in intermediate economic theory (Li & Tobias, 2006), severity analysis of injury in traffic accidents (Eluru, Bhat & Hensher, 2008), inappropriate medication use and health outcomes in the elderly (Fu et al., 2004), well-being and the family (Winkelmann, 2005), self-assessment of work disability (Kapteyn, Smith & van Soest, 2007), user perceptions of protected left-turn signals (Zhang, 2007), to name only a few. We refer to Greene & Hensher (2010) and relevant references therein for detailed exposition of the ordered choice models and a comprehensive review of the studies using the ordered logit/probit models in various fields. Surprisingly, the choice models have not attracted much attention from scholars in the field of entrepreneurship research. A study by Kuckertz & Wagner (2010) to investigate the role of business experience and sustainability orientation on entrepreneurial intentions is one of a few studies that use the ordered probit models in entrepreneurship research.

variable in a nonlinear model is not simply equal to the relevant parameter as in the OLS models but depends on the values of all the variables included in the model (cf. Greene and Hensher, 2010; Long and Freese, 2006).

Now another question comes: what  $x$  includes. Then we have to go back to theory or prior research on EC. Given the current state of our knowledge, we consider contextual- and individual explanations underlying respondents' preferences in choosing entrepreneurship as a career.

### 3.2.1 Contextual explanations

Contextual explanations include all factors that are related to a broader social and economic framework that influence and/or correlate to individual behavior with regard to entrepreneurship (cf. e.g., van Gelderen and Masurel, 2011). Cultural and social capital (cf., e.g., Bourdieu, 1986) such as family or friends, social networks, role models, and so on that can help in building favorable attitudes of an individual and/or mobilizing resources to entrepreneurship are the major factors included in this category.

*Cultural capital.* We can understand cultural capital as a collective term for the spiritual and material development among individuals, groups, communities, nations and the entire mankind (Bourdieu, 1986). According to Bourdieu, informal, formal qualifications and achievements are three elements in cultural capital that could frame ability, knowledge and attitudes about the venture creation process providing the basis for action. We expect that children of entrepreneurial parents have an advantage in terms of cultural capital to start an enterprise. There are several studies showing that children of self-employed parents have higher probability of choosing entrepreneurial career (Mazzarol et al., 1999, Greve and Salaff, 2003). Here we have used parents' profession whether they are self-employed or not as a measure of cultural capital because entrepreneurial parents' creation of cultural capital are early exposure to an entrepreneurial environment, transmission of values both direct and indirect, and work experience in the parents' business. This is simple and easily measureable. Kim et al. (2006) have also used exactly the same measure.

*Social capital*<sup>10</sup>. According to Bourdieu (1986, p. 248): "Social capital is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition ...". We use three measures of social capital such as respondents' self-assessment (in a five point ordinal scale) expecting support from family and friends in initiating a new enterprise, friendship with

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<sup>10</sup> We refer to Leenders and Gabbay (1999), Baron et al. (2000), Gabbay and Leenders (2001), Lin et al. (2001), and among others about the concepts of social capital.

entrepreneurs (yes or no), and acquaintance with other entrepreneurs (yes or no). Besides, we explore similarities/differences among the respondents' EC with respect to the residence, income of the municipalities and others to capture more about the broader social and economic framework that can shape attitudes of an individual and/or possibility of mobilizing resources to entrepreneurship.

There is an important difference between cultural and social capital the way these concepts are defined and operationalized here. Cultural capital is values and attitudes gained from the close family, while social capital refers to values and attitudes gained from the society and the possibility of mobilizing resources to attain ones' goals. These two concepts can be overlapping and could therefore also be treated together.

### *3.2.2 Individual explanations*

People are different physically, mentally, intellectually, personality-wise, psychologically and experience-wise giving rise to different attitudes or preferences or capabilities (cf., e.g., Parker, 2009; Lucas, 1978). It is also reasonable to assume that people have different types of assessments, both of themselves and of their career paths. For example, some people are less interested in becoming an entrepreneur, have less self-confidence, are less likely take risk and so on. Individual factors include gender, age, factors related to proactive personality (PAP)<sup>11</sup> and career anchors preferences. We have utilized self-assessments by the respondents in a five point ordinal scale to measure their career preferences and PAP.

Recently, cognitive psychology has emerged as an important theory to explain entrepreneurial careers at the individual level (Baron 1997, 1998 and 1999; Keh et al., 2002; Mitchell et al., 2002; Simon and Houghton, 2002). This means that researchers nowadays are more interested in how entrepreneurs think, than in specific personality traits of entrepreneurs. Self-assessment means that a respondent classifies herself with various attitudes or characteristics. It should be noted that this is not a study of psychological traits, self-assessments first and foremost tell us something about what thoughts respondents have about themselves. Such self-assessments may be related to motivation for entrepreneurship. Segal et al. (2005) found, for

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<sup>11</sup> Literally, a proactive person controls a situation by making things happen rather than waiting for things to happen and then reacting to them (Hornby, 2000). Proactive people are those who do not blame circumstances, conditions, or conditioning for their behavior (Covey, 2004). Their behavior is a product of their own conscious choice, based on values, rather than a product of their conditions. In the literature, PAP is measured through proactive personality scale (PPS) based on respondents' level of agreement to 17 statements about their attitudes or behaviors on a 7 point Likert scale (so called 17 items PPS). Initially, Bateman and Crant (1993) developed PPS based on 17-items. But the shortened version created by Seibert, Crant and Kraimer (1999) are often used for empirical investigation.

example, that self-assessments of entrepreneurial skills, tolerance for risk and the desire to be independent were significantly related to entrepreneurial intentions. Schein's (1975, 1978) five original career anchors are included in the analyses through questions about the degree of importance in a five point ordinal scale of the following factors in the respondents' career decisions: autonomy, desire to become a manager, security, creativity and technical competence. We have also included two career anchors, such as lifestyle and pure challenge, based on Schein's revised version (Schein, 1990).

Table 1 presents the variables including their definitions and hypothesized relationships with the different measures of EC. As discussed above, we have categorized the variables as contextual- and individual factors. The contextual factors include socio-economic characteristics of the municipalities and cultural and social capital. Parents' status as a self-employee or owner of a business serves as a proxy of cultural capital since children with such parents probably have been exposed to the entrepreneurial environment. Entrepreneurship courses and business activities in elementary or secondary schools are also indicators of cultural capital. Access to role models and perceived support from family and friends represent social capital. The individual factors consist of demographic variables such as gender and age, and self-assessments of different abilities, PAP, and career anchors.

**Table 1.** Variables, definitions and hypothesized relationships with the different measures of EC

Variable	Definition	Variable type	Relation with EC
<b>Contextual (1)</b>			
Municipality	Ranking the municipalities based on income level	Dummy	?
	1=the municipality is coastal, 0=otherwise	Ranking	+
	Ranking the municipalities based on unemployment level	Ranking	+
School	School (12 different schools)	Categorical	?
<b>Contextual (2): Cultural- and social capital</b>			
S_employed parents	1= having at least one of the parents self-employed or owning a business, 0=otherwise	Dummy	+
Ecourse_vgs	1= entrepreneurship course taken at secondary school, 0=otherwise	Dummy	+
Ecourse_gk	1= entrepreneurship course taken at elementary school, 0=otherwise	Dummy	+
Entbuz_vgs	1= participated in entrepreneurship business activity at secondary school, 0=otherwise	Dummy	+
Entbuz_gk	1= participated in entrepreneurship business activity at elementary school, 0=otherwise	Dummy	+

Subject	Subject of specialization of the students	Categorical	?
Relatives as role model	1= respondent having relatives owning a business, 0= otherwise	Dummy	+
Friends as role model	1= respondent having friends owning a business, 0= otherwise	Dummy	+
Others as role model	1= respondent knowing others owning a business, 0= otherwise	Dummy	+
Support	Perceived support from friends/relatives to start an enterprise	5 point ordinal scale	+
<b>Individual (1): Demographic characteristics</b>			
Age	1= respondents born after 1991, 0=otherwise	Dummy	+
Gender	1= female, 0 =otherwise	Dummy	+
<b>Individual (2): Personal, interests, abilities and PAP</b>			
Confidence	Having self-confidence to do an activity	5 point ordinal scale	+
Improvising	Perceiving him/herself very good in improvising	5 point ordinal scale	+
Energetic	Being energetic and hard working	5 point ordinal scale	+
Obstacle	Enjoying in facing and overcoming obstacles <sup>1</sup>	5 point ordinal scale	+
Exciting	It is exciting if one's ideas turn into reality <sup>1</sup>	5 point ordinal scale	+
Excellence	Excellent in identifying opportunities <sup>1</sup>	5 point ordinal scale	+
Status quo	Loving to challenge the status quo <sup>1</sup>	5 point ordinal scale	?
Opportunity	Spotting a good opportunity long before others <sup>1</sup>	5 point ordinal scale	+
<b>Individual (4): Variables related to career anchors</b>			
Independence	Favoring independence	5 point ordinal scale	+
Creative	Motivated in creating something new	5 point ordinal scale	+
Leadership	Wishing to take a leadership role in career	5 point ordinal scale	+
Academic	Having strong academic interests	5 point ordinal scale	-
Life style	Expecting a certain life style	5 point ordinal scale	?
Future	Dedicated to achieve a secured future	5 point ordinal scale	?
Challenge	Prepared to meet strong challenges	5 point ordinal scale	+

Note: <sup>1</sup> Rephrased from Kikul and Gundry (2002, p. 89<sup>12</sup>).

<sup>12</sup> Kickul and Gundry (2002) use five items from Bateman and Crant's (1993) scale: (1) "I enjoy facing and overcoming obstacles to my ideas"; (2) "Nothing is more exciting than seeing my ideas turn into

### 3.3 Methods

We have utilized three types of analyses such as descriptive and univariate analysis, bivariate analysis (using chi-squared test) and multivariate analysis (using OL models) to investigate the respondents' motivation toward EC. First we compared a variety of characteristics of the respondents to explore the types of the respondents having different ratings of EC. Then we performed associative analyses to identify the variables that are associated to various measures of EC. Here univariate- and associate methods serve as exploratory analysis. Finally, we used the OL models based on factors influencing and/or being correlated to EC as discussed above. We formulated and reformulated the models a number of times. Consequently we generated a substantial body of empirical results during the iterative process of model building. We arrived at the final specification based on the systematic process of model building. We estimated the models in Stata (Long & Freese, 2006). Lastly, we compared and discussed the results.

## 4. Analysis

### 4.1 Results

In the first stage, we applied descriptive statistics of the respondents' rankings of their preferences toward EC in relation to the various variables specified in Table 1. We computed mean and proportion of the rankings of the preferences. Table 2 presents descriptive statistics such as mean and standard deviation<sup>13</sup>, and the distribution of the rankings. Mean ranged from 2.55 to 3.19 for the different measures of EC. Average age in the sample was 18 years. We can see that the highest proportion of the respondents were neutral in ranking their preferences in EC3 and EC4 while they were more likely disagreeing in EC2 and EC5. The rankings clearly show that the respondents did not want to choose EC because the probability of disagreeing was always higher than the probability of agreeing.

**Table 2.** Descriptive statistics and statements of the respondents (in proportion to total)

Different measures of EC	Mean	Std. dev.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
EC2	2.55	1.15	27.72	32.97	28.26	7.61	3.44
EC3	2.77	1.21	20.8	17.36	32.73	15.19	13.92
EC4	3.19	0.99	12.55	26.73	40.18	13.82	6.73
EC5	2.70	1.06	28.05	29.87	27.5	7.83	6.74

reality"; (3) "I excel at identifying opportunities"; (4) "I love to challenge the status quo"; and (5) "I can spot a good opportunity long before others can."

<sup>13</sup> However, it is more accurate to use median or mean to measure the central tendency and quartiles or percentiles to measure the dispersion of ordinal variables.



We examined the respondents' rating in relation to subject of their specialization, municipalities they live or they come from and so on. There was no significant difference in rankings of EC according to the subject of their specialization. Surprisingly, the rankings were not significantly different for the respondents having had taken the entrepreneurship course and business training in their elementary schools either. Similarly, rankings were not significantly different with respect to the coastal- and non-coastal municipalities<sup>14</sup>. We also explored the differences/similarities with respect to income and unemployment levels in the municipalities. This did not give any significant differences in respondents' ranking either. The results may be attributed to small differences in the unemployment rates and income levels between the municipalities. The social and economic framework of the coastal and non-coastal municipalities may not be different enough that can alter the career preferences of the respondents.

In the second stage, we used chi-squared statistics to explore whether the respondents' preferences toward EC and the variables having significant differences in the respondents' preferences from the first stage were significantly associated. Table 3 presents the chi-squared statistics for different measures of EC and relevant categorical variables. As we see in the table, respondent's age, having entrepreneurial parents, having relatives, friends or others owning their own business, perceived support from family or friends to establish an enterprise, most of the variables related to personal abilities, PAP, and career anchors were significantly associated with the different measures of EC. The observed relation of age and EC may in reality be a relationship of EC and time to completion of college.

**Table 3.** Chi-squared statistics between different measures of EC and other variables

EC→ Likely related variables↓	EC1	EC2	EC3	EC4
Age group (young vs not)	15.82**	7.91*	5.70	2.19
Driving vs other courses	14.35*	3.13	6.70	2.69
Entrepreneurship course (if taken in VGS)	4.73	8.21*	12.46**	10.97**
Entrepreneurship business (if taken in VGS)	7.18	11.96**	10.73**	16.11***
Having at least one of the self-employed parents	27.10***	6.40	18.16	17.15
Having entrepreneurial relatives	6.82	20.43***	12.26**	20.00***
Having entrepreneurial friends	4.08	8.52*	23.93***	16.45***
Knows others owning a business	19.35***	12.26**	14.06***	23.75***
Perceived support from family/friends to establish	71.20***	33.53***	38.10***	49.53***

<sup>14</sup> Because the coastal- and non-coastal municipalities have different economy so we hypothesized that the respondents had different preferences toward EC.

en enterprise					
<b>Variables related to personal abilities and PAP</b>					
Having self-confidence		49.85***	18.45	31.12**	19.74
Improvising		64.51***	47.03***	50.10***	34.06***
Energetic		29.14**	31.49**	38.12***	41.21***
Obstacles		47.02***	50.53***	68.59***	56.10***
Exciting		59.10***	39.52***	39.26***	51.48***
Excellence		81.71***	37.55***	50.64***	28.22**
Status quo		101.36***	45.25***	107.26***	39.44***
Opportunities		85.86***	54.89***	70.80***	31.92**
<b>Variables related to career anchors</b>					
Leadership		56.08***	66.31***	45.97***	62.94***
Creative		60.06***	42.73***	71.17***	57.12***
Independence		23.50	22.70	40.12***	22.86
Academic		ns	ns	ns	ns
Life style		27.81**	16.52	31.00**	38.33***
Future		ns	ns	ns	ns
Challenge		19.66	13.94	29.30**	27.06**

\*, \*\*, \*\*\* represent levels of significance at 10%, 5% and 1%, respectively.

In the third stage, we used multivariate analysis using the OL models relating preferences of the respondents toward EC to contextual and individual factors, including personal abilities, PAP, and career anchors as discussed above (cf. Table 1). Table 4 presents the results of the OL models<sup>15</sup>. The paragraphs that follow summarize the results of the models having the best specification based on iterative process of model building. We took misspecification problems such as heteroscedasticity, multicollinearity, omitted variables, and wrong functional form into account during the modeling process.

<sup>15</sup> We estimated four OL models, viz., EC1, EC2, EC3 and EC4 to investigate the antecedents underlying the girls' preferences of the different measures of EC. The variables included in the models are presented in the first column of Table 4. The columns "Est." contain the maximum likelihood estimates of the models. The columns "Odds ratio" contain the odds ratios of the respective estimates. The columns labeled "z-stat." present the respective z-statistics of the estimates which are equal to the corresponding estimate divided by its standard errors with the two-tailed significance level. Number of observations is the number of observations included in the model estimation. The number of observations is fewer than total sample in each model because of the missing values in the relevant variables. Stata automatically excludes the observations with missing values, called listwise deletion. Log likelihood with zeros only is the value of the log likelihood when all the variables are simultaneously zero. Log likelihood at convergence gives the value of the log likelihood at convergence. Likelihood ratio statistic is a statistic which is distributed as a chi-squared random variable with degrees of freedom equal to the number of the parameters in the model. If the test statistic exceeds the critical value, the null hypothesis that all the variables simultaneously zero is rejected. The test statistic indicates the null hypothesis is rejected in each case. The likelihood ratio index, also called pseudo  $R^2$  or McFadden's  $R^2$ , is a measure of fit of the model to the data. The threshold parameters, also called cut-points, differentiate the adjacent rankings of the degree of the respondents' agreement.

All the models<sup>16</sup> are highly statistically significant because the null hypotheses that all the coefficients in the models were simultaneously different from zero were rejected based on the log-likelihood ratio tests in each case. The results in Table 4 are reported both as standard logit coefficients and odds ratios<sup>17</sup>. Interpreting the results is substantially different with the odds ratios because the effect of a change in an explanatory variable is no longer dependence on the level of the other variables in the model (cf., Long and Freese, 2006, p. 133). The estimates are “robust” in the sense that “robust standard errors” are computed instead of “usual” standard errors, which take into account violations of the assumptions of a model (cf., e.g., Long and Freese, 2006). Here, it should be noted that some of the models contain coefficient estimates of low level of significance; the inclusion of the variables associated with those coefficients, all of them have the plausible signs, did not affect the remaining estimates.

Age of the respondents was significantly associated to higher EC in the second model only. Having relatives, friends or others establishing their own enterprises increased the probability of having higher EC but those variables did not become significant in each model. It seems that having at least one of the self-employed parents increased the probability of having higher EC.

Surprisingly the results indicate that attending an entrepreneurship course did not contribute to increased preference toward EC. However, participating in a business training activity contributed to higher degree of EC. The probability of increased preference toward EC were always positively associated with perceived support from family or friends to establish an enterprise as expected.

We also included eight variables related to personal abilities and PAP. The results showed that the probability of having higher EC were negatively associated with a perceived value in confidence and energetic while positively associated with persons who are more improvising, ready to meet obstacles, challenging status quo and recognizing opportunities long before others as expected but the variables were not significant in all the models.

The variables related to career anchors such as expecting a certain life style, motivated in creating something new and wishing to take a leadership role in career were highly statistically significant implying that higher values of those variables were also associated with the increased probability of being in higher category of EC in all the models.

<sup>16</sup> The odds ratios are simply the exponential of the respective coefficients (cf., e.g., Long and Feese, 2006). For example, the odds ratio of the coefficient with a magnitude of -0.0787525 is equal to 0.92. The odds ratios are therefore never negative.

<sup>17</sup> Interpreting the coefficients is substantially different when the logit coefficients are presented as standard coefficients or the odds ratio. However, sign of a coefficient is important.

The results are generally plausible, but with a rather variable pattern of significance of the variables across the different models. Similarly, the magnitudes of the coefficients do not remain the same across the models. Moreover, the z-statistics of the estimated parameters do not show any general tendency. The z-statistics of some coefficients increase and some decrease with the different models.

## 4.2 Discussion and Implications

The results from Tables 2-4 provide several theoretical and methodological understandings about measures of motivating young females toward EC in peripheral and marginal regions. The results support the arguments by Bygrave (2003).

Table 2 shows that the proportion of entrepreneurial girls varies between 11 and 38%, depending on how the question is asked. This indicates that attitudes to entrepreneurship is a complex matter, and this must be taken into consideration in the discussion of possible measures to increase female entrepreneurship. Factors influencing EC in all the four models should therefore be regarded as more important than others.

Cultural capital, both in the form of self-employed parents and entrepreneurial education, have a certain impact on girls' EC, but these factors are less important than expected. Self-employed parents have positive impact at 5 % level only in one of the four models. This is contrary to Nesse (2010) who found a stronger relationship here, but partly in accordance with Kim et al. (2006), who did find any impact at all of parents's profession on children's EC. Anyway, the good news is that it seems possible to develop positive attitudes to entrepreneurship independently of parent's profession.

It is important to discuss the lack of intended effects of attending a course on entrepreneurship in secondary schools. Our results clearly indicate that entrepreneurship education should not start at elementary level, at least not if the purpose is to encrease the probability of EC. For students at secondary level, courses in entrepreneurship still have no effect on EC, since the bivariate relations in table 3 disappear in the multivariate analysis in Table 4. But for secondary students, the participation in starting, running, and closing down a student business has positive effect on EC. Cox, Mueller & Moss (2002) also showed that introductory courses on entrepreneurship decreased confidence level of undergraduate students to start their own business. There are several possible reasons for this. One of the major reasons could be the complexity of the entrepreneurial process presented to the students. This could also indicate that traditional classroom teaching may not be an appropriate approach in raising entrepreneurship skills or motivation of students. Rather a more experimental and practical learning would probably be better (McNaughton & Armitage, 2010). Entrepreneurial courses would help to improve the participants' knowledge on both opportunities and risks associated with establishing the businesses. This knowledge may reduce EC



of the participants who would perceive entrepreneurial careers as risks rather than opportunities.

**Table 4.** Estimation results of the OL models

Models→ Variables↓	EC1			EC2			EC3			EC4		
	Est.	Odds ratio	z-stat.	Est.	Odds ratio	z-stat.	Est.	Odds ratio	z-stat.	Est.	Odds ratio	z-stat.
Age	.2913077	1.3382	0.47	-1.303136	0.2717	-2.18	-.5252852	0.5914	-0.91	-.7850929	0.4561	-1.61
Relative_rolemod	.1539804	1.1665	0.85	.4500739	1.5684	2.54	.3266724	1.3863	1.75	.3236256	1.3821	1.64
el	.051282	1.0526	0.20	.3069076	1.3592	1.18	.9832817	2.6732	3.89	.3649756	1.4405	1.24
Friends_rolemod	.1663418	1.1810	0.88	.0352326	1.0359	0.20	.0871676	1.0911	0.45	.4188494	1.5202	2.01
el	.3534852	0.7022	1.93	.0793066	0.9238	0.45	.232671	0.7924	1.31	.3076968	0.7351	1.62
Others_rolemode	.3947346	1.4840	1.78	.4756217	1.6090	2.13	.2876113	1.3332	1.28	.6169255	1.8532	2.27
l	-.064666	0.9374	-0.30	-.0020485	0.9980	-0.01	.0205166	1.0207	0.09	-.0488169	0.9524	-0.18
Parents	.4660749	1.5937	4.44	.2289755	1.2573	2.83	.3019575	1.3525	3.66	.4105193	1.5076	4.24
Entbuz_vgs	--	--	--	-.202842	0.8164	-1.77	--	--	--	--	--	--
Ecourse_vgs	.2244701	1.2517	1.93	--	--	--	--	--	--	--	--	--
Support	-.2385214	0.7878	-1.89	-.1092052	0.8965	-0.88	-.2590116	0.7718	-2.14	-.2377809	0.7884	-1.85
Confidence	--	--	--	.2418288	1.2736	2.18	.3492229	1.4180	2.94	.2790404	1.3219	2.19
Improvising	--	--	--	--	--	--	--	--	--	.1010828	1.1064	0.80
Energetic	.2107192	1.2346	1.41	--	--	--	--	--	--	--	--	--
Obstacle	.3652268	1.4408	2.88	.1077829	1.1138	0.79	.2100178	1.2337	1.41	.093405	1.0979	0.81
Exciting	--	--	--	.2105091	1.2343	1.30	.3140907	1.3690	2.02	--	--	--
Excellence	.3002339	1.3502	2.98	.3574521	1.4297	3.59	.1099703	1.1162	1.10	.3499776	1.4190	3.31
Status quo	.1961319	1.2167	2.58	.2237676	1.2508	3.06	.2583465	1.2948	3.32	.2895475	1.3358	3.65
Opportunity	--	--	--	--	--	--	--	--	--	.1627651	1.1768	1.89
Leadership												
Creative												
Life style												
<b>Threshold parameters</b>												
$\alpha_1$	4.214387			1.107084			1.660289			3.702331		
$\alpha_2$	5.96182			2.07086			3.471456			5.357980		
$\alpha_3$	7.95131			3.686148			5.657537			7.666439		
$\alpha_4$	9.309947			4.776729			7.029398			--		
<b>Summary statistics</b>												
Number of observations			477			474			478			439
Log likelihood with zeros only			-660.47626			-736.12929			-682.91515			568.49251
Log likelihood at convergence			-589.03442			-688.51554			-616.50998			-497.58177
Likelihood ratio statistic			122.52			77.83			133.35			128.24
Likelihood ratio index			10.82			6.47			9.72			12.47

Note: (1) An estimate is significant at 99%, 95% or 90% confidence level if the z-statistic associated with the estimate is  $\pm 2.58$ ,  $\pm 1.96$  or  $\pm 1.64$  (two-tailed test) respectively. (2) -- means the variable is not included in the model.

Social capital in the form of perceived support from family or friends is significant in all models both in Tables 3 and 4. If we look at Table 3, other role models than parents (friends, relatives, others) seem important, but these factors are only significant at 5 % level in one of four models in Table 4. All in all, this indicates that public authorities can support young women's entrepreneurial careers by connecting them to experienced entrepreneurs.

Most of the results regarding personal abilities, PAP, and career anchors, with a few exceptions, are consistent with theory and findings from previous studies. Of the unexpected findings we can mention that being energetic, and having high self-confidence, have negative relation with EC. It is also interesting to see that creativity has a significantly positive relation with girls' EC. Nesse (2010) did not find any relation between creativity and girls' entrepreneurial intentions. And last, but not least, Nesse (2010) found that girls had a barrier against entrepreneurship in the sense that high preference for a secure future was negatively related to entrepreneurial intentions. In this study, however, there is no significant relation between secured future and EC, so this barrier is not there anymore. Sometimes a nonsignificant relation is good news! Since leadership ambitions and creativity can be strong predictors of EC, it might well be that courses to promote female leadership and innovation are more important than entrepreneurial courses to reach the goal of more female entrepreneurship.

Because respondents' self-assessments of their EC in fact do not depend on their self-assessment of the variables serving as proxy for personal abilities, PAP, and career anchors, some of the results must be interpreted as being associative rather than causal.

Since many of the relationships are significant according to bivariate analysis but not according to multivariate analyses, cautions must be taken to draw conclusions based only on bivariate analyses indicating that multivariate analysis can give more robust findings.

How might we apply these results to improving modeling processes of an entrepreneurial phenomenon? First we question whether OLS models are suitable statistical tools to predict entrepreneurial phenomena since OLS models estimate or predict the average value of a dependent variable on the basis of the fixed values of explanatory variables and consequently do not take into account the inconsistent and non-transitive behavior of a person (cf., e.g., McFadden, 2001; Ben-Akiva & Lerman, 1985). It is therefore important to take into account random behavior of human beings in modeling and as we stated earlier, the choice models such as ordered logit or ordered probit can take into account and predict behavior in probabilistic terms. More importantly, using the OLS models to analyze ordinal variables is the most serious shortcoming of the studies in entrepreneurship research as it is well-known that OLS models are appropriate only when the dependent variables are



continuous (cf., e.g., Haire et al., 2009; Gujarati, 2003) violating assumptions of the OLS models resulting in biased and inconsistent estimates and possibly leading to ambiguous conclusions (McKelvey and Zavoina, 1975; Gujarati, 2003; Long and Freese, 2006), researchers should therefore rethink of using the OLS models in such situations.

## 5. Conclusions

Understanding the degree to which various factors influence and/or are correlated to EC and the propensity to be an entrepreneur is important if we are able to be prescriptive about entrepreneurial phenomena. With the increased emphasis on entrepreneurship, a broader and firmer foundation on entrepreneurial studies is needed. If most of the antecedents underlying ECs and the propensity to be an entrepreneur are stable personal characteristics, then attempts to increase the number of entrepreneurs by influencing their EC are likely to be difficult in the short run. On the other hand, if most of the antecedents are contextual and cognitive such as broader socio-economic framework, then such efforts in promoting EC and entrepreneurship are likely to increase the number of entrepreneurs. Participating in a business training activity contributed to higher degree of EC suggesting that this could also contribute to reduce the gender gap in EC. The probability of increased preference toward EC were always positively associated with perceived support from family or friends to establish an enterprise as expected. The results showed that the probability of having higher EC were negatively associated with a perceived value in confidence and energetic while positively associated with persons who are more improvising, ready to meet obstacles, challenging status quo and recognizing opportunities long before others as expected but the variables were not significant in all the models. The variables related to career anchors such as expecting a certain life style, motivated in creating something new and wishing to take a leadership role in career were highly statistically significant implying that higher values of those variables were also associated with the increased probability of being in higher category of EC in all the models. Since ordinal dependent variables, which are commonly used to measure an entrepreneurial phenomenon, violates assumptions of the OLS models resulting in biased and inconsistent estimates and possibly leading to ambiguous conclusions (McKelvey and Zavoina, 1975; Gujarati, 2003; Long and Freese, 2006), researchers should therefore rethink of using the OLS models in such situations.

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## E-commerce Adoption by Indonesian Small, Medium, and Micro Enterprises (SMMEs): Analysis of Factors and Benefits

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### Abstract

Indonesia is one of countries that realize the significant economic contributions of Small, Medium, and Micro Enterprises (SMMEs). Accordingly, the use of e-commerce in Indonesia does not only target Small and Medium Enterprises (SMEs), but also micro enterprises. Although there are a lot of studies on e-commerce adoption by SMEs, there are fewer studies that are focused on e-commerce adoption by SMMEs. Thus, this study intends to understand the influencing factors and benefit of Indonesian SMMEs' e-commerce adoption. In order to identify and analyze comprehensive factors from within and outside the firm, the Business Environment framework is used. In the research model, there are compatibility, human resources, financial capability, primary stakeholders, supporting e-commerce entities, government, socio-economic, and technological infrastructure factors. The internal compatibility and consumer factors and human resource factors are proved to be the critical factors that affect the adoption of e-commerce by Indonesian SMMEs. This study also found that the benefits gained from the adoption of e-commerce are significant for Indonesian SMMEs.

**Keywords:** electronic commerce, SMMEs, adoption factors, benefit.

### 1. Introduction

Indonesia is one of countries that realize the significant economic contributions of SMEs. Depending on their contributions towards Gross Domestic Product (GDP) and employment, SMEs prove their participation in national economic development (Ayyagari et al., 2007; Caniëls and Romijn, 2005). In developing countries, very substantial numbers of poor working people rely for their livelihood on employment in SMEs (Caniëls and Romijn, 2005). Moreover, SMEs also have an influential positive characteristic, which is their flexible adaptation to economic conditions (Berry et al., 2001;



Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2010b). It was demonstrated in 1998, when the major Indonesian conglomerates' involvement in banking and investment resulted in severe economic setback (Berry et al., 2001). In the crisis, the SMEs' flexibility led to their stable growth as in the case of Jepara furniture industry (Sandee et al., 2000). Thus, SMEs empowerment has become a strategic economic development program in Indonesia.

However, Indonesia differs from other developing countries. Most of Indonesian enterprises are in the micro level. The percentage reached 98.88% in 2009 (Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2010a). Moreover, the micro enterprises have 91.03% share of Indonesian employment and 33.08% share of Gross Domestic Product (GDP) (Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2010a). Therefore, the economic development of Indonesia not only focuses on SMEs, but also on micro enterprises.

Nowadays, there is a growth of Information and Communication Technology (ICT) implementation in the economic development. Successful implementation of ICT offers the prospect of substantial competitive advantage, for large companies as well as SMEs (Thorp, 1998). Another research also found positive signs that SMEs can take advantage of electronic commerce (e-commerce), as a type of ICT special form, in helping to grow their business (MacGregor et al., 2002).

Although there are a lot of studies on e-commerce adoption by SMEs, there are fewer studies that focused on e-commerce adoption by Small, Medium, and Micro Enterprises (SMMEs). There are also studies on Indonesian SMEs (Kartiwi, 2006; Kartiwi et al., 2006; Kartiwi and MacGregor, 2007) and studies on Indonesian SMMEs (Govindaraju and Chandra, 2012; Govindaraju et al., 2012). However, the studies' intentions are limited to understand the barriers and goals of e-commerce adoption and the stakeholders' influence in the process.

In the e-commerce adoption by SMMEs, it is important to understand the influencing factors, not only the barriers. The barriers are factors that obstruct the e-commerce adoption process. On the other hand, the influencing factors have a broader definition. They are critical factors in determining the e-commerce adoption decision. Therefore, there is an urgent need for advanced study on e-commerce adoption by Indonesian SMMEs.

This study intends to complement previous studies by studying the influencing factors to support the enhancement of Indonesian SMMEs' e-commerce adoption rate. Besides, this study is also focused on the e-commerce benefits for Indonesian SMMEs. It is important because their achievements in adopting e-commerce will direct their future strategy and prove the advantages of the SMMEs empowerment program.

## 2. Prior Research

### 2.1 Indonesian SMMEs

Because of the significant role of SMMEs, Indonesian government declared the establishment of the Ministry of Cooperatives and Small and Medium Enterprises. In addition, they also established the Law of the Republic of Indonesia Number 20 Year 2008 on Micro, Small and Medium Enterprises. The law stipulates the definition of SMMEs based on their assets, excluding land and buildings, and gross income. The definition in Table 1 is used in this study.

**Table 1.** The Criteria of SMMEs

<b>Scale of Enterprises</b>	<b>Assets - excluding land and buildings (Indonesian Rupiah)</b>	<b>Gross Income (Indonesian Rupiah)</b>
Micro	≤ 50,000,000	≤ 300,000,000
Small	> 50,000,000 - 500,000,000	> 300,000,000 - 2,500,000,000
Medium	> 500,000,000 - 10,000,000,000	> 2,500,000,000 - 50,000,000,000

Furthermore, Indonesian government determined nine sectors of SMMEs (Bagian Data - Biro Perencanaan Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2009). They are: (1) Agriculture, Livestock, Forestry and Fisheries, (2) Mining and Quarrying, (3) Manufacturing Industry, (4) Electricity, Gas and Water Supply, (5) Building, (6) Trade, Hotels and Restaurants, (7) Transportation and Communication, (8) Finance, Real Estate & Business Services, and (9) Services.

The focus on this study is the Trade, Hotels, and Restaurants sector and Manufacturing Industry sector. Both of the sectors are chosen because they have high employment levels, gross domestic values, and export values (Bagian Data - Biro Perencanaan Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2009). The number of SMMEs in those sectors is also enormous (Bagian Data - Biro Perencanaan Kementerian Koperasi Dan Usaha Kecil Dan Menengah Republik Indonesia, 2009). Besides, we also consider the sectors' potency in adopting e-commerce.

### 2.2 E-commerce

There are various definitions of e-commerce. Some of the definitions are: (1) e-commerce is an emerging concept that describes the process of buying, selling, or exchanging of products, services, and information via computer networks including the internet; it also includes servicing customers, collaborating with business partners, and conducting electronic transactions within an organization (Turban et al., 2005); (2) e-commerce is the process of buying and selling products and services by business players and consumers over the internet that involves financial transactions directly through internet

technology, consisting of business to business, business to consumer and consumer to consumer (O'Buyonge and Chen, 2006); and (3) e-commerce is process of information exchange and transaction, involving products and services, through information technology such as network, software, non-wireless electronic equipment, and wireless electronic equipment (Govindaraju and Chandra, 2010).

The last definition is a definition of e-commerce that includes the definition of mobile commerce (m-commerce). M-commerce, which is a development of e-commerce, can be identified by the usage of wireless electronic equipment and network. As nowadays the wireless technology is a widespread and common technology, the last definition of e-commerce is used in this study.

### 2.3 E-commerce Adoption Stages

There are studies (Kalakota and Robinson, 2001; Daniel et al., 2002; Toland, 2006; Rao et al., 2003) that were done to understand the e-commerce adoption process. The studies proposed different models of e-commerce adoption classification. In the previous study of Indonesian SMMEs (Govindaraju and Chandra, 2012), the non-adopter stage was added to the Rao, Metts, and Monge's model (Rao et al., 2003). Unlike the others, the revised model of e-commerce adoption level was based on sustainable pattern. The previous study also had proven that the model could be used to clearly classify the Indonesian SMMEs. The revised model is used in this study. It is presented in the Table 6.

**Table 6. E-commerce Adoption Stage (Govindaraju and Chandra, 2012)**

E-Commerce Adoption Stage	Description
<b>Non-adopter</b>	· No website
<b>Level 1 : Presence</b>	· Use websites (including Facebook, Multiply, Indonetwork domain, etc.) to display information about products and services · Communication on the website is a one way (from the seller only)
<b>Level 2 : Portals</b>	· Use websites (including Facebook, Multiply, Indonetwork domain, etc.) for two-way communication with customers and suppliers · Provide services such as ordering, product feedback, surveys and customization
<b>Level 3 : Transaction integrator</b>	· Use websites (including Facebook, Multiply, Indonetwork domain, etc.) for two-way communication with customers and suppliers · Providing services such as ordering, product feedback, surveys and customization
<b>Level 4 : Enterprise integration</b>	· Online payment and / or an online order fulfillment · Use websites (including Facebook, Multiply, Indonetwork domain, etc.) for two-way communication with customers and suppliers · Providing services such as ordering, product feedback, surveys

and customization

- Payment and / or an online order fulfilment
  - Integration of internal processes with online booking
  - Supplier Relationship Management (SRM) and Customer Relationship Management (CRM)
- 

## 2.4 E-commerce Adoption Model

There are some basic models that were often used in previous researches. They are the Innovation Diffusion (Azam and Quaddus, 2009) and TOE model (Seyal et al., 2004; Kiong, 2004). The studies that used the Innovation Diffusion model have a weakness. The model has a tendency to ignore some factors from within and outside the organization. Likewise, there is a bias in studies based on TOE and TAM, which is another basic model. The models do not identify the detail aspects in the firms and other aspects that influence the firms as the source of potential factors of e-commerce adoption (Govindaraju and Chandra, 2011). Furthermore, although some studies (Kurnia et al., 2009; Pearson and Grandon, 2005; Huy and Filiatrault, 2006; Wymer and Regan, 2005) modified the basic models, the theoretical backgrounds of their factor classification are not adequate.

Hereinafter, there is a framework that was used in the previous studies of Indonesian SMMEs (Govindaraju and Chandra, 2012; Govindaraju and Chandra, 2010; Govindaraju and Chandra, 2011). The framework is Business Environment. In the study, it is stated that Business Environment was able to explain e-commerce adoption by SMMEs. Thus, in order to identify and analyze comprehensive factors from within and outside the firm, the Business Environment framework is used in this study.

The business environment is divided into two major groups, which are internal and external environment. Internal environment includes the internal factors that can be controlled by the firm (Jain, 2009). The internal components are generally referred as 5M; it comprises man, machine, materials, management, and money. External environment consists of the factors that come from things outside the firm and have an impact on firm's business processes (Jain, 2009). Moreover, there are two types of external environment. They are micro and macro or general external environment.

## 2.5 E-commerce Benefits

The e-commerce benefits in this study are derived from previous studies (Molla, 2005; Kiong, 2004; Fitzgerald et al., 2004). These e-commerce benefits are presented in Table 3. These benefits are confirmed in this study to answer the question about the Indonesian SMMEs' achievement in e-commerce adoption.

**Table 3.** E-commerce Benefits

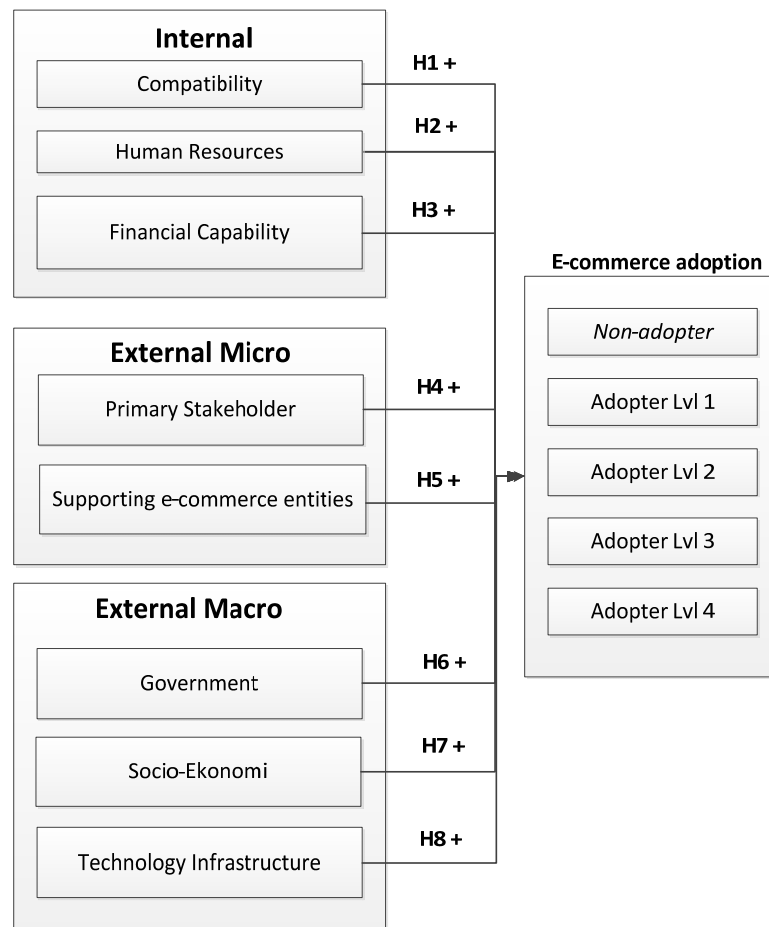
Label	Benefit
B1	Expanding the market (Molla, 2005; Kiong, 2004; Fitzgerald et al., 2004)
B2	Improving the company image or trademark (Fitzgerald et al., 2004; Kiong, 2004)
B3	Increase Sales (Fitzgerald et al., 2004)
B4	Improve service to the customer (Fitzgerald et al., 2004; Kiong, 2004)
B5	Increase customer loyalty (Molla, 2005)
B6	Improve business process flow (Kiong, 2004)
B7	Reduce operational cost (Kiong, 2004)
B8	Reduce the cost of purchasing and procurement (Molla, 2005)
B9	Improving relationships with suppliers (Molla, 2005)
B10	Increase profit (Kiong, 2004)
B11	Increase productivity (Kiong, 2004)
B12	Improving communication within the organization (Fitzgerald et al., 2004; Molla, 2005)
B13	Improve competitive position (Fitzgerald et al., 2004; Molla, 2005)
B14	Reduce distribution channels (Fitzgerald et al., 2004)
B15	Facilitate the order process (Fitzgerald et al., 2004)

### 3. Research Methodology

#### 3.1 Model Development

The model development is done by using classifying steps that are modified from previous study (Wymer and Regan, 2005). The steps are: (1) Study on literatures, (2) Organize the variables and items from previous research based on the author's name and year of research, (3) Label a new variable to each item in accordance with the Business Environment framework, (4) Group the items that exist under the new labels, (5) Eliminate redundant items, (6) Choose items that were used in the study with the consideration of significance and suitability when used in Indonesia. The last step is done by pilot case studies in three SMMEs. Using the result of pilot case studies, the model development is enriched by the SMMEs' knowledge about the real situation. The model that is used in this study is presented in Figure 1.

**Figure 1.** Research Model of Influencing Factors in E-commerce Adoption



### 3.1.1 Internal Environment

In the research model, the internal environment consists of several factors; they are presented in Table 4.

Compatibility factor is used because of its' significance in influencing the adoption of e-commerce (Kartiwi and MacGregor, 2007; Wymer and Regan, 2005). The items in the compatibility factor are taken from previous studies. They are compatibility with business requirements, compatibility with the products or services, and compatibility with company objectives. If SMMEs perceive that these compatibilities of e-commerce are high enough, their tendency to adopt e-commerce will be greater, and vice versa.

*H1: The compatibility factor has a positive influence on e-commerce adoption*

The next factor is human resources factor. There are two kinds of human resources, the owner or manager and the employee. Owners or managers of SMMEs have dominant roles in SMMEs' decision-making. Almost all of SMMEs' decisions are known in detail by the owners or managers. Therefore, the characteristics of the owners or managers that are related to e-commerce affecting the e-commerce adoption decision (Kapurubandara and Lawson, 2006).



**Table 4.** Factors in Internal Environment

Factor	Label	Item
Compatibility	V1	Compatibility of e-commerce with business needs (Kapurubandara and Lawson, 2006; Pearson and Grandon, 2005)
	V2	Compatibility of e-commerce with products or services (Kartiwi and MacGregor, 2007; Kapurubandara and Lawson, 2006)
	V3	Compatibility of e-commerce with the objectives of the firm <sup>a</sup>
Human Resources	V4	The courage of the owner or the manager of technology investment risk (Sutanonpaiboon and Pearson, 2006)
	V5	Knowledge of the owner or manager about the potential use of e-commerce (Kiong, 2004)
	V6	Employees' knowledge about e-commerce <sup>a</sup>
	V7	Employees' technical capabilities related to e-commerce (Kapurubandara and Lawson, 2006; Kiong, 2004; Wymer and Regan, 2005)
Financial	V8	The ability to buy new technology (Kiong, 2004)
Capability	V9	The ability to buy internet access (Sarлак et al., 2009)

<sup>a</sup> emerged in the pilot case study

Managers who are risk-takers, especially in adopting new technology, have tendencies to adopt e-commerce (Sutanonpaiboon and Pearson, 2006). Besides owners or managers, another important entity is employees. Employees who have knowledge and technical capabilities related to e-commerce will help in accelerating e-commerce adoption. Employees can also become the project champions in e-commerce adoption. Managers' knowledge about e-commerce, their courage to take risks and the knowledge of employees will lead to willingness in adopting e-commerce, and vice versa.

*H2: Human resources factor has a positive influence on e-commerce adoption*  
 The next factor is the financial capability. Financial capability is important to be considered in the adoption of e-commerce. Several studies included financial factors in their research models. In SMME with a good financial capability, the cost of e-commerce becomes less meaningful, and then the tendency to adopt e-commerce is higher, and vice versa.

*H3: The financial capability has a positive influence on e-commerce adoption*

### 3.1.2 Micro External Environment

Micro external environment relates to specific entities that affect the performance of SMMEs. In association with the adoption of e-commerce, micro external environment deals with the market and non-market entities. Consumers, competitors and suppliers directly relate to the market. Entities that directly relate to the market were called the primary stakeholders. On the other hand, the entities relate to non-market were called the supporting e-commerce entities. These entities could be either e-

commerce technology provider (vendor or portal), or information media to learn e-commerce.

As it is shown in Table 5, there are some new items that appear in the pilot case studies of this study. They are: (1) The number of consumers who potentially use e-commerce; one of the SMMEs' considerations in adopting e-commerce is consumers; if there are many potential consumers who use e-commerce, SMMEs tend to adopt e-commerce; (2) The number of service providers or portal sites for

**Table 5.** Factors in Micro External Environment

Faktor	Label	Item
Primary Stakeholder	V10	Compatibility of e-commerce with consumers (Sarлак et al., 2009)
	V11	The number of consumers who potentially use e-commerce <sup>a</sup>
	V12	The number of suppliers or partners who are already using e-commerce (Kiong, 2004; Wymer and Regan, 2005; Huy and Filiatrault, 2006)
	V13	The number of competitors who are already using e-commerce (Pearson and Grandon, 2005)
Supporting E-commerce Entities	V14	The number of vendors or service who make e-commerce applications (Kiong, 2004)
	V15	The number of service provider or portal site for e-commerce <sup>a</sup>
	V16	The number of Information media about e-commerce (Kapurubandara and Lawson, 2006)

<sup>a</sup> emerged in the pilot case study

e-commerce; e-commerce portals are easy to be found in the internet; in Indonesia there are many portal which users are SMMEs. The high perception of micro external environment factors will increase the tendency of e-commerce adoption, and vice versa.

*H4: Primary stakeholder factor has a positive influence on e-commerce adoption*

*H5: Supporting e-commerce entities factor has a positive influence on e-commerce adoption*

### 3.1.3 Macro External Environment

Macro external environment is an environment that is more general and more difficult to be influenced in comparison with the micro environment. In association with e-commerce adoption, the macro external environment deals with politic, economy, social, and technology factors. In this study, the external macro environment consists of government, socio-economic and technological infrastructure. These factors often appeared in studies using TOE model. If the factors presented in Table 6 highly perceived, the SMMEs' tendency to adopt e-commerce is also high, and vice versa.

- H6: Government factor has a positive influence on e-commerce adoption*  
*H7: Socio-economic factor has a positive influence on e-commerce adoption*  
*H8: Technological infrastructure factor has a positive influence on e-commerce adoption*

### 3.2 Data Collection and Analysis

The questionnaire in this study consists of three major parts. The first part is related to the profile of respondents. The second part consists of 26 statements. The aim of this part is to explore the factors that influence the e-commerce adoption decision. The third part of questionnaire is related to the confirmation of the e-commerce benefits.

**Table 6.** Factors in Macro External Environment

Factor	Label	Item
Government	V17	Government support on e-commerce for SMEs (Kapurubandara and Lawson, 2006)
	V18	The regulations regarding e-commerce in Indonesia (Kapurubandara and Lawson, 2006)
Socio-Economy	V19	Level of Internet usage in Indonesia <sup>a</sup>
	V20	Level of popularity of e-commerce in Indonesia (Kapurubandara and Lawson, 2006)
	V21	The ability of the Indonesian society in adopting new technology <sup>a</sup>
	V22	Economic levels of Indonesian society (Kapurubandara and Lawson, 2006)
Technology Infrastructure	V23	Speed of internet access (Kapurubandara and Lawson, 2006)
	V24	Security level of online payment (Kiong, 2004)
	V25	Conditions of telecommunications infrastructure and Internet network in Indonesia (Kiong, 2004)
	V26	The condition of roads and transportation in Indonesia as a media to deliver goods <sup>a</sup>

<sup>a</sup> emerged in the pilot case study

This research use four-point scale. Even-numbered scale is chosen because respondents have tendencies to choose a middle value. Details of the scale in this study are presented in Table 7.

**Table 7.** Scale of Questionnaire

Second Part				
Scale Type 1	Scale Type 2	Scale Type 3	Scale Type 4	Score
Very incompatible	Very low	Too few	Very Bad	1
Incompatible	Low	Few	Bad	2
Compatible	High	Many	Good	3
Very Compatible	Very High	Too Many	Very Good	4

Third Part	
Scale	Score
Strongly Disagree	1
Disagree	2
Agree	3
Strongly Agree	4

Questionnaires are distributed via e-mail, e-surveys, and direct meeting to SMMEs in Trade, Hotels, and Restaurants sector and Manufacturing Industry sector. 560 online questionnaires and 40 hardcopy questionnaires are distributed. 87 complete questionnaires are returned. Hence, the response rate is 14.5%. Profiles of respondents are presented in Table 8.

Next, the factor analysis and logistic regression are applied to test the research model. Factor analysis is aimed to test the construct validity, whether the items statistically fit in a factor or not. Before conducting factor analysis, some assumptions are also checked. These assumptions are normality, multicollinearity and sample adequacy. For further analysis, multinomial logistic regression is conducted to understand the difference between the levels of adoption.

**Table 8.** Profiles of Respondents

Profiles	Frequency	Percentage
<b>Enterprise size</b>		
Medium	4	4.60%
Small	12	13.79%
Micro	71	81.61%
<b>Adoption level</b>		
Non-adopter	27	31.03%
Level 1	17	19.54%
Level 2	35	40.23%
Level 3	8	9.20%
Level 4	0	0.00%
<b>Sector</b>		
Manufacture	16	18.39%
Retail	53	60.92%
Others	18	20.69%
<b>Education level</b>		
Lower than high school	1	1.15%
High School	26	29.89%
Diploma	7	8.05%
Bachelor	50	57.47%
Master	3	3.45%

## 4. Analysis

### 4.1 Critical Factors of E-commerce Adoption

Normal test result shows that V12 and V13 are not normal, so these items are excluded in subsequent analysis. Multicollinearity test is done using Bartlett's test. The significance of Bartlett's test results, which is 0.000, indicates that there is multicollinearity. In addition, the values of diagonal anti-image correlation from SPSS software are more than 0.5. Therefore, factor analysis can be applied. Based on the results of the sample adequacy test, the sample size is adequate because the KMO result is 0.827, which is higher than 0.5.

Since all assumptions are met, factor analysis can be used in this study. Factor analysis result is in Table 9, whereas the initial research model proposes eight factors. The difference is due to the integration between consumer and compatibility factors. The other factors in the model do not change much conceptually. Most of the items have high loading factors, except for V20 and V25, which loading values are less than 0.7. The revised model is developed based on the factors and items classified in the factor analysis.

**Table 9.** The Result of Factors Analysis

	Internal compatibilit y and consumer	Human resource s	Supportin g e- commerce entities	Component Technology infrastructur e	Governmen t	Socio- econom y	Financial capabilit y
V1	0,827						
V2	0,839						
V3	0,799						
V4		0,661					
V5		0,755					
V6		0,798					
V7		0,81					
V8							0,809
V9							0,835
V10	0,781						
V11	0,632						
V14			0,793				
V15			0,735				
V16			0,724				
V17					0,887		
V18					0,818		
V19						0,603	
V20							
V2						0,633	

1		
V2		0,74
2		
V2	0,702	
3		
V2	0,636	
4		
V2		
5		
V2	0,681	
6		

The result of reliability analysis is presented in Table 10. The results show that the financial ability, socio-economic, and technological infrastructure factors are not reliable since their value are under 0.7. Therefore, these factors are excluded in subsequent analysis.

**Table 10.** The Result of Reliability Analysis

Factor number	Factor	Cronbach's Alpha	Number of item
1	Internal compatibility and consumer	0,898	5
2	Human resources	0,896	4
7	Financial capability	0,691	2
3	Supporting e-commerce entities	0,795	3
5	Government	0,768	2
6	Socio-Economy	0,568	3
4	Technology Infrastructure	0,624	3

Subsequently, the normal score of four reliable factors are analyzed using binary logistic regression to determine the influence of these factors on e-commerce adoption decisions. The binary logistic regression is used since the dependent variable, which is the decisions to adopt or to not adopt e-commerce, is dichotomous. The result of binary logistic regression is presented in Table 11. The results indicate that the compatibility and consumer factor and human resources factor have positive and significant influences on e-commerce adoption decision.

**Table 11.** The Result of Binary Logistic Regression

Factor	B	Sig.
Internal compatibility and consumer	1.284	0.000
Human resources	0.960	0.002
Supporting e-commerce entities	0.202	0.477
Government	0.183	0.549

The detail result of the multinomial logistic regression is presented in Table 12. Based on the result, it can be concluded that the higher the perception of internal compatibility and consumer, the higher the level of e-commerce



adoption will be. Other findings show that the human factor has a significant influence in differentiating the e-commerce adoption in level 3 and in level 2.

**Table 12.** The Differences between Levels

Difference between	Significant factor	B	Sig
Level 1 compared with Non-Adopter	Internal compatibility and consumer	0,72 1	0,05 0
Level 2 compared with Level 1	Internal compatibility and consumer	1,14 0	0,01 1
Level 3 compared with Level 2	Internal compatibility and consumer	1,92 0	0,00 8
	Human resources	1,86 1	0,00 8

## 4.2 The Benefits of E-commerce Adoption

Besides identifying critical factors, this study also confirms the benefit of e-commerce adoption by SMMEs. From 60 e-commerce adopter SMMEs, there are only 54 SMMEs that are answered the third part of the questionnaire completely. According to the descriptive statistic in Table 13, most of the items' average scores are above three. It indicates that the e-commerce adoption benefits are really obtained by the SMMEs.

**Table 13.** Average Score of E-commerce Benefit.

Benefit	Component 1	Component 2
B1	.819	
B2	.870	
B3	.885	
B4	.901	
B5	.846	
B6	.791	
B7	.876	
B8	.744	
B9		.747
B10		.632
B11	.802	
B12	.843	
B13	.653	
B14	.827	
B15	.636	

Normal test result shows that all of the variables are normal. Multicollinearity test is done using Bartlett's test. The significance of Bartlett's test results, which is 0.000, indicates that there is multicollinearity. In addition, the values of diagonal anti-image correlation from SPSS software are more than 0.5. Therefore, factor analysis can be applied. Based on the results of the sample

adequacy test, the sample size is adequate because the KMO result is 0.853, which is higher than 0.5.

The factor analysis results in two factors of e-commerce adoption benefits. They are shown in Table 14. Depending on the reliability analysis, two items are eliminated, which are B13 and B15. Further analysis using discriminant analysis shows that the benefits associated with profit and supplier relationships are gained only by the adopters in level 2 and 3. Adopters in level 1 are not likely to gain these benefits.

**Table 14.** Result of Benefits Factor Analysis

Benefit	Component 1	Component 2
B1	.819	
B2	.870	
B3	.885	
B4	.901	
B5	.846	
B6	.791	
B7	.876	
B8	.744	
B9		.747
B10		.632
B11	.802	
B12	.843	
B13	.653	
B14	.827	
B15	.636	

**Table 15.** Result of Benefits Reliability Analysis

Factor	Alpha Cronbach		Item Eliminated
	Start	Finish	
Component 1	0,956	0,959	B13, B15
Component 2	0,809	0,809	

**Table 16.** Test of equality group means antara level 1 dengan level 2

	Wilks' Lambda	F	df1	df2	Sig.
REGR factor score 1 for analysis 1	.961	1.798	1	44	.187
REGR factor score 2 for analysis 1	.908	4.434	1	44	.041

**Table 17.** Test of equality group means antara level 2 dengan level 3

		Wilks' Lambda	F	df1	df2	Sig.
REGR factor score 1 for analysis 1	1	.983	.637	1	37	.430
REGR factor score 2 for analysis 1	2	.955	1.732	1	37	.196

## 5. Conclusions

In this study, the internal compatibility and consumer factor and human resource factor are proved to be the critical factors that affect the adoption of e-commerce by Indonesian SMMEs. In order to improve these critical factors, active participation of SMEs, governments, and private parties are required.

Factors related to human resources can be enhanced through training and provision of information about e-commerce. The Government may provide training through the Ministry of Cooperatives and SMEs or through state-owned partners. Private parties can begin to provide training to its partners, especially SMMEs, in order to work using e-commerce. Private and governmental parties can also provide IT services such as cloud computing, so that SMMEs do not need to spend too much effort in dealing with IT problems. If SMMEs' understanding about e-commerce is enough, then the owners or managers will support the implementation of e-commerce. Next, SMMEs can also adjust their business to e-commerce characteristics.

For the consumer factors, confidence in online trading should be improved. If the amount of consumers who buy online is increase, SMMEs will adopt e-commerce at the higher levels. Some consumers may not use e-commerce because it was difficult, especially in the way of payment. For example in Indonesia, online payment media, such as credit card, has not been popular because of the application difficulties. One of the solutions is to find alternative online payment method.

E-commerce development in Indonesia becomes important if the actual benefits offered are earned by the SMMEs. From the results of this study, it can be concluded that the benefits gained from the adoption of e-commerce are significant. E-commerce adoption in level 2 and level 3 will provide greater benefits than e-commerce adoption in level 1. Therefore, the development of SMMEs through the use of e-commerce should be improved.

For adoption up to the third level, the critical factor that must be considered is internal compatibility and consumer factor. At the third level of e-commerce, it is quite complicated because it deals with online transactions. Features, such as a shopping cart and an online payment facility, have been included in the web in the third level. Therefore, the human resources need to have more technical knowledge. To enhance human resource capability, one of the

solutions is the integration of entrepreneurship based on IT and the curriculum of compulsory education.

In the end, this study also has a weakness because we do not use a proportional sample. It is caused by the lack of e-commerce adoption level proportion data in the Indonesian SMMEs population. Thus, future studies can be focused on the mapping of e-commerce adoption by Indonesian SMMEs population.

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# The Application of Motivation-Ability-Opportunity Framework in Studying EMR Adoption by Physician

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## Abstract

The adoption of EMR is a critical agenda in the information technology and medical fields of study. As stated by Govindaraju, Hadining, and Chandra (2013), there is a gap in previous studies on EMR adoption, especially in their focus on the physicians as the EMR user. This study aims at not only developing a model of EMR adoption among physicians, but also exploring the influence of the physicians' previous experience with EMR. The model in this study is an advancement of Govindaraju *et al.* (2013) model. The refinement is done mainly because of the lack of physicians' specific characteristic incorporation and the lack of the influence of the physicians' previous experience exploration in the prior model. Next, 12 hypotheses in this study will be tested using a survey and statistical data processing methods.

**Keywords:** EMR, Adoption, AMO, physicians.

## 1. Introduction

Information technology (IT) has brought tremendous benefits in many sectors of human life, including health. One of these influential implementations of IT is the development of electronic medical records (EMR). EMR is an evolution of traditional medical record, but basically it still in line with the article 46 paragraph 1 of Medical Practice Law by Sjamsuhidajat, *et al.* (2006), which stipulates that a medical record is a file that contains records and documents about a patient's identity, and also medical examinations, treatments, actions, and other services provided to the patient.

EMR use not only enable the improvement of medical personnel' work performance in general (Lau, *et al.* 2012), but also support the physicians as its' main user (Miller and Sim, 2004). Though researchers and practitioners have no doubt in the advantages of EMR, the adoption of EMR is still a constant struggle. In many cases, rejection from users is not remarkable, and it leads to the low adoption rate of EMR among medical personnels. Thus, the

adoption of EMR is a critical agenda in the information technology and medical fields of study.

As stated by Govindaraju, Hadining, and Chandra (2013), there is a gap in previous studies on EMR adoption, especially in their focus on the physicians as the EMR user. Most of the previous studies used medical personnel, who are not physicians, as their respondent (Boonstra and Broekhuis, 2010; Hennington and Janz, 2007; Heselmans, *et al.* 2012; Lau, *et al.* 2012; Walter and Lopez, 2008). It is contradictive with the physicians' focal part in medical service, which is also the reason of their role as the vital user of EMR. Moreover, most of the previous studies worked with medical personnels or medical organizations that have knowledge and have used EMR in some or all of their services (Hennington and Janz, 2007; Lau, *et al.* 2012; Ludwick and Doucette, 2009; Miller and Sim, 2004; Su, *et al.* 2008). However, the real challenge in EMR adoption comes from they who have not any interaction with EMR before the project is started. This fact directs recent studies to discuss the preparation stage of EMR adoption by personnel or medical organizations having not used EMR (Cauldwell, *et al.* 2007; Garets and Davis, 2006; Hunter, *et al.* 2009; Randeree, 2007).

Therefore, this study aims at developing a model of EMR adoption among physicians who have adopted and have not yet adopted EMR. This study explains not only the failure in EMR adoption that is related to users' motivation, which consists of internal and external factors (Teh and Ahmed, 2011), but also the influence of the physicians' previous experience with EMR. The result of this study will give a new perspective in understanding EMR adoption.

## 2. Model Development

Govindaraju *et al.* (2013) used Ability, Motivation, and Opportunity (AMO) theory, an adapted-AMO theory by Olander & Thøgersen (1995), and Electronic Health Record System (EHRS) Adoption model developed by Anderson *et al.* (2007) to develop a model of EMR adoption among physicians. AMO theory was used as a foundation in building the model because of its compliance with the context of EMR adoption. As stated by MacInnis and Jaworski (1989) "Motivation" is considered as the drives, urges, wishes or desires which initiate the physicians' intention to use EMR (Govindaraju, *et al.* 2013). Consequently, in spite of other factors influence in EMR adoption, "Motivation" is the main enabler of the process.

Motivation, Ability, and Opportunity factors in AMO theory (Hughes, 2007) represent the physicians' psychological factor, internal factor, and also external factor, respectively (Hallahan, 2000). Next, the study incorporated the factor of intention in adapted AMO (Olander and Thøgersen, 1995). It explained that Intention is an embodiment of a person's motivation. This study is based on the concept in which Ability and Opportunity are defined as important preconditions to establish Behavior from Intention. Later, EHRS

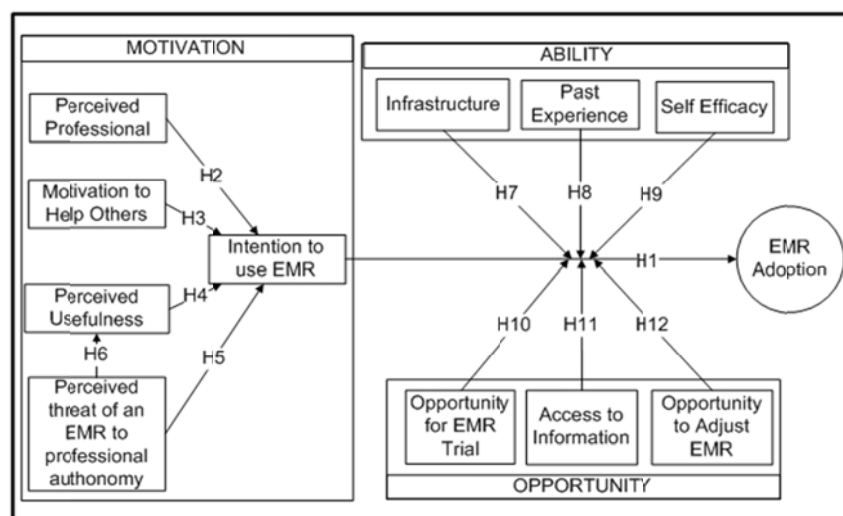
Model (Anderson, *et al.* 2007) was used to describe the Ability factor, which is a factor that can be controlled by the physicians (Hallahan, 2000).

The model in this study is an advancement of Govindaraju *et al.* (2013) model. The refinement is done mainly because of the lack of physicians' specific characteristic incorporation in the prior model. Moreover, as one of this study's objectives is to explore the influence of the physicians' previous experience with EMR, some adjustment was done regarding the Ability and Opportunity factors.

The motivation factor is detailed by analyzing previous studies focusing on physicians. One of them is Walter and Lopez (2008) that explains factors specifically related to physicians that affect EMR adoption. This model also considers the physicians' motivation to help others emphasized by Recker and Rosa (2012). Motivation to Help Others is a social motive arising from the instinct to help others in the open source system context. This motivation could become the primary motivation for the system users. In addition, Pinto *et al.* (2007) described that motivating factors for physicians to use EMR are among others, physicians' credibility and professional image. Both of these factors are specific characteristics owned by physicians that might have an influence on willingness to adopt EMR. Hence, the factors are added to the model.

The ability and opportunity factors are developed based on a number of previous works. Sykes *et al.* (2011) described that EMR adoption by physicians may be influenced by their access to the information conveyed by their colleagues. It is related to the study of Ammenwerth *et al.* (2006). It stated that the physicians' time and opportunity to interact with an EMR system affect the attitude of physicians in adopting EMR. Moreover, Adaptability of the EMR system may also affect the EMR adoption by physicians. If EMR has an ability to adapt to the physicians' way of work, physicians' resistance could be altered (Polat, *et al.* 2009).

**Figure 1.** Research Model



**Table 1.** Research Hypotheses

No.	Hypotheses
H1	Physicians' Intention to use EMR positively influences their EMR adoption
H2	Physicians' Perceived Professional positively influences their Intention to Use EMR
H3	Physicians' Motivation to Help Other positively influences their Intention to Use EMR
H4	Physicians' Perceived Usefulness positively influences their Intention to Use EMR
H5	Physicians' Perceived threat of an EMR to professional autonomy negatively influences their Intention to Use EMR
H6	Physicians' Perceived threat of an EMR to professional autonomy negatively influences their Perceived Usefulness
H7	Infrastructure positively moderates the influence of Intention to Use EMR on EMR Adoption
H8	Physicians' Past Experience positively moderates the influence of Intention to Use EMR on EMR Adoption
H9	Physicians' Self Efficacy positively moderates the influence of Intention to Use EMR on EMR Adoption
H10	Physicians' Access to System positively moderates the influence of Intention to Use EMR on EMR Adoption
H11	Physicians' Access to Information positively moderates the influence of Intention to Use EMR on EMR Adoption
H12	EMR System Adaptability positively moderates the influence of Intention to Use EMR on EMR Adoption

### 3. Research Methodology

This paper presents a preliminary study to develop a model of EMR adoption by physicians. The model development and variable operationalization have been done, and their results are presented in Figure 1 and Table 1. Accordingly, the data collection is done using questionnaire survey method. The sampling method in this study is purposive sampling. The sample is chosen considering the study's objective. This study is focused on EMR adoption by physicians who join medical organizations or small group practices, in which EMR use is encouraged, but not mandatory. The small group practices are included in this study because this form of medical service arrangement is popular in Indonesia. These small group practices usually facilitate the physicians with EMR systems to support the administration of the health care services.

The data collection has been done for 2 months. In the process there were several problems encountered. They are the physicians' tendency to refuse the questionnaire because of their busyness, ambiguous definition of EMR use, and an unclear question in the questionnaire. The problem was identified when the researchers did the direct data collection. To solve the problem regarding the questionnaires, two questions are revised.

The data collection will be continued. To increase the questionnaires return rate, approach to medical organizations and some personal approach to senior physicians will be done. Later, the data collected will be tested to several other statistical methods to ensure the statistical assumptions fulfillment. The hypotheses will later be tested using statistical methods with Partial Least Square.

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