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ENTERPRISE RESOURCE PLANNING ADOPTION AND SATISFACTION DETERMINANTS

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to my beloved son,

Diogo

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List of Abbreviations

AVE	Average Variance Extracted
BI	Behavioural Intention
CIM	Computer Integrated Manufacturing
ERP	Enterprise Resource Planning
IS	Information Systems
LV	Latent Variable
MANS	Management Support
MPS	Master Production Schedule
MRP	Material Requirements Planning
MRP II	Manufacturing Resource Planning
OEM	Original Equipment Manufacture
PEOU	Perceived Ease Of Use
PLS	Partial Least Squares
PU	Perceived Usefulness
SEM	Structural Equation Modelling
SQL	Structural Query Language
SYSQ	System Quality
TRAI	Training
USE	Use
USS	User Satisfaction

Abstract

Enterprise Resource Planning (ERP) systems are at the core of every firm. Making people use this costly and time consuming investment is one of the most important issues to deal with.
The main objective of the present dissertation is to find the key determinants that open the door to user satisfaction and adoption. A theoretical model was set and an online survey was conducted to understand ERP users' perspective on such matters.
The outcome was the model validation and the understanding that top management support, training, and the system quality are important constructs to assess adoption and user satisfaction. In fact, the latter (system quality) has a significant influence on the behavioural intention to use and also in the overall user satisfaction.

Keywords: Enterprise Resource Planning, ERP, Adoption, User Satisfaction, Adoption Models.

JEL classification: M15 – IT Management, M10 – General Business Administration.

Resumo

Os sistemas de *Enterprise Resource Planning* (ERP) fazem parte do centro nevrálgico de todas as empresas. Fazer com que as pessoas tirem partido de um investimento desta importância é um aspeto crucial que tem de se levar em conta.

É o principal objetivo da presente dissertação identificar os principais determinantes que levam à satisfação e adoção por parte dos utilizadores. Para este efeito foi elaborado um modelo teórico e levado a cabo um questionário *online* junto dos utilizadores de sistemas ERP.

O resultado foi a validação do modelo e a confirmação de que o suporte da gestão de topo, a formação e a qualidade do sistema são construtos decisivos para avaliar a adoção e satisfação por parte dos utilizadores. De fato, a qualidade do sistema tem uma influência muito forte na intenção comportamental de utilizar o sistema e também na satisfação global do utilizador.

Palavras-chave: *Enterprise Resource Planning*, ERP, Adoção, Satisfação do utilizador, Modelos de adoção

Classificação JEL: M15 – IT Management, M10 – General Business Administration

1. Introduction

1.1. Context & Motivation

In an increasingly competitive globalized market, the key to organisation's success is the ability to maintain and increase that competitive advantage (Porter, 1991).

In this new paradigm, organisations cannot compete on their own. Success can only be achieved through cooperation with other organisations like truly integrated and flexible supply chains (Lambert & Cooper, 2000).

Enterprise Resource Planning (ERP) is a natural evolution of the 80's manufacturing resource planning (MRP II), inheriting all the concepts and theories that date back to the 60's with first attempts to rationalise lead times and stock possession costs. ERP rapidly became the standard enhancing operational efficiency with the integration of business processes throughout all organisation (Akkermans, Bogerd, Yücesan, & van Wassenhove, 2003; Davenport, 1998).

In the past decades, ERP systems' usage numbers have increased tremendously and the worldwide ERP market summed 22.4 billion euros by 2013. The competition is fierce and the top five companies represent half of the market (SAP: 24%; Oracle: 12%; Sage: 6%; Infor: 6%, and Microsoft: 5%) (Pang, Dharmasthira, Eschinger, Brant, & Motoyoshi, 2014). Having these numbers in mind, is the utmost importance to realise how to gain new customers and retain existing ones.

After first failures of enterprise resource planning (ERP) systems in mid-1990's, the IS research community became intrigued by the factors in such *"productivity paradox"* (Brynjolfsson, 1993). Making people satisfied and really adopt the new ERP system is no easy process but is vital for the success in every organisation (Basoglu, Daim, & Kerimoglu, 2007). Having worked as the responsible for the entire IT infrastructure (hardware and software, including the ERP system) in a Portuguese SME, the author is quite aware of some major issues a firm has to deal with.

Various studies were developed to understand the main drivers that led users to adopt a certain ERP system (e.g., Bradley, 2008; Chien & Tsaur, 2007; Gorla, Somers, & Wong, 2010; Nwankpa & Roumani, 2014; Pan & Jang, 2008; Rajan & Baral, 2015; Sternad & Bobek, 2013; Tsai, Lee, Shen, & Lin, 2012; Youngberg, Olsen, & Hauser, 2009). Although the conclusions were very significant, reviewed studies are usually centred on a specific model or framework and fail to explain the relations between ERP user's adoption and user's satisfaction.

Hence, due to the inexistence of satisfactory contributions, the main motivation of the present work is to understand, in reality, what influences users' adoption and satisfaction with ERP systems.

1.2. Research Question

The present dissertation is a fruit of the author's personal interests and professional background working with ERP systems. Observing the reality, intriguing questions always subsist: "Given the same system, why certain people use it more than others?" "Why don't use available computers if that eases their jobs?" or simply "Do people use computers at work?"

Obviously, all these questions are highly ambiguous and ill constructed for an academic research question.

According to O'Leary (2013), the research question has a natural evolution, growing with literature, key experts, and supervisor inputs.

First of all, questions starting with Do/Does usually have simple Yes/No answers. Certainly this poor outcome in terms of implications to the field or practice is not what the researcher wants.

Secondly we need to define which "people" and what "computers at work" mean. So, after consulting with the supervisor and key experts on the field, the intended concepts became clearer and were "Enterprise Resource Planning (ERP) users".

Finally, after an introductory literature review, two main concepts emerged: ERP Adoption and ERP users' Satisfaction.

Therefore, after consulting all the suggested steps, a final question was developed:

"Which are the determinants for ERP user Adoption and Satisfaction for Portuguese users?"

This question follows all the characteristics of a good research question: is right for the author; is right for the field; is well articulated; is doable; and has the approval of those in the know (O'Leary, 2013).

1.3.Research Goals

The main research goal is to understand which are the main determinants affecting ERP user adoption and satisfaction. To better achieve this research goal, this main topic was divided into four more specific items.

The first two goals are to find ERP adoption and ERP satisfaction determinants identified throughout most literature. At the end of this stage the main determinant(s) will be identified and classified according to the subjacent concept.

Afterwards, having a theoretical basis on hand, a model will be proposed to assess the research main goal. This theoretical model will include selected constructs from previous contributes with validated predictive capabilities in other different empirical research models.

Lastly, the proposed theoretical model will be empirically validated through the application of SEM-PLS statistical method to the questionnaire output.

Summarizing, the specific goals are:

- Identify ERP Adoption Determinants
- Identify ERP Satisfaction Determinants
- Propose a theoretical model
- Validate the theoretical model

1.4.Methodological Approach

The present dissertation proposes a model to measure the determinants of ERP adoption and satisfaction based on literature and validated by a quantitative approach.

The method to achieve the defined goals is to have a scoped literature review on the matters of ERP adoption and satisfaction. Founded on this review, a model proposal will be built in order to have a structural body for validation. Next, this given model will be validated by the quantitative statistical method of PLS-SEM.

The intended instruments to operationalise the intended method will be based mainly on scientific papers, although some significant monographs will be referred to. The model validation's instruments will be a questionnaire to gather data, and the use of SmartPLS software to process the obtained data.

Table 1 – Methodological Approach

Objective	Method	Instrument
Identify ERP Adoption	Scoped Literature Review	Scientific papers
Identify ERP Satisfaction		
Model Proposal	-	-
Model Validation	Quantitative method PLS-SEM	Questionnaire / Survey SmartPLS

The intended methodological approach is condensed on Table 1. More in depth information about this subject can be found in Section 3 (Methodology).

1.5. Outline of the Thesis

To have a general perspective and therefore an easier reading of the given work, the dissertation structure is explained bellow.

The first chapter (Introduction), contains general information about the subject context and the author's motivation for this work, followed by the research question development and the intended objectives (goals). After having the objectives established, the methodological approach is summarised and the structure presented.

The second chapter (Literature Review) is the presentation of the state of the art on the particular dissertation subjects. The ERP concepts and evolution is reviewed as well as the research community contributions on ERP various studies, implementation, IS adoption, and IS success.

The third chapter (Methodology) explains more in depth the methodological approach on how the present work was developed. The scientific philosophical paradigm is defined and the adopted research strategy is presented. In the last part of the chapter, and to better follow this research methodology, a phased design is displayed.

The fourth chapter (Model Proposal) consists on the presentation of the research model resultant from the literature review, the identification of the constructs, and finally the materialisation into hypotheses.

In the fifth chapter (Empirical Methodology) the measurement instrument is described in detail and the data collection method is described and obtained data is characterized.

The sixth chapter (Data Analysis & Results) proves both the measurement and structural model's validity, which demonstrates the internal reliability of the measurement's items and the model's ability to support a valid contribution to the scientific community.

In the seventh chapter (Discussion) the hypothesis are discussed and theoretical and practical implications are presented. Last in this section, work limitations and clues for future work are referred.

The last chapter (Conclusion), includes a summary of the dissertation outcome, mentioning the importance of the presented model, and the most relevant findings.

2. Literature Review

2.1. ERP Concept & Evolution

2.1.1. ERP Concept

Enterprise resource planning (ERP) systems are defined as *"comprehensive, packaged software solutions that seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture"*(Klaus, Rosemann, & Gable, 2000, p. 141).

These systems assume a modular structure and provide information integration across every business area using a shared database (Davenport, 1998). ERPs started in the mid-1990´s and were used to outline and organize business processes across all the organisational groups. This integrative approach guaranteed that tasks and processes were performed always in the same way in every place the organisation is (McAfee, 2009).

Traditionally oriented for capital-intensive industries ERP systems achieved a maturity state of development. Tough in recent years, ERPs are being introduced to other sectors, such as retail, education, finance, insurance, healthcare and hotel chains (Shehab, Sharp, Supramaniam, & Spedding, 2004).

2.1.2. ERP Evolution

The history of the ERP system as we know it today was made of a continuous evolution and had five important milestones (Jacobs & Weston, 2007):

The 1960s: first computers in industry; the reorder point; and the material requirements planning (MRP).

In the 1960s, companies could afford to keep lots of "just-in-case" stocks on hand to satisfy customer demand. Most of customised software was designed to handle large volumes of inventory (Umble, Haft, & Umble, 2003).

Following this idea, designed in the 1950s, MRP was one of the first business applications to support concepts like material master data and bill-of-materials across all products and parts in one or more plants (Klaus et al., 2000).

With the increasing success, the concept rapidly evolved to a more comprehensive method that calculated all the necessary materials needed to fulfil any production order, the Material Requirements Planning (MRP)(Klaus et al., 2000).

The 1970s: MRP consolidation and the enhancement of computer hardware and software.

Although MRP meant a technological breakthrough, it wasn't a customer oriented technique. This level of complexity, the lack of proper integration, data accessibility, and flexibility made MRP difficult to adopt (Chung & Synder, 1999).

Despite all the difficulties and drawbacks, during this decade, MRP systems started to integrate all aspect of production planning and control cycle (Klaus et al., 2000).

The 70s also saw the birth of what would later become the major ERP vendors. Dating from the beginning of the decade, SAP (*Systemanalyse und Programmentwicklung*), was born in Mannheim, Germany. The primary intention of its creators was to deliver a standard software package for business. After this marketing breakthrough, also various enterprises like Lawson Software, J.D. Edwards, Oracle, and Baan, adopt this pre-packaged solution to make their way into success (Jacobs & Weston, 2007). By the end of the decade, Oracle offered the first commercial relational database management with the well-known Structured Query Language (SQL) which, in time, would become a standard (Deutsch, 2013).

The 1980s: Arrival of the manufacturing resource planning (MRPII).

By the beginning of the 1980s, J.D. Edwards started to incorporate an increasing number of new functions to the MRP packages. At certain point, the term MRP started to stand for manufacturing resource planning rather than just material requirements planning. This fact led to a new acronym: the MRPII (Jacobs & Weston, 2007).

MRPII process starts with a Master Production Schedule (MPS) based on long-term sales forecast. After the materials management module computes the material requirements, a capacity management module integrates the available production resources in the planning process. Once the planning process is optimized, a production schedule is created and schedule algorithms specify the assignment of workloads to machines/resources (Klaus et al., 2000).

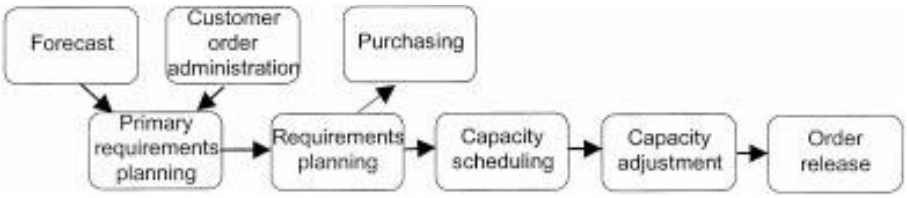


Figure 1 – Production planning within MRPII.
Source: (Klaus et al., 2000, p. 145)

The manufacturing environment where MRPII was born was guided by a demand-driven push philosophy, where batch production was the standard and the original equipment manufacture (OEM) products were relatively complex feature-dependant. The plant layout was product oriented and had a high degree of processes decoupling (Chung & Synder, 1999).

At the end of the 80s, IBM introduced the Computer Integrated Manufacturing (CIM) term in the COPICS software. This new framework had unique capabilities integrating all processes across the enterprise. The path to ERP was opened and the "across the enterprise" idea could finally be materialised (Jacobs & Weston, 2007)

The 1990s: MRPII and the first ERP systems.

Although the end 1980s IBM's CIM innovation was a good improvement, it lacked the accounting reflection of all the inbound and outbound inventory from raw materials to finished goods. Also the receiving and shipping transactions were not reflected in real time in the general ledger (Jacobs & Weston, 2007; Klaus et al., 2000).

In 1992, the SAP R/3 ERP product was released. Introducing a server-client hardware design, this new software suite represented a revolution in terms of flexibility. This paradigm shift provided the dispersal of a huge computer load to various small computers, lowering the cost effort of hardware investment. Also the open-architecture approach enabled third-party companies to develop specific software and integrate with SAP R/3 (Jacobs & Weston, 2007).

In terms of technology, most ERP systems include three distinct features: the data dictionary; the middleware; and the repository. The data dictionary is the structure statement and can be used across all organisational functional areas. The middleware is a system layer that allows data to be exchanged from a central to a remote system. Finally, the repository is the foundation of all business structure since it includes the definitions of the business processes, objects, and the organisation model (Chung & Synder, 1999).

The 2000s: Software vendors' consolidation.

The millennium bug (Y2K) was the event that marked the maturing of the ERP industry (Jacobs & Weston, 2007). After the astonishing growth in the 90s decade, the technology and "dot com" industries witnessed a serious stock crash which led both large and small vendors to re-evaluate their strategic positioning. The big players at the beginning of 2000 (SAP AG, Oracle, PeopleSoft and J.D. Edwards) were looking forward to increase market share throughout competitor acquisitions, mergers, or financing the development of new products. As a result of this tremendous competitive environment, in 2005, Oracle consummated the hostile takeover over the previously merged PeopleSoft/J.D. Edwards. Oracle and SAP AG became the industry's two major players (Jacobs & Weston, 2007).

2.2. The future of ERP

Following the high level of maturity reached by ERP systems, is expected that the industry now enters a new era. This new era should attend to matters such as ease of configuration, reduced implementation cycles and lesser financial efforts (Jacobs & Weston, 2007).

Coined by the Gartner Research Group (2000), the term ERP II introduced a new supply chain wide collaborative perspective. The main differences are six and the openness kind of this new concept of extended ERP is represented below on Table 2.

Table 2 – ERP vs. ERP II

Source: (Gartner Research Group, 2000) adapted.

	ERP	**ERP II**
Role	Enterprise optimization	Value chain participation/ c-commerce enablement
Domain	Manufacturing	All sectors/segments and distribution
Function	Manufacturing, sales and distribution, and finance processes	Cross-industry, industry sector and specific industry processes
Process	Internal, hidden	Externally connected
Architecture	Web-aware, closed, monolithic	Web-based, open, componentized
Data	Internally generated and consumed	Internally and externally published and subscribed

With the advent of a new globalised world, companies realised that concepts like integration and collaboration were fundamental for doing business. While ERP packages only focused on internal integration, the new called ERP II consists on the integration of

customers and vendors, with tools like Customer Relationship Management (CRM) and Supply Chain Management (SCM) respectively (Weston Jr., 2003).

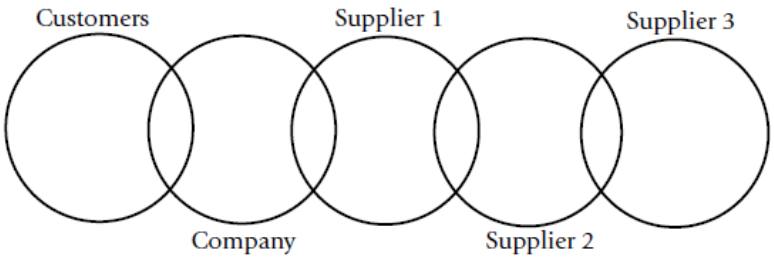


Figure 2 – ERP II integrated extended enterprise supply chain
Source: (Weston Jr., 2003, p. 50)

According to Weston Jr. (2003, p. 51) "One of the most important reasons that extended enterprise or ERP II systems are needed in the new economy is the absolute necessity to move data anywhere, at any time, within the company, within the value chain (customers, vendors), with the knowledge that data are up-to-date and accurate, and independent of language, location, and currency". Therefore is of utmost importance that firms improve operational and strategic capabilities and simultaneously find a better way to deliver faster and better through the supply chain. This can be achieved with a comprehensive ERP II package that includes tools like SCM, supplier/customer, etc., and enables internet-based collaborative commerce (Koh, Gunasekaran, & Rajkumar, 2008).

2.3.ERP Implementation

According to Scheer & Habermann (2000), the amount spent on the implementation phase is five times more than the cost of hardware and software license fees. The same authors also refer that with the expected decrease on hardware costs this proportion will certainly increase.

As seen before, the market will demand shorter implementation cycles with lower costs (Jacobs & Weston, 2007), as well as the requirement to seamlessly integrate inter-organisation collaborative features (Koh et al., 2008). Therefore, is the maximum importance to have a detailed look at the implementation phase.

According to Umble et al. (2003), an ERP implementation project can take a lot of time and money, but also interferes with the organisation's culture, requires extensive training, and can lead to issues that have short term impact.

So, how to implement a successful ERP system? Bingi et al. (1999) suggests that implementing a ERP system requires a previous extensive and thorough preparation. A truly "organisational revolution" must take place in order to achieve a successful outcome. Therefore, the author recommends ten major issues when dealing with complex ERP systems:

- Have the top management commitment;
- Careful business process reengineering;
- Well integrated specialized modules;
- Hire the right ERP consultants;
- Well planned implementation time;
- Control implementation costs;
- Select a suitable ERP vendor;
- Select the best employees for the project;
- Provide proper training to employees;
- Keep high employee morale.

In another point of view, Umble (2003) summarizes the critical success factors in a nine point list:

- Clear understanding of strategic goals;
- Commitment by top management;
- Excellent project management;
- Organizational change management;
- A great implementation team;
- Data accuracy;
- Extensive education and training;
- Focused performance measures;
- Multi-site issues.

Despite the different approaches, both authors agree on four key aspects: have the top management commitment, selecting the right implementation team, provide extensive training to employees, and have a well-planned and controlled project management.

2.4.ERP Studies

ERP is a multidisciplinary, and interdisciplinary field of study and the research community contribution is diverse and comprehensive (Moon, 2007). A study by (Esteves & Bohórquez, 2007) showed that the most investigated area is the implementation phase, in which success is by far the main topic. Although system usage and evolution are also addressed, other fields of study such as adoption still need more contributions.

The term ERP was coined in the early 1990s by the Gartner Group based in Stamford, CT. The company started to publish regular reports about the ERP technology where the inclusion criterion was the integration extent across the various functional modules (Jacobs & Weston, 2007).

Subsequently, research in ERP increased over the past years. To acquire a general idea of the evolution in published literature about ERP, main academic databases were scanned for the term *"Enterprise Resource Planning"* in the period 1990-2015. The results are shown below in Figure 3 (due to figures discrepancy, and to have an easier reading from the graphic, a factor of 0.1 was applied to Google Scholar search results).

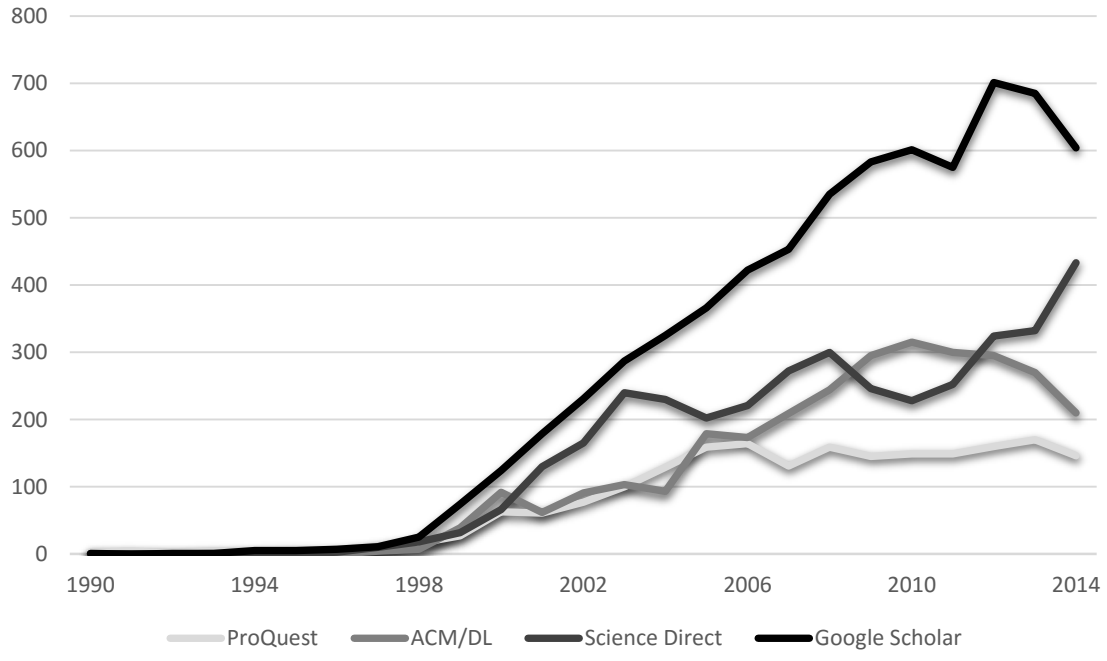


Figure 3 – Number of publications on "Enterprise Resource Planning" in major databases by year

These results reveal the growing interest in ERP over the past 25 years. The first relevant increase in the number of published work about ERP was in the year of 1997 with four times more hits than the previous year. Since then, the amount of work on ERP research has increased exponentially over the first decade of the 21st century with a considerable leap of 74% in 2000 (in relation to 1999) and an explicit growth of 346% in the end of the first decade (2009) when compared with 2000. Consistent with this growth, the numbers also show that ERP still is a prominent field in the research community, with about 6200 search results on average in the 2009-2014 period (Google, 2015).

After a closer look at published literature it's clear that the main focus has been the implementation phase success and system's technical aspects, neglecting themes like ERP system adoption (Esteves & Bohórquez, 2007; Moon, 2007; Pairat & Jungthirapanich, 2005; Shehab et al., 2004). This paradigm seems quite confusing when research indicates that software selection and preparation is the critical part of the implementation project (Shaul & Tauber, 2013). Therefore, stakeholder's adoption in ERP systems implementation can give a clearer insight on how to approach this early stages problematic (Hwang, 2005).

First, ERP adoption is mainly studied using several models and extensions mainly based on the contribution of psychology's Theory of Planned Behaviour (TRA) (Fishbein & Ajzen, 1975) in IS technologies research (Wu & Chen, 2005). Although there are various models that explain user's adoption, the Technology Acceptance Model (TAM) (Davis, 1986, 1989) is the most referenced in\ this area of research (Basoglu et al., 2007; Lee, Kozar, & Larsen, 2003; Venkatesh & Bala, 2008; Venkatesh, Thong, & Xu, 2012).

Secondly, researchers working on ERP system's success in most cases apply the DeLone & McLean (D&M) IS success model (DeLone, 1988) as the main tool to evaluate the system's implementation success (Mardiana, Tjakraatmadja, & Aprianingsih, 2015). In this case, success is understood as net benefits for the individual and the organisation, where user satisfaction and use are the main success drivers (Delone & McLean, 2003).

Finally, other findings about the critical factors were taken into consideration to uncover the main determinants of ERP success and adoption (Al-Mashari, Al-Mudimigh, & Zairi, 2003; Larsen, 2003).

Having this in mind, a set of papers about ERP adoption, success, and the main influencing dimensions were selected, each from a different publication in order to have a wider perspective on the matter (Table 3).

As seen before, investigators often tend to use the Technology Acceptance Model when studying ERP system's adoption. This model for IS adoption was generally considered to have a good fit explaining user's adoption of IS and being a robust method for study's support (Rajan & Baral, 2015; Sternad & Bobek, 2013; Vathanophas & Stuart, 2009; Youngberg et al., 2009). Also another approach by Pan & Jang (2008) was considered to assess the role of Technology, Organisation, and Environment (TOE) in ERP adoption.

Consistent with Rajan & Baral (2015) findings, Pan & Jang's (2008) TOE study found a strong influence of top management support in ERP user's adoption behaviour. Strong evidences show that having the commitment of top management encourages the effective ERP usage and increases the perception of usefulness by the end users (Bradley, 2008; Nwankpa & Roumani, 2014).

Another important aspect is system quality. Every survey using this dimension found a strong explanatory capability on both ERP adoption and success (Chien & Tsaur, 2007; Gorla et al., 2010; Rajan & Baral, 2015; Sternad & Bobek, 2013; Tsai et al., 2012). For example, Tsai et al. (2012) finds that system quality has the strongest impact on user satisfaction of all studied factors. Likewise, other reviewed researchers discovered that system quality often is among the most important influencers of behavioural intention and user's satisfaction (Chien & Tsaur, 2007; Tsai et al., 2012).

Table 3 – Recent studies on ERP

Author	Journal	Study purpose	Method / Model
(Youngberg et al., 2009)	International Journal of Information Management	Analyse the perceptions of selected ERP aspects on perceived usefulness and intention to use.	2 TAM adoption model extensions
(Sternad & Bobek, 2013)	Procedia Technology	Identify external factor that influence the ERP adoption among companies in maturity phase of the system use.	TAM adoption model adaptation
(Rajan & Baral, 2015)	IIMB Management Review	Determine the CSFs that influence ERP adoption.	TAM model and individual impact
(Pan & Jang, 2008)	Journal Of Computer Information Systems	Examine the TOE factors that affect ERP adoption in the communication's industry.	TOE adoption framework
(Chien & Tsaur, 2007)	Computers in Industry	Assess ERP system's success at three high-tech firms.	Revised D&M IS Success model
(Gorla et al., 2010)	The Journal of Strategic Information Systems	Understand the impact of three quality dimensions (information, system and service) on enterprise systems	D&M success model. Organisation impact of selected dimensions
(Tsai et al., 2012)	Information & Management	Understand how ERP selection criteria are linked with system and service quality influencing ERP system success.	Balanced Scorecard (SERVQUAL & D&M IS success model)
(Nwankpa & Roumani, 2014)	Computers in Human Behaviour	Understand how the concept of Organisational Learning Capability (OLC) influences ERP use.	OLC/D&M success model adaptation (no net benefits were studied)
(Bradley, 2008)	International Journal of Accounting Information Systems	Determine how ten management based critical success factors impact in ERP system's implementation success.	Multiple case study and related organisational impact.

Although this dimension could not directly explain the organisational impact, Gorla et al. (2010) found that it's explanatory nature is more related with the indirect impact through user's perception of how easy/difficult it is to use the ERP system. So, regardless the study objective (adoption or success), this construct is found to be one of the main influencers of user's behaviour intention and perception of the ease of use (Chien & Tsaur, 2007; Rajan & Baral, 2015; Sternad & Bobek, 2013; Tsai et al., 2012).

Both Youngberg et al. (2009) and Rajan & Baral (2015) refer the significant role that training has on ERP system's usage, underlining the critical need to educate users in system skills and communication. Training is a determinant factor for ERP system's success. Bradley (2008), in his study on how management CSFs influence ERPs system success, found that all successful projects showed that training had a higher quality. Also an earlier study by Amoako-Gyampah & Salam (2004), showed that training had a significant effect applied to adoption models, either directly on perceived ease of use, or indirectly on perceived usefulness through the benefits of ERP system's shared beliefs.

According to the reviewed literature, adoption studies revealed a deeper understanding of user's IS adoption in the ERP field. Furthermore, when compared with the large amount of published work about ERP systems the contributions regarding ERP adoption are very scarce. In addition, Wixom & Todd (2005) show that having the user satisfaction perspective in the assessment of ERP's usage helps to understand the direct consequence of adoption on user's perceptions.

Consequently, adoption models and user satisfaction will be addressed bellow in more detail.

2.5.IS Adoption

As seen above, one of the most used model to study ERP adoption is the Technology Acceptance Model. This model is based on the principles of the Theory of Reasoned Action to explain and predict the behaviours of organisation's individuals in a specific situation. According to Fishbein and Ajzen (1975) , TRA identifies two major factors that explain behavioural intentions: *"Attitude"* and *"Subjective Norms"*. This first factor is a consequence of a person's salient beliefs and the perceived outcome evaluation. The second factor influencing behavioural intention is explained by the individual normative beliefs and the motivation to comply (Vallerand, Deshaies, Cuerrier, & Pelletier, 1992). This attitude theory from psychology (TRA) was later on successfully adapted to information systems (IS) by Davis. According to Davis (1989), many variables can explain the adoption of information technology, but previous research identified two important constructs: perceived usefulness (PU) and perceived ease of use (PEOU). Therefore, in the particular case of IS, the system design features (external variables) indirectly influence the attitude toward using the system through the direct impact on PU and PEOU.

Another theoretical model used to explain the adoption is the theory of planned behaviour (TPB) introduced by (Ajzen, 1991). Ajzen postulated that attitude couldn't totally explain one's behaviour. Therefore, based on TRA, Ajzen showed that the subjective norms (social factor) and the perceived behavioural control had also an important role explaining adoption.

Even though, both TAM and TPB are solid models to assess individual's intention to use an information system, Davis' adoption model proven to be a more useful model for empirical research (Mathieson, 1991).

Due to the parsimonious nature of the Technology Acceptance Model, Venkatesh and Davis (2000) introduced a more complete model. The so-called Technology Acceptance Model 2, provides a detailed insight on how both social influence and cognitive instrumental processes influence usage intentions (up to 60%) (Venkatesh & Davis, 2000). Taking the previous model into consideration (TAM2), Venkatesh and Bala (2008) suggested an enhanced new model: TAM3. Having a more comprehensive approach, a new set of constructs were introduced and related to PEOU (anchor and adjustment). Also new hypotheses were considered such as the moderation effect of experience on key relationships (Venkatesh & Bala, 2008).

In an effort to integrate the most prominent eight theories (TRA; TAM/TAM2; MM; TPB/DTPB; C-TAM-TPB; MPCU; IDT; SCT) on the IS acceptance field, Venkatesh, Morris, Davis, & Davis (2003) presented a Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT postulates that there are three direct determinants of behavioural intention (performance expectancy, effort expectancy, and social influence) and two of the usage behaviour (behavioural intention and facilitating conditions). Also strong moderating influences were found and integrated in UTAUT model (experience, voluntariness, gender, and age) (Venkatesh et al., 2003). It's also important to mention that this extension was introduced to UTAUT in a consumer study context. UTAUT2 incorporates three new constructs specifically oriented to understand the consumer acceptance and use of technologies: hedonic motivation, price value, and habit.

All in all, the literature review showed that Technology Acceptance Model is the most suitable model to study adoption in IS, therefore numerous IS investigators apply this method to ERP research. Future research directions suggest that this model will continue to be the reference model although adjusted with particular extensions according to the technology specificity in analysis (Mardiana et al., 2015; Shih-Chih Chen, Shing-Han Li, & Chien-Yi Li, 2011).

2.6.IS Success

Another course of IS research is the investigation of user satisfaction. The DeLone & McLean (D&M) model for IS success is the most cited model to assess on how system's usage affects user's satisfaction (Lowry, Karuga, & Richardson, 2007). D&M IS Success model assumes that system and information quality indirectly affect individual and organisational impact through the reciprocally independent dimensions of use and user satisfaction (DeLone & McLean, 1992). An update to the original model took place 10 years after by the same authors and showed a new external construct: *"Service Quality"*. The authors felt the need to underline the importance of *"Intention to Use"* and *"Use"* aspects inside the former model's *"Use"* construct, creating new visible relations for research. Finally individual and organisational impact were merged into *"Net Benefits"* to have a better perspective of the final success variable (Delone & McLean, 2003). This multidimensional and interdependent model has proven to be solid when explaining various constructs, including user's satisfaction (Mardiana et al., 2015; Petter, DeLone, & McLean, 2008). Interestingly, although net benefits are directly explained by use and user satisfaction, this last construct is found to be the main driver of these same net benefits in various empirical applications of this model. Wixom & Todd (2005) found that both acceptance and user satisfaction theories should be considered when researching user perceptions on any IS. The authors empirically confirmed that user satisfaction, in both perspectives, had solid explanatory capabilities.

User satisfaction is therefore, one of the most important factor when addressing IS success (Mardiana et al., 2015; Tsai et al., 2012).

3. Methodology

3.1. Scientific Paradigm

The process of empirically validate previously postulated hypothesis is named scientific paradigm. Validation success allows the creation of models which have the ability of explain and predict the studied phenomena in the real world (Denning, 2005). Paradigms are defined as "*implicit or explicit assumptions about the nature of the world and of knowledge*" (Mingers, 2001, p. 242) (Kuhn, 1970).

According to Saunders, Lewis & Thornhill (2009, p. 108), the main topics of any research can be grouped and visually summarized in a Research "Onion" (Figure 4). This schematic presentation includes research philosophies, approaches, strategies, scale, time, and data collection and analys.

The onion top level (philosophy) relates with the development of knowledge in a particular area of study. The adopted research philosophy is determined by the nature of the knowledge and the assumptions of the researcher's perception of reality (Saunders et al., 2009).

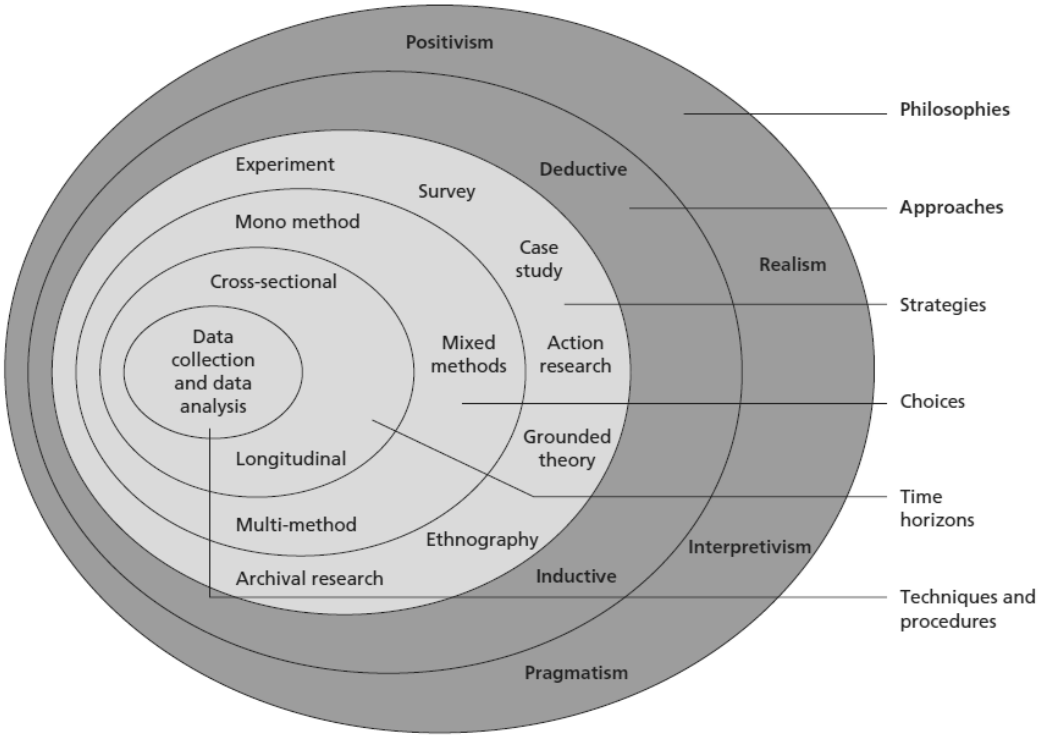


Figure 4 – The Research "Onion".

Source: Saunders, Lewis, & Thornhill (2009, p. 108)

Paradigms are primary because define the fundamental beliefs that guide the researcher on used methods but also on ontological and epistemological decisions. Four paradigms

are suggested for research purposes: positivist, post-positivist, critical theory, and related ideological position and constructivism (Guba & Lincoln, 1994).

According to Saunders et al. (2009), there are six research philosophies: positivism, realism, interpretivism, objectivism, subjectivism, and pragmatism.

After analysing 155 IS research papers, Orlikowski & Baraudi (1991), refer there distinct "epistemologies": positivism (discriptive or theoretical), interpretive, and critical. Confirming Orlikowski & Baroudi (1991) previous study, Myers & Klein (2011) also found a wide discussion about the positivist and interpretive research principles, but the same does not happen with critical epistemology.

Looking more in depth at the enunciated philosophies, we can enunciate that positivism is found to be empirical-analytic, objectivist and functionalist (Mingers, 2001).

When a researcher adopts the philosophical posture of the typical physical or natural scientist, observing social reality and producing generalising to the entire reality, the research will reflect a positivist philosophy (Saunders et al., 2009).

Positivist studies follow previously fixed relationships within phenomena by using structured instrumentation for theory testing, increasing the predictive comprehension of phenomena. These studies include "*formal propositions, quantifiable measures of variables, hypotheses testing, and the drawing of inferences about a phenomenon from the sample to a stated population*" (Orlikowski & Baroudi, 1991, p. 5).

Other approach is the interpretive paradigm, which is centered on subjectivist and constructivist (Mingers, 2001). In interpretivism philosophies, the researcher apprehends the interaction differences between humans like social actors and with the world (Saunders et al., 2009). The study or interpretive study does not impose a priori settings, examining the phenomena in its natural situations. The reuslt of this comprehension forms subjective and intersubjective meanings that will be associated and interpreted (Orlikowski & Baroudi, 1991).

A critical philosophy is charachterized by the "*critical stance towards taken-for-granted assumptions about organisations and information systems, and a dialectical analysis which attempted to reveal the historical, ideological, and contradictory nature of existing social practices*" (Orlikowski & Baroudi, 1991, p. 6).

IS research usually follows a single paradigm but Mingers (2001) recomends a combination of methods to improve depth and reliability of study conclusions. Mingers (2001) also underlines that is fundamental to clarify the meaning of "paradigm", "methodology", "method", and "technique" concepts. For this purpose, Table 4 is

presented below to illustrate the main differences, taking into consideration ontology, epistemology, axiology, and data collection.

The present dissertation is based in the computational science. The main goal is to find new theories using information systems as the primary method. Hence, the methodological approach is positioned in the positivist philosophy.

Table 4 – The Four research philosophies in management research comparison

Source: Saunders et al. (2009, p. 119)

	Positivism	**Realism**	**Interpretivism**	**Pragmatism**
Ontology *the researcher's view of the nature of reality or being*	External, objective and independent of social actors	Objective. Exists independently of human thoughts and beliefs or knowledge of their existence (realist), but is interpreted through social conditioning(critical realist)	Socially constructed subjective, may, change, multiple	External, multiple, view chosen to best enable answering of research question
Epistemology *the researcher's view regarding what constitutes acceptable knowledge*	Only observable phenomena can provide credible data, facts. Focus on causality and law like generalisations, reducing phenomena to simplest elements	Observable phenomena provide credible data, facts Insufficient data means inaccuracies in sensations (direct realism). Alternatively, phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context or contexts	Subjective meanings and social phenomena. Focus upon the details of situation, a reality behind these details, subjective meanings motivating actions	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating different perspectives to help interpret the data
Axiology *the researcher's view of the role of values in research*	Research is undertaken in a value-free way, the researcher is independent of the data and maintains an objective stance	Research is value laden; the researcher is biased by world views, cultural experiences and upbringing. These will impact on the research	Research is value bound, the researcher is part of what is being researched, cannot be separated and so will be subjective	Values play a large role in interpreting results, the researcher adopting both objective and subjective points of view
Data collection techniques most often used	Highly structured, large samples, measurement, quantitative, but can use qualitative	Methods chosen must fit the subject matter, quantitative or qualitative	Small samples in-depth, investigations, qualitative	Mixed or multiple method designs, quantitative and qualitative

3.2.Research Strategy

Research strategy is about having a deductive, inductive, or both approaches. Deductive approach is usually related with the positivist philosophy and follows the development of theories and hypotheses and definition of a research strategy to test it. Inductive approach is often related with interpretive philosophy, and a theory is formed after data collection and analysis.

The primary research output is an adoption and user satisfaction model of ERP usage. This model is defined as a set of propositions that express relationships among constructs (March & Smith, 1995). Following the definition of *"what's the reality?"*(Järvinen, 2004), the research approach of the studied reality is the ERP adoption and user satisfaction.

Since a model is proposed, this dissertation will follow a deductive approach. This approach comprehends two moments: the elaboration of research hypotheses deduced from literature review and experts' contributions; and the test of those same hypothesis. Therefore the model will have a predictive character.

3.3.Research Design

To reach the objectives described in chapter 1, the following phases were considered:

Phase 1 – Literature review on ERP's. Composed by concept definition, evolution, and previous research.

Phase 2 – Literature review on IS Adoption and Success models. Comprehending the most relevant theories, models, constructs and previous research on ERP adoption and user satisfaction.

Phase 3 – Model proposal. Based on literature review and on experts' input, an ERP adoption and user satisfaction model is proposed.

Phase 4 – Empirical study. The proposed model was validated and an online survey was conducted with the participation of ERP users.

Table 5 sums up the research design, indicating all methodological phases, methods, and instruments.

Table 5 – Dissertation research approach in all the methodological phases

Model ERP adoption and user satisfaction: Positivist Philosophy					
Phases	**Description**	**Type of Research**	**Method**	**Data Collection Technique**	**Data Analysis Technique**
Phase 1	Literature Review	Documental Research	Scoped review on ERPs	Scientific Digital Libraries	Reading, Comprehension & Systematisation
Phase 2	Literature Review		Scoped Review on IS Adoption and Success Models		
Phase 3	Model Proposal	Constructs & Hypothesis Definition	Quantitative Method	-	-
Phase 4	Model Validation	Confirmatory Research	Quantitative Method	Online Survey	Structural Equation Modelling

First phase main objective is to comprehend, through other authors' studies, the state of the art in ERP research field. Second phase goal is to understand how IS adoption and success has been studied on other contexts and technologies.

On the third phase the model was developed on the theoretical constructs and on the relations between those constructs. All the used constructs were previously theoretically and/or empirically justified. The same validation was taken into consideration with the relations between the latent variables. The main objective of this third phase was to define all hypotheses in order to follow a deductive methodology.

On the last phase (phase 4), the main aim is to confirm or disconfirm the defined hypotheses, *i.e.*, to validate the proposed model of assessing ERP's user adoption and satisfaction. From this model validation, theory can be inferred to predict similar realities within the same contexts.

4. Model Proposal

4.1.ERP Adoption and Satisfaction

Having the reviewed literature in mind, a question subsists: how do the identified three main external dimensions (System Quality (SYSQ), Management Support (MANS) and, Training (TRAI)) influence ERP system use and user satisfaction?

To address this question, and based on previous modelling research (Davis, 1989; Delone & McLean, 2003; Urbach, Smolnik, & Riempp, 2010; Venkatesh & Davis, 2000; Venkatesh et al., 2012), a theoretical model is presented (Figure 5) to assess the impact of management support (MANS), training (TRAI) and system quality (SYSQ) on ERP systems use (USE) and user satisfaction (USS) through the construct's effect on perceived usefulness (PU), perceived ease of use (PEOU) and the behavioural intention (BI).

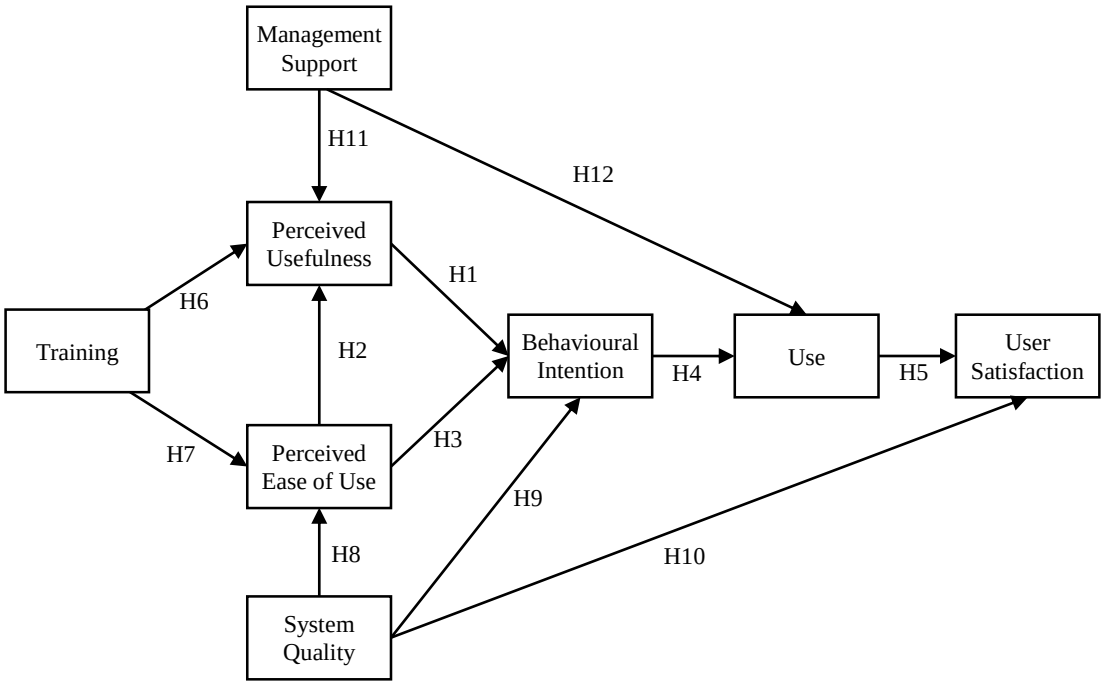


Figure 5 – Proposed model

4.2.Model Constructs

Following above literature review about ERP system's adoption and success, three relevant external factors were identified: Training (TRAI), Management Support (MANS) and System Quality (SYSQ) (Bradley, 2008; Chien & Tsaur, 2007; Gorla et al., 2010; Nwankpa & Roumani, 2014; Pan & Jang, 2008; Rajan & Baral, 2015; Sternad & Bobek, 2013; Tsai et al., 2012; Youngberg et al., 2009).

To measure these dimension's impact on ERP adoption and success, critical constructs were included for IS adoption evaluating: Perceived Usefulness (PU), Perceived Ease Of Use (PEOU), Behavioural Intention (BI) and, actual Use (USE) (Davis, 1989); and User Satisfaction (USS) to weigh this adoption impact on the individual user (DeLone & McLean, 1992). Main references to these constructs are shown on Table 6.

Perceived usefulness (PU) is defined as *"the extent to which a person believes that using a particular system would enhance his or her job performance"* (Venkatesh & Davis, 2000, p. 187)(Davis, 1989, p. 320)(Davis, 1989, p. 320). According to the same authors, perceived ease of use (PEOU) is understood as *"the extent to which a person believes that using a particular system would be free of effort"*. Behavioural intention (BI), which is directly influenced by PU and PEOU, is found as a mediator for the actual system's usage. This construct (BI) is comprehended as *"the degree of evaluative affect that an individual associates with using the target system in his or her job"* (Davis, 1993, p. 473) and has proven to be a strong predictor toward actual use (Sheppard, Hartwick, & Warshaw, 1988). Use, in turn, is the target dimension in most adoption models and measures the behavioural response to an individual's intention to use the system (Davis, 1993).

Previous research showed that after various empirical applications, PU and PEOU have proven to be good predictors of the behaviour intention and the attitude toward actually use an IS (Bueno & Salmeron, 2008)(Legris, Ingham, & Collerette, 2003).

Research shows that in order to ensure a successful ERP system, an overall organisation commitment driven by management is fundamental. This management commitment is crucial to resolve conflicts and to help to ensure that everybody cooperates towards the same goal (Bingi et al., 1999). Encouragement to use and support for usage are key factors to management support and help to build a perception of the system's usefulness (Urbach et al., 2010).

Another relevant factor that cannot be dissociated from adoption is the system quality. System quality is defined as *"the degree to which the system is easy to use for the purposes of accomplishing some task"* (Schaupp, Weiguo Fan, & Belanger, 2006, p. 3). Urbach et al. (2010), found further evidence of the importance of system quality when assessing an IS. In their empirical survey, system quality proven to be one of the most important constructs and exhibited the highest score among the external factors effect on the model.

Due to the complexity of ERP systems, the *"knowledge transfer"* can be challenging. Training is critical for users to adequately cope with all the functionalities and responsibilities (Bingi et al., 1999). According to Ruivo, Oliveira, & Neto (2014, p. 170), assessing perceived training *"is a measure of how easy it is for users to be trained on the system, to understand the content material, and to navigate through topics applied to daily tasks".* This particular construct is relevant because also offers some insight about organisation's culture toward human resources.

Summarizing, these three dimensions were considered the most relevant for assessing the external stimulus: Management support (MANS), System quality (SYSQ) and Training (TRAI).

Originally seen as the most used single measure to assess IS success, user satisfaction is defined as the *"recipient response to the use of the output of an information system"* (DeLone, 1988, p. 68). For example, Urbach (2010) identifies user satisfaction as the main influencer of the model with a large effect on individual impact and therefore on IS success.

Table 6 – Constructs and main references

Construct	Concept	Reference
Perceived Usefulness (PU)	The extent to which a person believes that using a particular system would enhance his or her job performance	(Davis, Bagozzi, & Warshaw, 1992; Venkatesh & Davis, 2000)
Perceived Ease Of Use (PEOU)	The extent to which a person believes that using a particular system would be free of effort	(Davis et al., 1992; Venkatesh & Davis, 2000)
Behavioural intention (BI)	The degree of evaluative affect that an individual associates with using the target system in his or her job	(Venkatesh & Davis, 2000)
Use (USE)	Behavioural response to an individual's intention to use the system	(Davis et al., 1992)
Training (TRAI)	A measure of how easy it is for users to be trained on the system, to understand the content material, and to navigate through topics applied to daily tasks	(Ruivo et al., 2014)
Management Support (MANS)	The effort on encouragement to use and support for usage driven by management	(Urbach et al., 2010)
System Quality (SYSQ)	The degree on which the system is easy to use and complies with functionality, reliability, flexibility, data quality, and integration needs for the purposes of accomplishing some task.	(Delone & McLean, 2003; Urbach et al., 2010)
User satisfaction (USS)	Recipient response to the use of the output of an information system	(Delone & McLean, 2003; Urbach et al., 2010)

4.3.Hypotheses to explain ERP Use and User Satisfaction

According to Davis (1989), Perceived Usefulness (PU) showed to be a strong influencer when studying user intentions and should never be rejected. Although this construct has seen some mixed results, in general, has been validated by various researchers in the MIS area as one important predictor of user's behaviour intention (BI) (Petter et al., 2008).
Also several empirical studies used this relation to evaluate user's adoption of ERP systems. Youngberg et al. (2009), in their study to analyse user perceptions of a particular ERP component, found a strong linkage of these two constructs. Other studies also discovered a very significant relationship when using perceived usefulness to explain user's behavioural intention (BI) (Rajan & Baral, 2015; Sternad & Bobek, 2013).
Thus, we believe that perceived usefulness (PU) is a good predictor of user's behavioural intention (BI) towards ERP system use.

H1. Perceived ERP Usefulness has a positive effect on users Behavioural Intention

As Davis (1989) demonstrated, perceived ease of use is a direct influencer of perceived usefulness. In his research, the author found that the influence PEOU had on behaviour was largely mediated by PU. This is mainly explained because *"users are driven to adopt an application primarily because of the functions it performs for them, and secondarily for how easy or hard it is to get the system to perform those functions"* (Davis, 1989, p. 333). In the elaboration of a very comprehensive study, Venkatesh & Davis (2000) confirmed, with a very significant statistical validation, the influence of perceived ease of use on perceived usefulness.
Rajan & Baral (2015), applying this relation to the specific case of ERP's area of research, found strong support in this relation. Also other researchers confirmed that perceived ERP ease of use has a direct positive effect on user's ERP perceived usefulness (Sternad & Bobek, 2013; Youngberg et al., 2009).
Therefore we hypothesise that ease of use is a reliable predictor of the perceived usefulness.

H2. Perceived ERP Ease of Use of has a positive effect on its Perceived Usefulness.

Influencing behavioural intention directly and indirectly (through PU), the perceived freeness of effort that a user experiences from IS usage, partially explains the behavioural intention (Davis, 1989). PEOU has shown a lower significance level than PU in past studies (Petter et al., 2008), nevertheless there is a strong theoretical basis for this relation and the direct impact relevance cannot be disregarded (Venkatesh & Davis, 2000).
On the subject of ERP studies this impact is also evident. In recent studies made including this particular relation, researchers found support for this relation (Rajan & Baral, 2015; Sternad & Bobek, 2013).
Hence, we believe that perceived ease of use will have a positive effect on behavioural intention.

H3. Perceived ERP Ease of Use has a positive effect on users Behavioural Intention.

Previous research showed that the behavioural intention (BI) has a significant impact on the actual system's usage (USE) (Davis et al., 1992). Also, Venkatesh & Davis (2000) found that the user's behavioural intention fully mediated the PU, PEOU and subjective norm on actual system use. Further on, Legris et al. (2003) in a meta-analysis of empirical research made with adoption models found that almost all studies that tested the BI-USE relation found a positive relation to report.
Confirming previous findings in other IS fields, ERP systems studies also found a strong relation between user's behavioural intention (BI) and actual ERP use (USE) (Sternad & Bobek, 2013; Youngberg et al., 2009).
For this reason, we expect that the behavioural intention in using ERP systems may have a significant and positive effect on actual use of enterprise resource planning systems.

H4. User Behavioural Intention has a positive effect on ERP Use.

According to Delone & McLean (2003), the study of usage (USE) impact on the user satisfaction (USS) is a determinant relation to assess the success with any IS. This construct (USS) has been found to be the most important dimension influencing net benefits when evaluating IS success (Mardiana et al., 2015; Tsai et al., 2012).
Although theory underlines the importance of usage (USE) influence on user satisfaction (USS) when studying ERP, the most recent contributions are scarce.
Therefore, we predict that ERP system use (USE) may have a positive on user satisfaction (USS).

H5. ERP system Use has a positive effect on User Satisfaction

As seen above, training assumes a very important role on a successful implementation and maintenance of an ERP system. People need to understand how the right flow of information can help the organisation as well as their own tasks (Bingi et al., 1999).
Various ERP studies also show that this fact is mainly explained by the direct influence of training on the perceived ERP usefulness (PU) (Bradley, 2008; Rajan & Baral, 2015; Youngberg et al., 2009).
Thus, we hypothesize that user training (TRAI) will have a positive effect on both perceived ERP usefulness (PU) and ease of use (PEOU).

H6. User Training has a positive effect on Perceived ERP Usefulness

Having a perfect understanding of the system, as a result of a good training programme, largely enhances user's perceptions about how easy is to use the system (Ruivo et al., 2014). Also, Amoako-Gyampah & Salam (2004) found strong evidence that user training (TRAI) strongly influences the perceived ERP ease of use (PEOU).

H7. User Training has a positive effect on Perceived ERP Ease of Use

System quality (SYSQ) is often found to be one of most relevant constructs and is always found strong support when assessing matters of IS adoption (Schaupp et al., 2006; Urbach et al., 2010). This particular construct is widely considered as one of the best explanatory construct and is often considered in ERP research (Chien & Tsaur, 2007; Gorla et al., 2010; Rajan & Baral, 2015; Sternad & Bobek, 2013; Tsai et al., 2012). In recent studies, a significant impact of System quality on the perceived ERP ease of use was also found to be very relevant (Gorla et al., 2010; Sternad & Bobek, 2013).
According to these evidences we postulate that system quality has a positive effect on the perceived ERP system ease of use.

H8. ERP System Quality has a positive effect on Perceived ERP Ease of Use

An important relation that literature indicates, is the influence that the system quality has on users behavioural intentions
This fact also applies to ERP research, Chien & Tsaur (2007) when assessing the implementation of an ERP solution in three firms found that the most significant influencer of user behavioural intention was the ERP system quality.

Hence, we believe that the ERP system quality (SYSQ) may have a positive effect on user behavioural intention (BI)

H9. ERP System Quality has a positive effect on User Behavioural Intention

According to (Petter et al., 2008) various researchers have been studying the effect of system quality in user satisfaction through a diversity of intermediate dimensions and using different IS types. A recent study in IS success found a significant relationship between these two dimensions, system quality was found to be the most significant dimension to explain user satisfaction (Urbach et al., 2010).

In the case of ERP systems research this relation is also found true. System quality is indeed an important influencer of user satisfaction with the ERP system (Chien & Tsaur, 2007; Tsai et al., 2012).

Therefore we expect that the system quality (SYSQ) has a strong and positive effect on user satisfaction (USS).

H10. ERP System Quality has a positive effect on User Satisfaction

According to Bingi et al. (1999), top management role is not only to fund the ERP system, all managerial levels must have full commitment during all stages and ensure that all process runs smoothly. Management support is decisive to build up user's perceptions on system usefulness (Urbach et al., 2010).

Moreover, recent studies show that management support is vital and forms user's perceptions on how useful the system is (Bradley, 2008; Nwankpa & Roumani, 2014; Rajan & Baral, 2015). In fact, Nwankpa & Roumani, (2014) say that management intervention *"educates"* users about ERP's usefulness.

Thus, we hypothesize that management support (MANS) influences positively the ERP usefulness.

H11. Management Support has a positive effect on Perceived ERP Usefulness

According to Urbach et al. (2010), having management support is essential to motivate system's use.

With similar conclusions, several recent studies point out that this management encouragement can largely influence the use frequency of ERP systems (Bradley, 2008; Nwankpa & Roumani, 2014; Pan & Jang, 2008).

Hence, we expect that the management support (MANS) may increase effective ERP use (USE).

H12. Management Support has a positive effect on ERP Use

5. Empirical Methodology

5.1. Measurement Instrument

The research model was validated through the quantitative method using previously proven and tested scales in order to operationalize each construct and increase validity. Hence, in the development of the measurement instrument items were adapted from the previously confirmed empirical studies.

Considering the reviewed literature, a set of items was selected for each construct. After a thorough discussion, the most appropriate a group of items from previously validated empirical studies was chosen having into consideration the validity and model's best fit.

Afterwards, a first draft was created and pre-tested with a panel of ten randomly chosen ERP end-user's from different organisations. The first part included an introduction and a set of sample characterisation questions. On the second part the chosen model's construct were measured using a seven-point Likert-type scale (1- Completely disagree, (…) 7- Completely agree).

All inputs about appearance and instructions were taken into account and the final survey instrument was then ready to send. Table 7 contains the final measurement items used for testing the structural model.

Table 7 – Measurement Items

Construct	*Code*	*Indicator*	*Reference*
Perceived Usefulness (PU)	PU1	Using the system improves my performance in my job	(Venkatesh & Davis, 2000) Cronbach's alpha =0.973
	PU2	Using the system in my job increases my productivity	
	PU3	Using the system enhances my effectiveness in my job.	
	PU4	I find the system to be useful in my job.	
Perceived ease of use (PEOU)	PEOU1	My interaction with the system is clear and understandable.	(Venkatesh & Davis, 2000) Cronbach's alpha =0.953
	PEOU2	Interacting with the system does not require a lot of my mental effort.	
	PEOU3	I find the system to be easy to use.	
	PEOU4	I find it easy to get the system to do what I want it to do.	
Behavioural intention (BI)	BI1	I intend to continue using the ERP in the future.	(Venkatesh et al., 2012) Cronbach's alpha =0.964
	BI2	I will always try to use the ERP in my daily life.	
	BI3	I plan to continue to use the ERP frequently.	
Use (USE)	USE1	At the present time, I consider myself to be a frequent user of the ERP.	(Davis et al., 1992) Cronbach's alpha =1
Training (TRAI)	TRAI1	According to users programme training, please rate the degree of how was training on the system.	(Ruivo et al., 2014) Cronbach's alpha =0.911
	TRAI2	According to users programme training, please rate the degree of how was their understanding of the content training material.	
	TRAI3	According to users programme training, please rate the degree of how worthy is navigating through the topics after training and applied in daily tasks.	
Management support (MANS)	MANS1	My supervisor actively encourages me to use the ERP.	(Urbach et al., 2010) Cronbach's alpha =0.864
	MANS2	My organisation's leadership explicitly supports the ERP.	
System quality (SYSQ)	SYSQ1	Our ERP is easy to navigate.	(Urbach et al., 2010) Cronbach's alpha =0.956
	SYSQ2	Our ERP allows me to easily find the information I am looking for.	
	SYSQ3	Our ERP is well structured.	
	SYSQ4	Our ERP is easy to use.	
	SYSQ5	Our ERP offers appropriate functionality.	
	SYSQ6	Our ERP offers comfortable access to all the business applications I need.	
User satisfaction (USS)	USS1	The ERP supports adequately my area of work and responsibility	(Urbach et al., 2010) Cronbach's alpha =0.975
	USS2	The ERP is efficient.	
	USS3	The ERP is effective.	
	USS4	The ERP satisfies me on the whole.	

5.2. Data Collection

The data was collected by the means of an online survey addressed by email to end-users that work with ERP systems in their organisation's routine tasks, activities and business processes.

Several ERP end-users from different industries were reached by email to aid this endeavour. Answers were collected between the beginning of June of 2015 and the 31st

of August. In this three month period, 260 invites were sent and 157 answers received. Two (2) answers were found incomplete and 155 were considered valid. This represents a response rate of 60.4%.

To test the non-response bias of the 155 responses, early respondents were confronted with the late respondents and then compared with the sample distributions using Kolmogorov-Smirnov (K-S) test (Ryans, 1974).The K-S test results showed that the sample distributions were the same across early and late respondents. To confirm that no factor explained individually the majority of the variance, a common method using the Harman's one-factor test was performed (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Sample size was considered large enough and appropriate to perform statistical tests (Cohen, 1992).

Table 8 – General sample characterisation

Sample characteristics		***(n=155)***
Gender		
Female	61	39.4%
Male	94	60.6%
Instruction level		
Lower than bachelor	47	30.3%
Bachelor	82	52.9%
Master or Higher	26	16.8%
Organisation size		
Less than 20 workers	43	27.7%
21 – 100 workers	58	37.4%
101 – 500 workers	37	23.9%
More than 500 workers	17	11.0%

In Table 8 we can observe the sample distribution according to gender, instruction level, organisation size, most used ERP functional modules, and ERP experience (in years).

The respondent average user's age was 39 years with a standard deviation of 9 years. According to gender we can observe an uneven sample distribution, having more male (60.6%) than female (39.4%) respondents. In terms of education level, the sample presents a very high level of users with an academic degree (69.7%), from which 16.8% have a master degree or higher.

Although organisations with less than 100 workers are the majority (65.2%), the large enterprises also share a significant contribution with 34.8%. Also in terms of hierarchical participation, the sample is fairly elucidative with 45.8% operational level users, 34.2%

junior managers, and 20.0% senior managers. The average job experience was 13 years with a standard deviation of 9 years, showing a wide range of sample data.

Hence, the sample presents a balanced distribution in terms of organisational size, experience, and hierarchical representation.

Table 9 – ERP usage sample characterisation

Sample characteristics		***(n=155)***
Used ERP		
SAP	64	41.3%
Other / Don't know	46	29.7%
Compiere	20	12.9%
Primavera	17	11.0%
SAGE	7	4.5%
Navision	1	0.6%
Used ERP Functional Modules		
Sales	72	46.5%
Procurement	63	40.6%
Accounting	61	39.4%
Stocks & Logistics	54	34.8%
Treasure	52	33.5%
Human Resources	51	32.9%
CRM	40	25.8%
Production	40	25.8%
Business Intelligence	36	23.2%
Other	13	8.4%
ERP experience		
Less than 5 years	68	43.9%
6 – 10 years	37	23.9%
More than 10 years	50	32.2%

Table 9 shows the descriptive statistics relative to ERP. In line with the worldwide data, is no surprise to find SAP as the most used ERP software. Although the sample size is small to infer any kind of conclusion, it's curious that open source software (Compiere and Odoo) is becoming more of a choice in the midst of ERP users. Another important issue about ERP branding is the fact of a considerable amount of people don't know the name of the software they work with (11.6%).

The mainly used functional module is Sales (46.5%), followed by Procurement (40.6%) and Accounting (39.4%). Roughly one third of the respondents use the Stocks & Logistics (34.8%), Treasure (33.5%) and Human Resources (32.9%) modules. In the lowest end we can find the CRM (25.8%), Production (25.8%) and Business Intelligence (23.2%) modules. Other modules (8.4%) were mainly related with documental management.

Lastly, we can observe that the average experience with ERPs is around 8.4 years with a standard deviation of 6.6. The majority of users is familiarised with an ERP system at

least for 5 years (67.7%), however there is a large concentration of people with little experience with an ERP solution.

Having the sample described in detail, follows an in depth assessment of the proposed theoretical model with the measurement and structural models validation.

6. Data Analysis & Results

6.1. Assessment of the measurement model

To examine the relationship and causal effects of the proposed model (Figure 5) the structural equation modelling (SEM) with partial least squares (PLS) method was used (Hair, Ringle, & Sarstedt, 2011; Ringle, Wende, & Will, 2005). The use of PLS is considered adequate to test the measurement model and to validate the causality of a structural model. PLS minimizes the residual variances of the endogenous constructs and requires smaller samples (Hair et al., 2011; Hair, Ringle, & Sarstedt, 2013; Henseler & Chin, 2010). Consistent with above, all constructs were operationalized with the contribution of previous studies on this area. Afterward the measurement model was examined to evaluate reliability and construct's validity (Ringle et al., 2005).

Table 10 – Measurement model results

Construct	Item	Outer loading	Internal reliability	Composite reliability	Cronbach's alpha	Ave	Discriminant validity?
BI	BEHI1	0.956	0.913	0.977	0.964	0.933	Yes
	BEHI2	0.956	0.914				
	BEHI3	0.985	0.971				
MANS	MANS1	0.958	0.917	0.935	0.864	0.878	Yes
	MANS2	0.916	0.839				
PEOU	PEOU1	0.934	0.872	0.966	0.953	0.877	Yes
	PEOU2	0.915	0.837				
	PEOU3	0.946	0.896				
	PEOU4	0.951	0.904				
PU	PUSE1	0.970	0.941	0.980	0.973	0.924	Yes
	PUSE2	0.957	0.916				
	PUSE3	0.970	0.941				
	PUSE4	0.948	0.899				
SYSQ	SYSQ1	0.883	0.780	0.965	0.956	0.821	Yes
	SYSQ2	0.913	0.833				
	SYSQ3	0.929	0.863				
	SYSQ4	0.924	0.854				
	SYSQ5	0.873	0.761				
	SYSQ6	0.914	0.836				
TRAI	TRAI1	0.947	0.898	0.944	0.911	0.848	Yes
	TRAI2	0.967	0.935				
	TRAI3	0.844	0.712				
USE	USE1	1.000	1.000	Single Item			
USS	USS1	0.957	0.915	0.981	0.975	0.930	Yes
	USS2	0.964	0.929				
	USS3	0.967	0.934				
	USS4	0.970	0.940				

Table 10 indicates that items reliability are above .700 (Hair Jr., Hult, Ringle, & Sarstedt, 2013). This means that all items are equally reliable (Table 11). Furthermore the convergent and discriminant validities are demonstrated in Table 10.

Table 11 – Cross-Loadings

	Behav-ioural Intention (BI)	Manage-ment Support (MANS)	Perceived Ease Of Use (PEOU)	Perceived Useful-ness (PU)	System Quality (SYSQ)	Training (TRAI)	Use (USE)	User Sat-isfaction (USS)
BI1	**0.956**	0.442	0.596	0.676	0.689	0.489	0.410	0.749
BI2	**0.956**	0.453	0.650	0.682	0.630	0.567	0.484	0.670
BI3	**0.985**	0.438	0.662	0.702	0.678	0.555	0.410	0.739
MANS1	0.458	**0.958**	0.386	0.504	0.292	0.298	0.412	0.366
MANS2	0.397	**0.916**	0.318	0.333	0.329	0.261	0.329	0.373
PEOU1	0.656	0.373	**0.934**	0.657	0.718	0.564	0.414	0.694
PEOU2	0.585	0.374	**0.915**	0.525	0.580	0.520	0.306	0.603
PEOU3	0.595	0.305	**0.946**	0.464	0.706	0.581	0.300	0.635
PEOU4	0.627	0.370	**0.951**	0.530	0.790	0.617	0.342	0.700
PU1	0.699	0.448	0.564	**0.970**	0.587	0.489	0.409	0.703
PU2	0.636	0.428	0.549	**0.957**	0.550	0.456	0.386	0.650
PU3	0.651	0.428	0.531	**0.970**	0.542	0.437	0.421	0.692
PU4	0.739	0.461	0.597	**0.948**	0.592	0.479	0.445	0.727
SYSQ1	0.590	0.320	0.645	0.470	**0.883**	0.519	0.310	0.719
SYSQ2	0.579	0.270	0.698	0.492	**0.913**	0.577	0.254	0.705
SYSQ3	0.660	0.291	0.671	0.575	**0.929**	0.590	0.297	0.766
SYSQ4	0.598	0.256	0.770	0.500	**0.924**	0.573	0.283	0.726
SYSQ5	0.684	0.340	0.616	0.626	**0.873**	0.524	0.293	0.819
SYSQ6	0.630	0.301	0.677	0.546	**0.914**	0.503	0.305	0.785
TRAI1	0.569	0.343	0.646	0.474	0.646	**0.947**	0.252	0.611
TRAI2	0.548	0.229	0.611	0.493	0.596	**0.967**	0.236	0.602
TRAI3	0.389	0.259	0.381	0.352	0.377	**0.844**	0.222	0.393
USE1	0.451	0.401	0.366	0.433	0.320	0.257	**1.000**	0.356
USS1	0.713	0.370	0.694	0.678	0.812	0.582	0.373	**0.957**
USS2	0.717	0.379	0.676	0.694	0.799	0.569	0.342	**0.964**
USS3	0.713	0.424	0.647	0.721	0.780	0.557	0.323	**0.967**
USS4	0.726	0.343	0.701	0.694	0.817	0.590	0.335	**0.970**

Table 12 – Interconstruct correlation and square root of AVEs

	BI	MANS	PEOU	PU	SYSQ	TRAI	USE	USS
BI	**0.966**							
MANS	0.460	**0.937**						
PEOU	0.659	0.380	**0.937**					
PU	0.711	0.460	0.584	**0.961**				
SYSQ	0.689	0.327	0.750	0.592	**0.906**			
TRAI	0.557	0.301	0.611	0.485	0.604	**0.921**		
USE	0.451	0.401	0.366	0.433	0.320	0.257	**Single Item**	
USS	0.744	0.393	0.705	0.722	0.832	0.596	0.356	**0.964**

Note: diagonal elements are square roots of average variance extracted (AVE), off-diagonal elements are correlations

As presented in Table 10, all items converge and share a high proportion of variance. This fact is of particular importance as these constructs explain more than half of the variance of their indicators. Commonality shows that construct's outer loadings have much in common when measuring each of the latent variables (LV).

The empirical results on the discriminant validity show that each construct is distinct from other constructs. Considering a more liberal criterion (Hair Jr. et al., 2013), from Table 11Table 12 it's inferred that each indicator is associated with only one construct. The cross-loading table show that indicator's outer loadings are greater than all of their loadings on other constructs. An item loading is considered high if the loading coefficient is above 0.600 and considered low if the coefficient loading is below 0.400 (Gefen & Straub, 2005).

Since cross loadings indicators are considered a rather liberal criterion in terms of discriminant validity, a more conservative approach to assess discriminant validity was also taken into consideration. The Fornell-Larcker criterion validates constructs by comparing the square root of Average Variance Extracted (AVE) with the results of the latent variable correlation (Fornell & Larcker, 1981; Hair et al., 2011). This criterion is based on the idea that a construct shares more variance with its associated indicators than with any other construct, Table 12 reports that comparison. It shows that that all the model´s constructs are validated and that measures of different constructs differ from one another.

The results of the measurement model show the item's reliability and convergent validity. In other words, the model's LV, behavioural intention (BI), management support (MANS), perceived ease of use (PEOU), perceived usefulness (PU), system quality (SYSQ), training (TRAI), use (USE), and user satisfaction (USS), are well represented by all the questions posed to ERP end-users. Once the measurement model is confirmed in terms of reliability and validity using PLS, the next step is to assess the structural model.

6.2. Assessment of the structural model

Before the assessment of the structural model we tested all the constructs for multicollinearity, which is considered to be a threat to experimental model design (Farrar & Glauber, 1967), we calculated the variance inflation factor (VIF). Test results showed

that multicollinearity doesn't exist, all variance inflation factors obtained were lower than 4.671, which is well below than the threshold of 10 (Diamantopoulos & Siguaw, 2006; Gujarati & Porter, 2009).

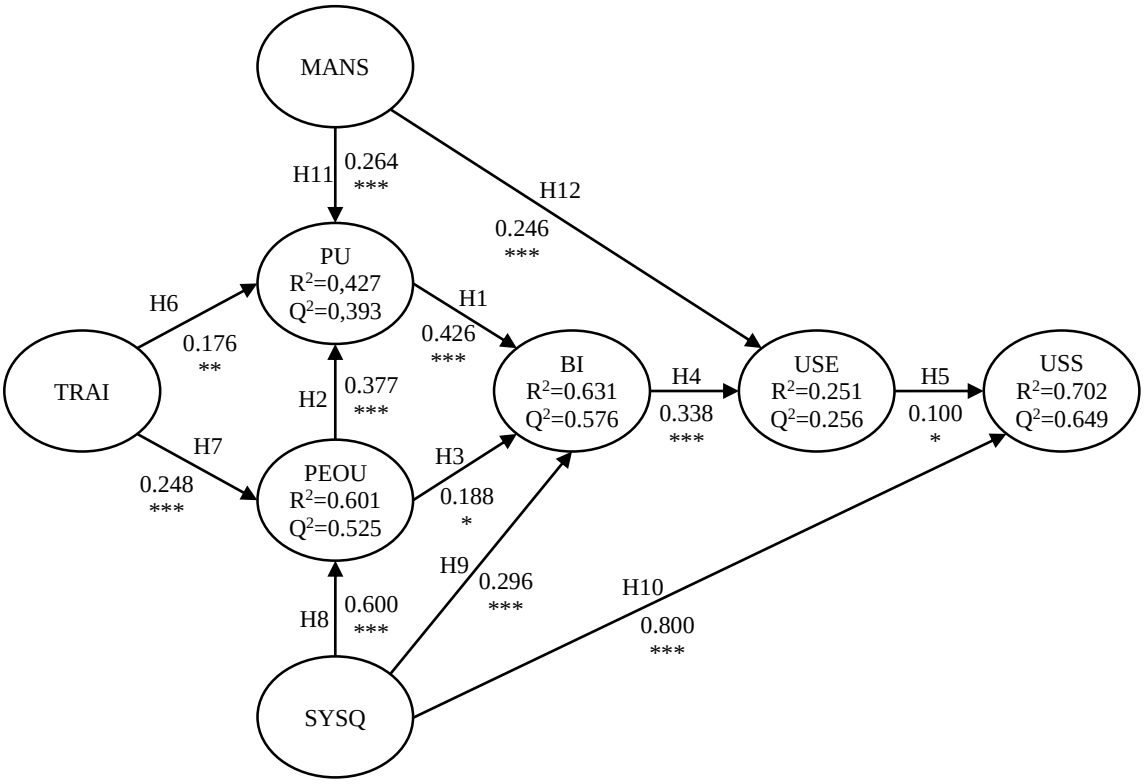
The structural model's quality was evaluated using bootstrapping, a resampling technique that draws a large number of subsamples retrieved from the original dataset. In this case 5000 subsamples were used to determine the path's significance within the structural model (Henseler, Ringle, & Sinkovics, 2009). Structural model results can be observed in Figure 6.

After establishing the validity of the structural model, the structural paths were assessed to test the research hypotheses. Training ($\hat{\beta}$= 0.176, p<0.010), Management Support ($\hat{\beta}$= 0.264, p<0.001), and Perceived Ease of Use ($\hat{\beta}$= 0.377, p<0.001), explain 42.7% of the variation in Perceived Usefulness. In other hand, Training ($\hat{\beta}$= 0.248, p<0.001) and System Quality ($\hat{\beta}$= 0.600, p<0.001), explain 60.1% of the Perceived Ease of Use.

Behaviour Intention, is explained in 63.1% by the constructs of Perceived Usefulness ($\hat{\beta}$= 0.426, p<0.001), Perceived Ease of Use ($\hat{\beta}$= 0.188, p<0.050) and System Quality ($\hat{\beta}$= 0.600, p<0.001). Behaviour intention ($\hat{\beta}$= 0.338, p<0.001) and Management Support ($\hat{\beta}$= 0.246, p<0.001) explain 25.1% of the ERP system Use, while the same Use ($\hat{\beta}$= 0.100, p<0.010) together with System Quality ($\hat{\beta}$= 0.800, p<0.001) explains 70.2% of the variation in User satisfaction. As presented in Table 13, all paths are statistically significant and therefore all hypotheses are supported.

Table 13 – Model Structural Paths

Hypothesis	Path	$\hat{\beta}$	t-Value	p-Value
H1	Perceived Usefulness → Behavioural Intention	0.426	6.062	0.000
H2	Perceived Ease Of Use → Perceived Usefulness	0.377	3.223	0.002
H3	Perceived Ease Of Use → Behavioural Intention	0.188	1.903	0.059
H4	Behavioural Intention → Use	0.338	4.075	0.000
H5	Use → User Satisfaction	0.100	1.875	0.063
H6	Training → Perceived Usefulness	0.176	2.248	0.026
H7	Training → Perceived Ease Of Use	0.248	3.293	0.001
H8	System Quality → Perceived Ease Of Use	0.600	7.898	0.000
H9	System Quality → Behavioural Intention	0.296	2.847	0.005
H10	System Quality → User Satisfaction	0.800	19.369	0.000
H11	Management Support → Perceived Usefulness	0.264	3.264	0.001
H12	Management Support → Use	0.246	2.958	0.004



Path * significant at p < .050; ** significant at p < .010; *** significant at p < .001.

Figure 6 – Structural Model Results

The presented model supported all paths having at least a small predictive impact, as seen in Table 14. The five dependant latent variables are explained in more than half of the variances except PU and USE. User satisfaction (USS) with R^2=0.702, behavioural intention (BI) with R^2=0.631, and Perceived Ease of Use (PEOU) with R^2=0.601, present values that can be considered substantial. Q^2 is a measure of the predictive success and positive values confirm the model's predictive relevance (Geisser & Eddy, 1979; Stone, 1974). Results show positive values for Use (Q^2=0.256), Perceived Usefulness (Q^2=0.393), Perceived Ease of Use (Q^2=0.525), Behavioural Intention (Q^2=0.576) and User Satisfaction (Q^2=0.649).

Table 14 – Results of hypotheses tests

Hypothesis	Independent Variable	→	Dependent Variable	Findings	Conclusion
H1	Perceived Usefulness (PU)	→	Behavioural Intention (BI)	Positively & statistically significant *** ($\hat{\beta}$ =0.426, p<0.001)	Supported with medium effect
H2	Perceived Ease Of Use (PEOU)	→	Perceived Usefulness (PU)	Positively & statistically significant *** ($\hat{\beta}$ =0.377, p<0.001)	Supported with small effect
H3	Perceived Ease Of Use (PEOU)	→	Behavioural Intention (BI)	Positively & statistically significant * ($\hat{\beta}$ =0.188, p<0.050)	Supported with small effect
H4	Behavioural Intention (BI)	→	Use (USE)	Positively & statistically significant *** ($\hat{\beta}$ =0.338, p<0.001)	Supported with small effect
H5	Use (USE)	→	User Satisfaction (USS)	Positively & statistically significant * ($\hat{\beta}$ =0.100, p<0.050)	Supported with small effect
H6	Training (TRAI)	→	Perceived Usefulness (PU)	Positively & statistically significant ** ($\hat{\beta}$ =0.176, p<0.010)	Supported with small effect
H7	Training (TRAI)	→	Perceived Ease Of Use (PEOU)	Positively & statistically significant *** ($\hat{\beta}$ =0.248, p<0.001)	Supported with small effect
H8	System Quality (SYSQ)	→	Perceived Ease Of Use (PEOU)	Positively & statistically significant *** ($\hat{\beta}$ =0.600, p<0.001)	Supported with large effect
H9	System Quality (SYSQ)	→	Behavioural Intention (BI)	Positively & statistically significant *** ($\hat{\beta}$ =0.296, p<0.001)	Supported with small effect
H10	System Quality (SYSQ)	→	User Satisfaction (USS)	Positively & statistically significant *** ($\hat{\beta}$ =0.800, p<0.001)	Supported with large effect
H11	Management Support (MANS)	→	Perceived Usefulness (PU)	Positively & statistically significant *** ($\hat{\beta}$ =0.264, p<0.001)	Supported with small effect
H12	Management Support (MANS)	→	Use (USE)	Positively & statistically significant *** ($\hat{\beta}$ =0.246, p<0.001)	Supported with small effect

Notes:

Path Coefficient $\hat{\beta}$: * significant at p<0.010; ** significant at p<0.050.; *** significant at p<0.001

Effect size: >0.350 large; >0.150 and ≤0.350 medium; >0.20 and ≤0.150 small (Chin, 1998; Cohen, 1988)

7. Discussion

7.1.Hypotheses discussion

All presented hypotheses were empirically supported for ERP systems. Though the given model show predictive capacities supporting all hypotheses, results show different levels of support. These singularities will be addressed below.

Results show that the model's inner triangle, *i.e.* hypotheses 1, 2, and 3, show different effects. All effects are significant and positive but have different strengths. In the first hypothesis, perceived usefulness has a very significant influence on behavioural intention ($p<0.001$) and also has medium effect explaining this relation ($0.350 > f^2 > 0.150$). The relation between perceived ease of use and perceived usefulness (hypothesis 2) is very significant ($p<0.001$) and has a medium explanatory effect ($0.350 > f^2 > 0.150$). Hypothesis 3 shows different results. The statistical significance of perceived ease of use impact on behavioural intention is low ($p<0.050$), and the effect is small ($0.150 > f^2 > 0.020$). These results are all consistent with Sternad & Bobek (2013) and Rajan & Baral (2015) findings in ERP adoption studies about these three hypotheses.

Hypotheses influencing use (H4, H12) both show positive significant impact ($p<0.001$) and a small effect ($0.150 > f^2 > 0.020$). As a matter of fact, the findings are in the same line with previous ERP studies that studied the same kind of relations (Nwankpa & Roumani, 2014; Rajan & Baral, 2015; Youngberg et al., 2009).

Hypothesis 11 shows management support impact on perceived usefulness. This relation is positive, highly significant ($p<0.001$), and shows a small effect ($0.150 > f^2 > 0.020$) explaining perceived usefulness. Results are consistent with Bradley's (2008) qualitative study on how management support was required but wasn't the most important fact explaining project's success. Also Nwankpa & Roumani (2014) sustain that management support is important educating users about ERP system usefulness.

Considering reviewed literature, results on training effect on perceived usefulness and on perceived ease of use are somewhat disappointing. Model results show that training has a medium significance ($p<0.010$) and a small effect ($0.150 > f^2 > 0.020$) towards perceived usefulness (hypothesis 6), and a high statistical significance ($p<0.001$) but also small effect ($0.150 > f^2 > 0.020$) explaining perceived ease of use (hypothesis 7). Literature stresses the critical importance of this specific construct's contribution to IS adoption in general and in ERP systems in particular (Bradley, 2008; Rajan & Baral,

2015; Ruivo et al., 2014; Youngberg et al., 2009). Although is also positively and significantly related to the model, training is the weakest independent latent variable.

System quality is without a doubt the most influencing independent LV of the model. This construct impact on perceived ease of use is vast ($p<0.001$) and has a large explanatory effect ($f^2 > 0.350$). This result is consistent with the previous ERP adoption study by Sternad & Bobek (2013). Hypothesis 9 shows a weaker link of system quality with behavioural intention, presenting a small explanatory effect ($0.150 > f^2 > 0.020$) and a high statistical significance ($p<0.001$).

Finally, the difference between hypotheses related with user satisfaction (H5 and H10) are quite revealing of system's quality weight in explaining user's perceptions about an ERP system. We have hypothesis 5 with a weak linkage between use and user satisfaction in terms of statistical significance ($p<0.050$), and in explanatory capabilities (small effect: $0.150 > f^2 > 0.020$). In opposition to this result, system quality showed a very high statistical significance ($p<0.001$) as well as a large effect ($f^2 > 0.350$) when explaining user satisfaction. Our results confirm what other ERP studies suggested: System quality (SYSQ) is a key component to take into consideration (Chien & Tsaur, 2007; Tsai et al., 2012).

7.2. Theoretical implications

The present research work has three main theoretical implications. First, is among the first works to empirically assess ERP system's adoption and user satisfaction under the same model. Secondly, the integration of dimensions from adoption models (Davis et al., 1992; Venkatesh & Davis, 2000), combined with the ones coming from the DeLone & McLean model (DeLone & McLean, 1992; Delone & McLean, 2003) and other mix approaches (Ruivo et al., 2014; Urbach et al., 2010), constitute a unique combination to consider.

Thirdly, results suggest that user satisfaction can be largely explained by system quality. System quality should be observed as a decisive construct when assessing an IS system, specifically ERP systems.

7.3. Practical implications

The presented model offers a mean of organisations to assess and predict the adoption and user satisfaction of their ERP systems. As seen before, ERP systems' adoption and

user satisfaction are built on multidimensional and interdependent dimensions, and while some relations are stronger than others, analysis should never isolate or reject one particular construct.

Although management support and training showed a lesser significance, this doesn't mean the influence should be disregarded since the influence exists and is statistically supported.

However, results are quite clear: system quality has the best explanatory capabilities and can largely and directly explain user satisfaction. Hence, practical implications to industry should be taken into account when implementing and maintaining an ERP system.

A correct understanding of the organisation's real necessities and requirements is vital to ensure that the configuration, parameterisation, and development of needed functionalities are process oriented and without any clutter influencing system quality. Other aspect to have in mind is the importance of ensuring that all system components (hardware and software) are well balanced and integrated in order to assure fast and reliable data access.

7.4.Limitations and future work

The present study has some limitations. First, the sample data was collected from several organisations representative of major industries, but doesn't have a comprehensive and exhaustive industry-wide panorama. Also, the sample was obtained from just one European country, and represents a nationwide perspective. Although the results are statistically relevant, further surveys with a larger territorial scope will increase the model's explanatory capabilities.

The proposed model suggest a deeper study of the influence strength of System Quality with the other constructs. The most intriguing finding relates with the explanatory capabilities of this construct (SYSQ) opposed to the classical adoption and success theories when studying user satisfaction.

8. Conclusions

Nowadays, ERPs are at the core of every modern and competitive business. This multidimensional IS manages all the information flow and is critical for every organisation stakeholder.

Having this in mind, it is vital to understand what motivates individuals to best use the given ERP system. Hence, the present dissertation aims to find the main determinants influencing ERP user adoption and satisfaction.

Literature review points out to three most significant constructs influencing adoption and satisfaction (independent LV) which are System Quality (SYSQ), Management Support (MANS), and Training (TRAI). Additionally there are other relevant constructs to take into consideration in the model development: Perceived Usefulness (PU); Perceived Ease Of Use (PEOU); Behavioural Intention (BI); Use (USE); and User Satisfaction (USS). These are the key dimensions (LV) found and validated to assess user adoption and satisfaction.

The questionnaire answers was representative of various organisation sizes and user's experience with ERP systems. The collected data is relevant to validate both the measurement and the structural model's results.

All hypothesis were confirmed enabling a good basis for theoretical and practical implications support. Theoretically, the present dissertation is among the very first works to combine IS Adoption and IS Success theories, and empirically study ERP system's adoption and user satisfaction under the same model. Furthermore, the present model found that system quality is a decisive determinant of user satisfaction with the ERP system.

In practical terms, a special care about system quality must always take place. All system components ought to be carefully defined in a holistic approach, in order to achieve perfect balance and consequently influence user satisfaction and adoption.

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Appendix A – Questionnaire (online survey print screens)

ERP Assessment

About the ERP questionnaire

This questionnaire is part of an academic research. This survey seeks to understand user satisfaction of ERP.

ERP systems create an integrated product that manages the majority of operations in a company. ERP are designed to support multiple business functions, such sales, accountability, planning and control, production, stocks control, human resources, among others. Some examples of ERP are: SAP, Navision, Sage, PHC, Primavera among others.

Your answer will make a significant contribution to the academy. This study is important to understand the satisfaction factors of ERP usage. All collected data is under a strict criterion of confidentiality and anonymity. To answer this questionnaire will take approximately 10 minutes.

Thank you for participating.

Next

Powered by SurveyMonkey

ERP Assessment

ERP Assessment

* **Age**

* **Gender**

- ○ Female
- ○ Male

* **What is your education level?**

- ○ Less than hight school
- ○ High school
- ○ College degree
- ○ Post-Graduation
- ○ Master Degree
- ○ PhD
- ○ Post-Doc
- ○ Other

* **For how long do you work? (years)**

* **In which country do you work regularly?**

* **How many workers does your organization have?**

* **What is your role in the organization?**

- [ ] Administration
- [ ] Financial & Accounting
- [ ] Sales
- [ ] Marketing
- [ ] Logistics
- [ ] Procurement
- [ ] Production
- [ ] Quality
- [ ] Human Resources
- [ ] Public Relations
- [ ] R&D
- [ ] Technology
- [ ] Other

* **Please indicate your hierarchical level**

- ( ) Senior management
- ( ) Junior management
- ( ) Operational

* **In which area or areas do you use the ERP software?**

- [ ] Business Intelligence
- [ ] Procurement
- [ ] Accounting
- [ ] CRM
- [ ] Stocks & Logistics
- [ ] Production
- [ ] Human Resources
- [ ] Treasure
- [ ] Sales
- [ ] Other

* **For how many years have you been using an ERP software solution?**

* **Please indicate the software that you use:**

- ◯ SAP
- ◯ SAGE
- ◯ Primavera
- ◯ Navision
- ◯ GIAF/Indra
- ◯ Compierre
- ◯ PHC
- ◯ Other (please specify)

* **Is your organization's ERP in a Cloud service?**

- ◯ Yes
- ◯ No
- ◯ Do not know

* **System Quality**

Please assess the system quality of your organization's ERP system.

Our ERP:

	1- Completely disagree	2	3	4	5	6	7- Completely agree
is easy to navigate.	◯	◯	◯	◯	◯	◯	◯
allows me to easily find the information I am looking for.	◯	◯	◯	◯	◯	◯	◯
is well structured.	◯	◯	◯	◯	◯	◯	◯
is easy to use.	◯	◯	◯	◯	◯	◯	◯
offers appropriate functionality.	◯	◯	◯	◯	◯	◯	◯
offers comfortable access to all the business applications I need.	◯	◯	◯	◯	◯	◯	◯

* **Behavioral Intention**

	1- Completely disagree	2	3	4	5	6	7- Completely agree
I intend to continue using the ERP in the future.	◯	◯	◯	◯	◯	◯	◯
I will always try to use the ERP in my daily life.	◯	◯	◯	◯	◯	◯	◯
I plan to continue to use the ERP frequently.	◯	◯	◯	◯	◯	◯	◯

* **I frequently use the following ERP module:**

	1- Completely disagree	2	3	4	5	6	7- Completely agree
Accounting	○	○	○	○	○	○	○
Business Intelligence (BI)	○	○	○	○	○	○	○
CRM	○	○	○	○	○	○	○
Human Resources	○	○	○	○	○	○	○
Inventory	○	○	○	○	○	○	○
Production	○	○	○	○	○	○	○
Purchase	○	○	○	○	○	○	○
Sales	○	○	○	○	○	○	○
Treasury	○	○	○	○	○	○	○

* **ERP usage**

	1- Completely disagree	2	3	4	5	6	7- Completely agree
At the present time, I consider myself to be a frequent user of the ERP.	○	○	○	○	○	○	○

* **User Satisfaction**

Please indicate your satisfaction with your organization's ERP software.

The ERP:

	1- Completely disagree	2	3	4	5	6	7- Completely agree
supports adequately my area of work and responsibility	○	○	○	○	○	○	○
is efficient	○	○	○	○	○	○	○
is effective	○	○	○	○	○	○	○
satisfies me on the whole	○	○	○	○	○	○	○

* **Training**

Please assess the users program training.

According to users program training, please rate the degree of how:

	1- Completely disagree	2	3	4	5	6	7- Completely agree
was training on the system	○	○	○	○	○	○	○
was their understanding of the content training material	○	○	○	○	○	○	○
worthy is navigating through the topics after training and applied in daily tasks	○	○	○	○	○	○	○

* **Perceived Usefulness**

	1- Completely disagree	2	3	4	5	6	7- Completely agree
Using the system improves my performance in my job.	○	○	○	○	○	○	○
Using the system in my job increases my productivity.	○	○	○	○	○	○	○
Using the system enhances my effectiveness in my job.	○	○	○	○	○	○	○
I find the system to be useful in my job.	○	○	○	○	○	○	○

* **Perceived Ease of Use**

	1- Completely disagree	2	3	4	5	6	7- Completely agree
My interaction with the system is clear and understandable.	○	○	○	○	○	○	○
Interacting with the system does not require a lot of my mental effort.	○	○	○	○	○	○	○
I find the system to be easy to use.	○	○	○	○	○	○	○
I find it easy to get the system to do what I want it to do.	○	○	○	○	○	○	○

* **Management Support**

Please assess the organizational culture with respect to using the ERP.

	1- Completely disagree	2	3	4	5	6	7- Completely agree
My supervisor actively encourages me to use the ERP.	○	○	○	○	○	○	○
My organization's leadership explicitly supports the ERP.	○	○	○	○	○	○	○

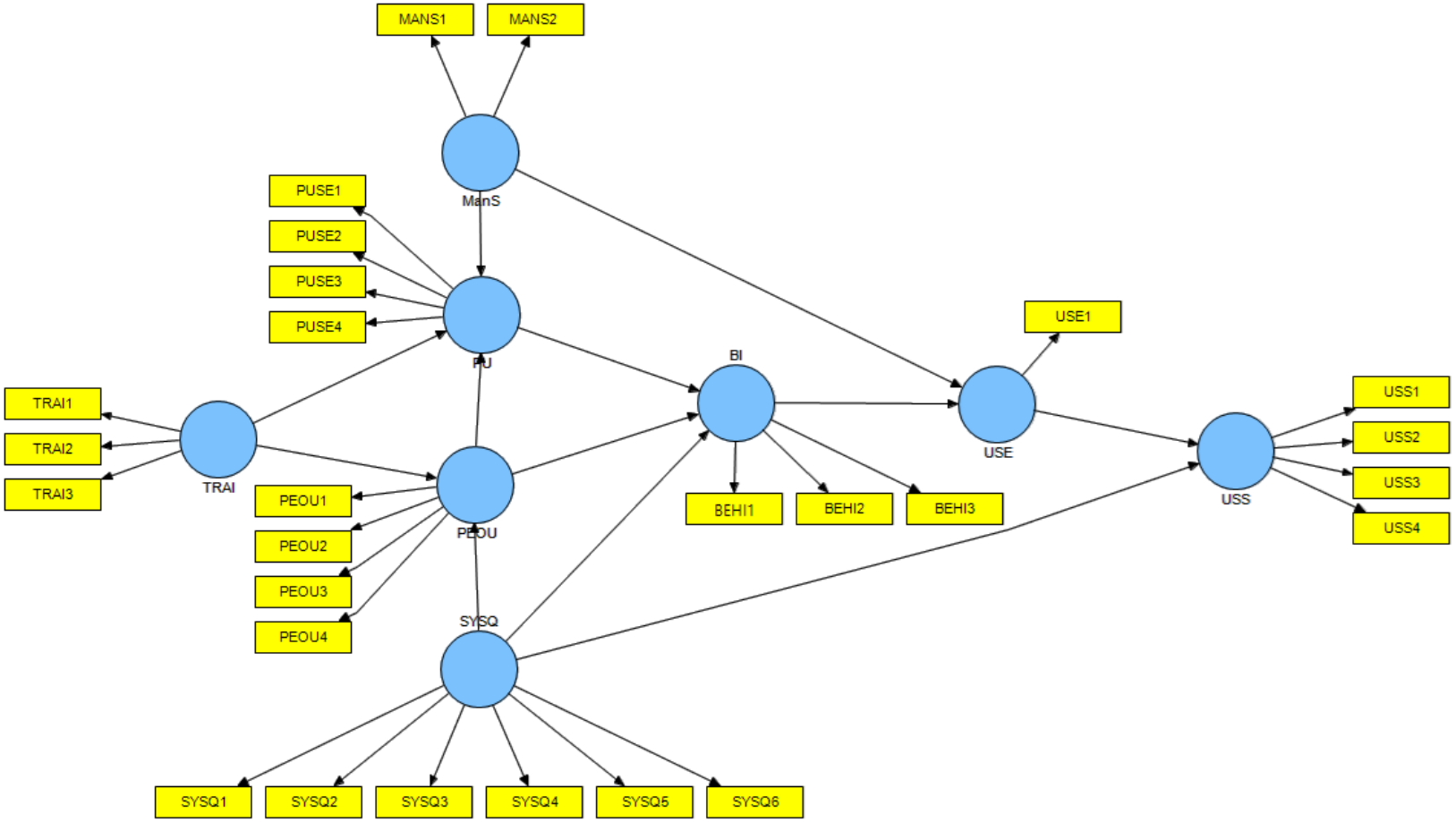
* **What is your degree of familiarity with the Open Source Master of ISCTE-IUL**

- ○ 1- Low
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7- High

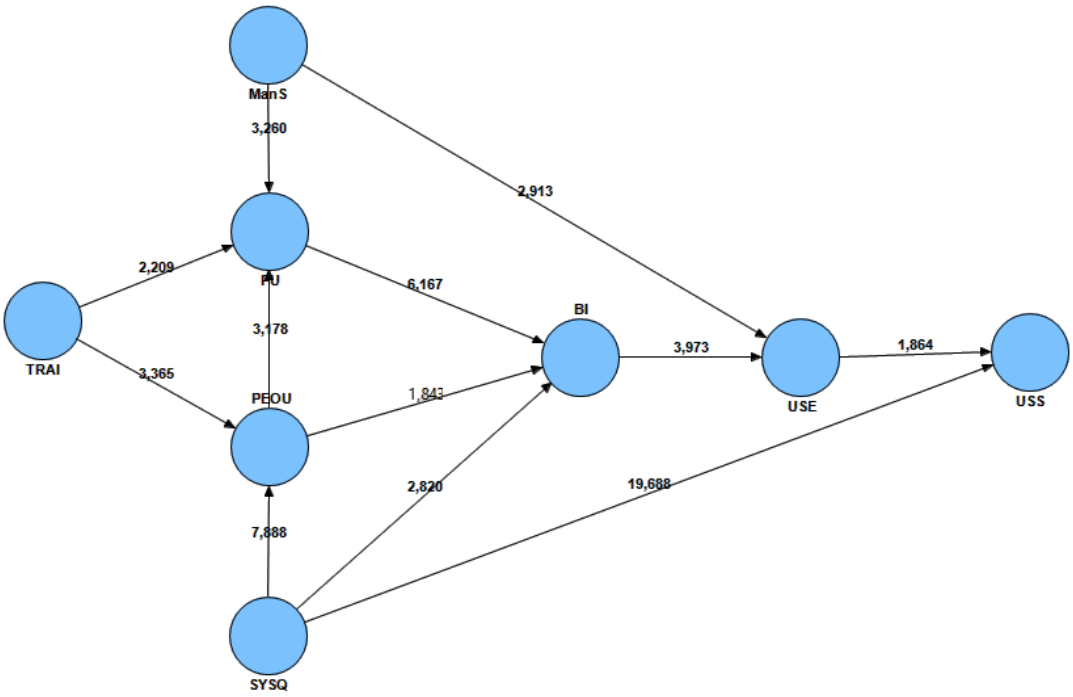
Observations (optional)

Done

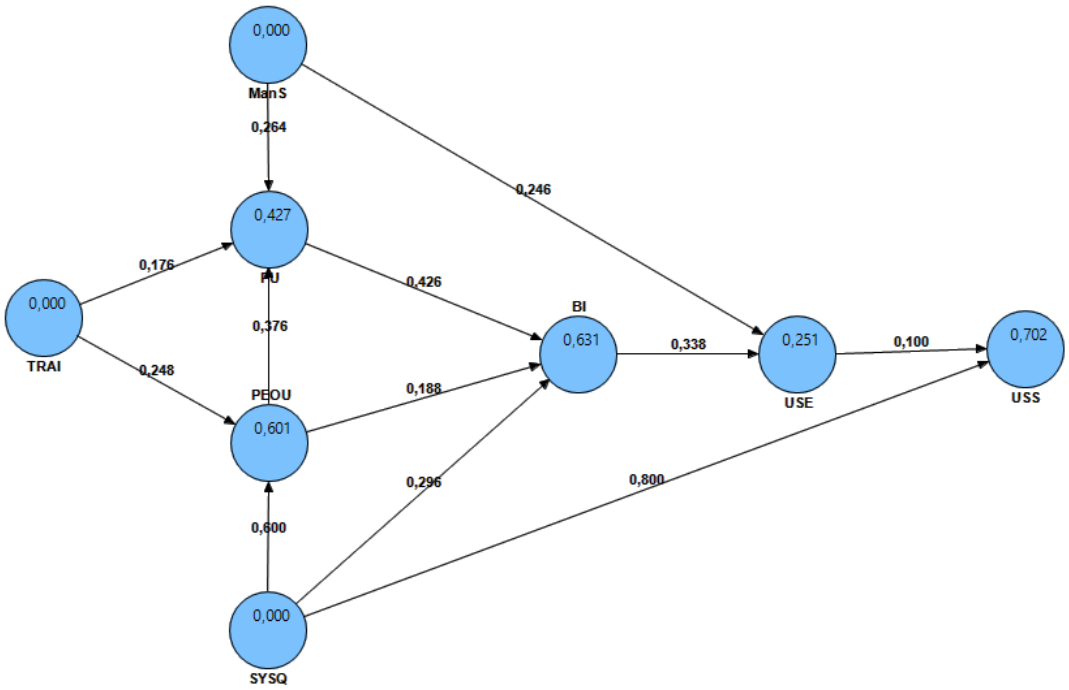
Appendix B – SmartPLS Measurement model



Appendix C – SmartPLS Structural Model: Bootstrap results



Appendix D – SmartPLS Structural Model: PLS results



Appendix E – PLS Overview – Bootstrap Results

Outer Loadings (Mean, STDEV, T-Values)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)
BEHI1 <- BI	0,955478	0,954801	0,014265	0,014265
BEHI2 <- BI	0,956093	0,955362	0,014641	0,014641
BEHI3 <- BI	0,985251	0,985153	0,004260	0,004260
MANS1 <- ManS	0,957542	0,959910	0,008716	0,008716
MANS2 <- ManS	0,915820	0,910965	0,041770	0,041770
PEOU1 <- PEOU	0,933575	0,933216	0,020796	0,020796
PEOU2 <- PEOU	0,914858	0,914167	0,023039	0,023039
PEOU3 <- PEOU	0,946386	0,946301	0,012376	0,012376
PEOU4 <- PEOU	0,950850	0,951196	0,011489	0,011489
PUSE1 <- PU	0,969850	0,969845	0,007917	0,007917
PUSE2 <- PU	0,956969	0,956582	0,012644	0,012644
PUSE3 <- PU	0,969992	0,969305	0,010077	0,010077
PUSE4 <- PU	0,947932	0,947260	0,014070	0,014070
SYSQ1 <- SYSQ	0,883300	0,881875	0,023147	0,023147
SYSQ2 <- SYSQ	0,912840	0,912089	0,016811	0,016811
SYSQ3 <- SYSQ	0,928923	0,928003	0,015352	0,015352
SYSQ4 <- SYSQ	0,923964	0,923493	0,014572	0,014572
SYSQ5 <- SYSQ	0,872635	0,871441	0,029134	0,029134
SYSQ6 <- SYSQ	0,914197	0,913909	0,014313	0,014313
TRAI1 <- TRAI	0,947371	0,948074	0,009066	0,009066
TRAI2 <- TRAI	0,966887	0,966875	0,006832	0,006832
TRAI3 <- TRAI	0,844000	0,840740	0,048020	0,048020
USE1 <- USE	1,000000	1,000000	0,000000	
USS1 <- USS	0,956458	0,956111	0,009619	0,009619
USS2 <- USS	0,963860	0,963251	0,010495	0,010495
USS3 <- USS	0,966544	0,965891	0,008324	0,008324
USS4 <- USS	0,969527	0,969147	0,007420	0,007420

	T Statistics (|O/STERR|)
BEHI1 <- BI	66,979021
BEHI2 <- BI	65,304652
BEHI3 <- BI	231,300697

MANS1 <- ManS	109,864495
MANS2 <- ManS	21,925231
PEOU1 <- PEOU	44,892935
PEOU2 <- PEOU	39,709558
PEOU3 <- PEOU	76,467702
PEOU4 <- PEOU	82,761008
PUSE1 <- PU	122,496467
PUSE2 <- PU	75,687774
PUSE3 <- PU	96,259784
PUSE4 <- PU	67,370839
SYSQ1 <- SYSQ	38,159994
SYSQ2 <- SYSQ	54,298971
SYSQ3 <- SYSQ	60,510233
SYSQ4 <- SYSQ	63,407996
SYSQ5 <- SYSQ	29,952215
SYSQ6 <- SYSQ	63,870977
TRAI1 <- TRAI	104,492327
TRAI2 <- TRAI	141,533648
TRAI3 <- TRAI	17,575879
USE1 <- USE	
USS1 <- USS	99,434337
USS2 <- USS	91,840113
USS3 <- USS	116,116494
USS4 <- USS	130,665885

Appendix F – PLS Overview – PLS Results

Structural Model Specification

PLS
Quality Criteria
Overview

	AVE	Composite Reliability	R Square	Cronbachs Alpha
BI	0,932590	0,976468	0,630887	0,963754
ManS	0,877807	0,934897		0,864385
PEOU	0,877072	0,966140	0,601373	0,953292
PU	0,923965	0,979840	0,426579	0,972566
SYSQ	0,821225	0,964970		0,956348
TRAI	0,848240	0,943536		0,911244
USE	1,000000	1,000000	0,250630	1,000000
USS	0,929507	0,981393	0,701601	0,974715

	Communality	Redundancy
BI	0,932590	0,198428
ManS	0,877806	
PEOU	0,877072	0,470211
PU	0,923965	0,159472
SYSQ	0,821225	
TRAI	0,848240	
USE	1,000000	0,190289
USS	0,929507	0,642434

Redundancy

	redundancy
BI	0,198428
ManS	
PEOU	0,470211
PU	0,159472
SYSQ	
TRAI	
USE	0,190289
USS	0,642434

Cronbachs Alpha

	Cronbachs Alpha
BI	0,963754
ManS	0,864385
PEOU	0,953292
PU	0,972566
SYSQ	0,956348
TRAI	0,911244
USE	1,000000
USS	0,974715

Latent Variable Correlations

	BI	ManS	PEOU	PU
BI	1,000000			
ManS	0,460111	1,000000		
PEOU	0,659018	0,380295	1,000000	
PU	0,711133	0,459942	0,584179	1,000000
SYSQ	0,688973	0,327283	0,749849	0,591608
TRAI	0,556545	0,300966	0,610628	0,485113
USE	0,450626	0,400977	0,366257	0,432804
USS	0,744180	0,392486	0,705161	0,722354

	SYSQ	TRAI	USE	USS
BI				
ManS				
PEOU				
PU				
SYSQ	1,000000			
TRAI	0,604215	1,000000		
USE	0,320404	0,256970	1,000000	
USS	0,832284	0,595924	0,356054	1,000000

R Square

	R Square

BI	0,630887
ManS	
PEOU	0,601373
PU	0,426579
SYSQ	
TRAI	
USE	0,250630
USS	0,701601

Cross Loadings

	BI	ManS	PEOU	PU
BEHI1	0,955478	0,441467	0,596356	0,676127
BEHI2	0,956093	0,453128	0,650206	0,682005
BEHI3	0,985251	0,438164	0,661468	0,701790
MANS1	0,458335	0,957542	0,385644	0,503844
MANS2	0,396640	0,915820	0,318338	0,332867
PEOU1	0,655927	0,373435	0,933575	0,656953
PEOU2	0,584634	0,374157	0,914858	0,525413
PEOU3	0,594667	0,304869	0,946386	0,463871
PEOU4	0,627124	0,370155	0,950850	0,529817
PUSE1	0,699043	0,448008	0,563729	0,969850
PUSE2	0,636441	0,428052	0,548916	0,956969
PUSE3	0,650590	0,427978	0,530852	0,969992
PUSE4	0,739400	0,461113	0,597392	0,947932
SYSQ1	0,590280	0,320438	0,645089	0,469877
SYSQ2	0,578964	0,270363	0,697937	0,492310
SYSQ3	0,659844	0,291335	0,670770	0,575038
SYSQ4	0,598117	0,255964	0,769504	0,499502
SYSQ5	0,683535	0,339611	0,615604	0,625704
SYSQ6	0,629464	0,301207	0,677296	0,545994
TRAI1	0,569434	0,342552	0,645882	0,473649
TRAI2	0,547990	0,229272	0,610499	0,492639
TRAI3	0,389416	0,258783	0,380510	0,351845
USE1	0,450626	0,400977	0,366257	0,432804
USS1	0,713349	0,369865	0,694188	0,678001
USS2	0,717141	0,378457	0,676108	0,693701
USS3	0,713134	0,424196	0,646945	0,721350
USS4	0,725948	0,343048	0,700532	0,693604

	SYSQ	TRAI	USE	USS
BEHI1	0,689010	0,489368	0,410394	0,748730
BEHI2	0,629732	0,566786	0,484398	0,669654
BEHI3	0,678154	0,554650	0,409514	0,738745
MANS1	0,292078	0,298417	0,411689	0,366370
MANS2	0,329415	0,261382	0,328587	0,372612
PEOU1	0,717772	0,563599	0,413890	0,693641
PEOU2	0,579745	0,520226	0,305819	0,603398
PEOU3	0,706072	0,581387	0,299929	0,635184
PEOU4	0,790068	0,617338	0,342250	0,699692
PUSE1	0,586870	0,489371	0,409241	0,703260
PUSE2	0,549456	0,456356	0,385558	0,650361
PUSE3	0,541883	0,437108	0,421331	0,691740
PUSE4	0,591659	0,478646	0,444469	0,726598
SYSQ1	0,883300	0,519303	0,309572	0,718490
SYSQ2	0,912840	0,577242	0,254396	0,704766
SYSQ3	0,928923	0,589518	0,296749	0,765526
SYSQ4	0,923964	0,572801	0,282821	0,725874
SYSQ5	0,872635	0,523539	0,293117	0,819168
SYSQ6	0,914197	0,502518	0,304558	0,785097
TRAI1	0,646420	0,947371	0,252248	0,610800
TRAI2	0,596002	0,966887	0,236111	0,601631
TRAI3	0,377448	0,844000	0,221997	0,392734
USE1	0,320404	0,256970	1,000000	0,356054
USS1	0,812108	0,581524	0,373165	0,956458
USS2	0,799445	0,568452	0,341776	0,963860
USS3	0,780229	0,557246	0,322548	0,966544
USS4	0,816702	0,589946	0,334602	0,969527

AVE

	AVE
BI	0,932590
ManS	0,877807
PEOU	0,877072
PU	0,923965
SYSQ	0,821225

TRAI	0,848240
USE	1,000000
USS	0,929507

Communality

	communality
BI	0,932590
ManS	0,877806
PEOU	0,877072
PU	0,923965
SYSQ	0,821225
TRAI	0,848240
USE	1,000000
USS	0,929507

Total Effects

	BI	ManS	PEOU	PU
BI				
ManS	0,112461			0,263855
PEOU	0,348895			0,376481
PU	0,426223			
SYSQ	0,504828		0,599912	0,225855
TRAI	0,161514		0,248152	0,269236
USE				
USS				

	SYSQ	TRAI	USE	USS
BI			0,337603	0,033629
ManS			0,283610	0,028251
PEOU			0,117788	0,011733
PU			0,143894	0,014334
SYSQ			0,170431	0,817345
TRAI			0,054528	0,005432
USE				0,099612
USS				

Composite Reliability

	Composite Reliability
BI	0,976468
ManS	0,934897
PEOU	0,966140
PU	0,979840
SYSQ	0,964970
TRAI	0,943536
USE	1,000000
USS	0,981393