An Evaluation Model of User Satisfaction with Enterprise Resource Planning Systems

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Abstract: Over the past decade, organizations have made important investments in enterprise resource planning (ERP) systems. However, despite huge investments, many ERP projects failed to achieve corporate goals and led companies to financial difficulties. Accordingly, an appropriate choice of method for ERP success evaluation is much needed. Assessing post-implementation success of ERP systems from the perspective of individual users is crucial because underachievement of the implemented ERP systems may be due in part to underutilization of the systems by the users. User satisfaction is regarded as being one of the most important constructs to evaluate the success of an ERP system from a user perspective. Many conceptualizations are proposed in the literature to measure this construct. From these, the End User Computing Satisfaction (EUCS) instrument developed by Doll & Torkzadeh (1988) seems to be the most appropriate regarding the unique context of ERP systems. Many reported ERP failures and the lack in agreement as to the way to evaluate their contribution to enterprise performance, have led us to conduct an empirical investigation of user satisfaction with several ERP systems. Empirical data was collected using a survey questionnaire which was distributed to ERP users working in four large Tunisian industrial groups. A total of 174 responses were collected and analyzed using structural equation modeling. This study offers a new conceptualisation of ERP user satisfaction. We identify two underlying components of satisfaction: satisfaction with ERP technological features and satisfaction with its content. The findings of this study are useful to IT managers and directors by helping them to evaluate the key components of ERP user satisfaction and then to choose the appropriate ERP for their organization, and also to act separately on one or both of these two components to improve overall satisfaction. Managers should consider, on the one hand, the intrinsic attributes of the system such as user-friendly interface, easy to use features and presentation quality of the screen and, on the other hand, the quality of information content and its fit with the task supported.

Keywords: User satisfaction, ERP, system quality, information quality, measurement instrument, Structural Equation Modeling.

1. Introduction

The Globalization and uncertainty of markets have led many firms to use information technology (IT) to make their business processes more efficient and achieve business connectivity. Enterprise resource planning (ERP) systems have emerged as one of the best information technologies for organizations to synergize their internal resources and support critical business functions. ERP systems are defined as software suites, built to collect and organize data from various levels of an organization. They help businesses run important processes, such as manufacturing, supply chain, sales, finance, human resources and others. (Chou & Hong, 2013; Hsu *et al.*, 2015; Rajan & Baral, 2015; Almajali *et al.*, 2016). By integrating and streamlining several business processes and connecting activities across departments, these extensive software packages are believed to create operational synergy and enhance overall business performance. However, the complexity and scale of the system implementation process has, resulted in failures and implementation difficulties (Kanaracus, 2011)

Over the past few decades, many companies all over the world have made significant investment in enterprise resource planning (ERP) systems. However, despite huge investments, many ERP projects have failed to achieve corporate goals and led companies to financial difficulties (Saade & Nijher, 2016; Calisir et Calisir, 2004). According to Panorama Consulting (2015), 67.5 percent of organizations failed to realize half of their projected benefits after ERP implementation, and the number of reported ERP failures has increased by five-percent since 2014. Besides, as these systems encompass every aspect of a business, an unsuccessful launch may cripple the company's ability to service its customers (Frejik & Powel, 2015).

Accordingly, an appropriate choice of method for ERP success evaluation is much needed. There are two perspectives of IT evaluation used in information systems research (Delone & McLean, 1992; Grover *et al.*,

Reference this paper: Mekadmi, S., and Louati, R., 2018. An Evaluation Model of User Satisfaction with Enterprise Resource Planning Systems. *The Electronic Journal Information Systems Evaluation,* 21(2), pp. 143-157, available online at www.ejise.com

1996). The first perspective focuses on actual IT use including acceptance as well as individual and organizational impacts and the second one emphasizes on user attitudes and perceptions thus on adoption behaviors and levels of satisfaction with IT. Measuring ERP success from costs, benefits and productivity improvements perspective would be ideal (Zhu *et al.*, 2010; Pan *et al.*, 2011); nonetheless because of the difficulty that involves such measurements, other ones have received widespread acceptance as a surrogate measure.

Assessing post-implementation success of ERP systems from the perspective of individual users is crucial because underachievement of the implemented ERP systems may be due in part to underutilization of the systems by the users (Hsu *et al.*, 2015). IS literature has given much attention to how to best measure it (Calisir & Calisir, 2004; Chien & Tsaur, 2007; Kanellou & Spathis, 2013).

User satisfaction is considered as one of the most important constructs to evaluate the success of an IT venture from a user perspective. Many researchers have recognized it as a critical determinant of the success of IS (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988; DeLone & McLean, 1992; Igbaria & Tan, 1997; Hou, 2012; Al-Jabri, 2015).

Our research examines how to evaluate the intangible benefits from using Enterprise Resource Planning (ERP) systems. They are post-implementation benefits that are multidimensional and are evaluated at an end user-level. We use the End-User Computing Satisfaction (EUCS) instrument developed by Doll & Torkzadeh (1988) adapted to the specificities of the technology and context under study.

The investigation was carried out in four industrial groups of great importance in the Tunisian economy operating in the areas of food, services, chemicals and electronics. These groups have implemented a number of modules of an ERP in their subsidiaries (essentially “finance/accounting” - inventory management – production/manufacturing – Purchase/supply – sales and orders – human resource management…) to consolidate and integrate their management systems at Headquarters to help in the procedures of reporting and structuring.

The aim of this study is to explore the idea that satisfaction could be understood differently, depending on whether it relates to the attributes of the system itself or its information products. Toward that end, this research is designed to contribute to IS literature by revisiting End-User Computing Satisfaction (EUCS) instrument developed by Doll & Torkzadeh (1988) and adapting it to ERP characteristics. Research findings will be of value to any company that wants to refine the assessment of user satisfaction towards ERP by identifying more pragmatic elements that sustain user judgments of an ERP system.

The remainder of this paper is organized as follows: The first section presents the theoretical foundations of “satisfaction” and reviews the most important studies in this regard. In the following section, a conceptual model of user satisfaction towards ERP software is proposed and leads to the development of a measurement instrument for the concept. The third section addresses the research methodology, followed, in the final section, by the presentation of results from an empirical study. This paper concludes with a discussion about our findings and directions for future research.

2. User satisfaction as a metric for Information Technology evaluation

Increased spending on different information technologies and their mixed impacts on productivity have led to multidimensional evaluations of their contribution to organizational performance. Obviously, an appropriate choice of method for this evaluation is much needed. Two perspectives of IT evaluation have been developed in information systems research (Delone & McLean, 1992; Grover *et al.*, 1996); actual IT use including acceptance and individual and organizational impacts on the one hand, and on the other, user attitudes and perceptions reflecting adoption behaviors and levels of satisfaction with IT. The accuracy of IS usage as a method for success evaluation has been criticized in the literature, especially in the context of imposed or involuntary use or IT failure. Regardless of how powerful and enabling a technology may be, it will not lead to better performance unless it enhances user performance by increasing user efficiency and effectiveness, or if it provokes positive perceptions of the technology. The design of any evaluation method must take into account the important role of perceptions and attitudes that reinforce satisfaction.

Compared to other evaluation perspectives, user satisfaction is widely considered as superior because of its application in different contexts, its ease of operationalization, its relationship with other important variables in the analysis and systems development, and its content validity (Mahmood *et al.*, 2000; Somers *et al.*, 2003). A number of authors consider it an important alternative to measuring the contribution of IS to organizational efficiency (Ives *et al.*, 1983; Baroudi *et al.*, 1986; Thong & Yap, 1996). Earlier on, Power and Dickson (1973) argued that satisfaction facilitates the use of an information system. Sometime later, the work of Gelderman (1998), Mahmood *et al.*, (2000), and Zviran *et al.* (2005) empirically validated the reliability and the importance of satisfaction measures.

The literature on ERP systems seems to be more focused on issues related to their adoption and implementation rather than on the post-implementation stage (Hsu et al., 2015). According to a literature review conducted by Esteves and Bohorquez (2007), 47 percent of ERP publications examine the implementation phase while only 15 percent focus on post-implementation usage (Hsu et al., 2015). This latter perspective should deserve more interest because underachievement of ERP systems may be a result of the underutilization of the system by the user. Additionally, positive impacts for the organization are considered as a result of accumulated benefits that individuals obtain from their use of the ERP applications (Ifinedo *et al.*, 2010).

Due to measurement problems, the IS literature shows that a subjective judgment centric approach such as satisfaction is preferable to objective measures such as usage and performance (Raymond 1985). For Delone and McLean (1992), (1) the explanatory power of the satisfaction measure, (2) the existence of the measurement instruments in the literature to measure satisfaction, and finally, (3) the conceptual and even practical weakness of the other IS success measures are all good reasons for considering user satisfaction as a reliable measure.

A number of definitions of user satisfaction have been proposed in IS literature. These definitions have evolved with the changes in IS environment (Hou, 2012). Doll and Torkzadeh (1988) defined end-user computing satisfaction as "*the affective attitude towards a specific computer application by someone who interacts with the application directly*" (page 261). Au et al. (2002) characterized it as an emotional and an overall cognitive evaluation of the user, that is, his or her level of achievement related to his or her experience with IT.

In the case of an ERP system, Somers *et al.* (2003) indicated that user satisfaction refers to the extent to which a user perceives that a system meets his or her information requirements. Lebana-Cabanillas *et al.* (2013) defined satisfaction as the general attitude manifested by users as a result of experience accumulated through using behavior of ERP systems. For Hsu et al. (2015), user satisfaction is the extent to which users perceive a match between their requirements and ERP functionality. Lastly, Almajali *et al.* (2016) suggest that user satisfaction can be utilized as an important indicator to assess the ERP system and illustrate if the information system works efficiently.

Moreover, by emphasizing the subjective and the multidimensional nature of the satisfaction construct there is a need for a perceptual rather than a purely economic evaluation. Bailey and Pearson (1983) have already raised the issue concerning which part of an organization is best placed to express a user level of satisfaction. Beyond the technical vision of IT professionals as well as from a practical point of view, IS users are best positioned to make judgments concerning the specific applications that they manipulate. The evaluation of satisfaction is therefore based on an end-user's perspective.

User satisfaction has been employed as a metric for IS success from the early years of IS evaluation (Al Jabri, 2015). Most of the work on user satisfaction is based on organizational psychology literature (Au et al., 2002) which has focused on the attitude of individuals, their motivation at work, and resulting behaviors. One of the common points to these different definitions is to consider user satisfaction of IS as a favorable attitude towards a tool, requiring a user to make a judgment on its ability to support or to help in problem solving. Accordingly and in the same line of thinking of Doll & Torkzadeh (1988), ERP user satisfaction is conceptualized in the present study as the affective attitude towards an ERP format and content by someone who interacts with the application directly.

3. Conceptualization of ERP user satisfaction

Several conceptual frameworks have been proposed to investigate IS end-user satisfaction. The conceptualizations proposed by Bailey & Pearson (1983) and Doll & Torkzadeh (1988) have received the most attention from IS researchers. These two instruments are the most widely used by later studies, either partly or in their entirety, to build new tools for measuring satisfaction. These instruments have the double advantage of contributing to the standardization of measuring instruments and being applicable in specific contexts of ERP as such.

The instrument developed by Bailey & Pearson in 1983 to measure user information satisfaction (UIS), is one of the first conceptualizations of the satisfaction construct in the psychology literature. This instrument was developed in order to improve the productivity of corporate IT departments. The structure and dimensionality of the satisfaction construct has received much attention in the literature. Using the work of Bailey & Pearson (1983), Ives *et al.* (1983) carried out an exploratory factor analysis and proposed a condensed instrument with 13 items for measuring user satisfaction. In a replication using exploratory techniques, Baroudi & Orlikowski (1988) confirmed the factor structure of Ives *et al.* (1983) model. The analysis of data collected from 358 users of transactional systems in 26 different organizations yielded the same structure of satisfaction with three factors, namely quality of information produced, services offered by Information Systems Division (ISD) and relations with its personnel, and knowledge and implication. It should however be noted that the instrument, as developed by Bailey & Pearson (1983) remains appropriate in the context of automation of primary business applications because it focuses on the indirect users of computer systems, who do not manipulate the system themselves but rather evaluate it based on the information it produces.

In the late 1980s, with the emergence of decentralized IT architectures, users became more autonomous in their use of available information systems thus accentuating the need for a revised concept of satisfaction. The first study undertaken in this new context was that of Doll & Torkzadeh (1988). The researchers propose to integrate variables associated with conditions of enhanced interaction of users with IS, in particular the variable: “ease of use”. Based on a study of 618 users interacting with 250 different applications, the authors developed an instrument consisting of 12 items to measure the overall satisfaction of the direct use of a specific computer application. Five key elements of satisfaction were identified: (1) the information content, (2) accuracy of applications, (3) format of output, (4) ease of use of system, and (5) updating of content and response times. Since its introduction, Doll & Torkzadeh’s (1988) instrument has become a reference in the field of IS research. It has been widely used, validated and generalized by other researchers. Furthermore, the instrument’s validity has been confirmed in the case of specific applications including business intelligence systems (McHaney & Cronan, 1998; Chen *et al.*, 2000; Hou, 2012) and ERP applications (Somers *et al.*, 2003; Zviran *et al.*, 2005; Law & Ngai, 2007; Wu & Wang, 2007; Kanellou & Spathis, 2013). As the aim of our research is to measure user satisfaction towards ERP systems that are based on decentralized computer architecture and that consist of applications directly employed by users, the instrument of Doll & Torkzadeh (1988) is more appropriate than that of Bailey & Pearson (1983). As recommended by Doll & Torkzadeh (1988), this highly standardized instrument needs to be adapted to take account of certain features specific to ERP systems.

Our study takes a multidimensional perspective of satisfaction and suggests that several dimensions make up the satisfaction construct. The main concern is the choice of a set of pertinent dimensions that ensure a complete and comprehensive coverage of the concept. Given the variety of IS environments where satisfaction has been studied, it is quite difficult to ensure the relevance of the dimensions to be selected. There have been a number of critical literature reviews in studies on IS satisfaction measurement to help in identifying the points they have in common (Mahmood et al., 2000; Au et al., 2002; Zviran & Erlish, 2003). Their main goal is to help researchers choose dimensions to evaluate end-user satisfaction.

Faced with this difficulty and lack of consensus on the issue (Melone, 1990), it is imperative to review the literature in this domain. Several instruments have been developed to measure the construct of satisfaction, including that of Bailey & Pearson (1983), Ivari (1987), and Doll & Torkzadeh (1988) in the case of end-user computing.

A review of the literature on the evaluation of satisfaction towards an IS as well as those studies using the measure of EUCS in the context of ERP systems (Somers *et al.*, 2003; Zviran *et al.*, 2005; Law & Ngai, 2007; Wu & Wang, 2007; Hou, 2012; Kanellou & Spathis, 2013) allow us to formulate a multidimensional approach to

satisfaction. The dimensions of the proposed conceptual model are based primarily on ECUS instrument. The dimension "usefulness of content" is added to the model because of its relevance to assess the information content of the ERP system. The dimension "Service Quality" is deeply adapted to consider apart from "timeliness", other important aspects like "running smoothness", "friendly interface", "absence of bugs and downtimes".

The evaluation of satisfaction takes into account the intrinsic qualities of an ERP system and quality of its output (Fig. 1).

Usefulness of the content is a central dimension of satisfaction (Mahmood et *al.*, 2000). It has been mobilized in many studies about the use of information system and specifically those dealing with satisfaction (Bailey and Pearson 1983, Zviran et al., 2005). It relates to the value and interest of the information provided by IS to its users. Davis (1989) defines usefulness of the content as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (page 320).

Bailey & Pearson (1983) use the notion "perceived utility" and define it in terms of the "*cost and usefulness of information*" and also as the "*relative balance between the cost and the considered usefulness of the computer-based information products or services that are provided "* (p. 542). Doll & Torkzadeh (1988) do not accurately use the term usefulness but deal with the content of the system described as the degree to which the system meets users' needs. This conceptualization has also been adopted by Somers et al. (2003) and Hou (2012). Zviran et *al.* (2005) considered perceived usefulness of the ERP system, in the whole, as a determinant of user satisfaction, and usefulness of the information content as a dimension of user satisfaction.

In this research, usefulness of content for an ERP system is defined as the intensity with which the user believes that the system meets his/her business needs and produces personalized analysis that match his/her job requirements.

Bailey & Pearson (1983) define content ***reliability*** as "the consistency and the dependability of the output information" (p. 541). This definition does not cover the accuracy of information. Doll & Torkzadeh (1988) maintain this distinction by mobilizing two dimensions: "timeliness" for updating content and "accuracy of the information". While conceptually this distinction may seem obvious, empirically it is much less so (McKinney et al., 2002). Reliability of the content is defined here both by its accuracy and by its timeliness. Thus, reliability measures the consistency and the degree of updating of information produced.

Completeness of the content is an important dimension of satisfaction. It refers not only to the comprehensiveness of information but also to its accuracy in terms of the level of detail provided. Many authors have distinguished the two notions in their works (Bailey & Pearson, 1983; Etazdi-Amoli & Farhoomand, 1996; Goodhue, 1998). The completeness of content considers the precision of information as a component of comprehensiveness: Information that lacks precision is incomplete. Therefore, completeness measures the comprehensiveness of information and also the accuracy in terms of details provided.

In the analysis of computer user satisfaction, ***output format*** or the quality of reports produced by the system or the format of IT screens are of particular importance. The presentation of information (tables, graphics, reports…) on the screen, if clear, understandable, structured and easy to comprehend, increases the quality of an application. Although the issue, of impact of information presentation on satisfaction has not been widely addressed in IS research, this dimension was considered by Doll & Torkzadeh (1988). The authors addressed the issue of presentation via "format" which studies the layout and clarity of the contents of an application. In this research, the output format is measured by the quality of reports produced by the systems and the degree of clarity of IT screens.

Ease of use is one of the dimensions of satisfaction used by Doll & Torkzadeh (1988) and Etezadi-Amoli & Farhoomand (1996). It refers to the level of physical and mental effort that an individual must apply to use a system (Davis, 1989). They show that ease of use influences both the attitude of the user towards a system as well as its perceived usefulness. The perceived ease of use allows understanding how the user perceives the degree of clarity and comprehensibility in his/her interaction with an IS. Regarding satisfaction towards an ERP, the perception of ease of utilization reflects the usability of interface system, the ease of accessing its content

and the know-how of its features, that is to say, the ease with which the user has access to system applications and obtains the reports he/she needs for his/her tasks.

Service quality of the system refers to its technical qualities. Among its technical characteristics, the speed of screen displays and the access to applications play vital roles in the formation of the level of satisfaction towards them. Indeed, the relevance of information is a function of ease of access and the time to display screens and to restitute data. In this sense, our evaluation of satisfaction takes into account these characteristics. Palmer (2002) retains the concept of "downloading time" as one of the dimensions of usability of a website. The traditional instrument to measure satisfaction by Ives et al., (1983) includes this dimension for an attitudinal evaluation of IS supplier services rather than the intrinsic qualities of the IS itself. Doll and Torkzadeh (1988) include the service quality of the system into the « timeliness » dimension.

Ultimately the user satisfaction towards ERP can be modeled as follows:

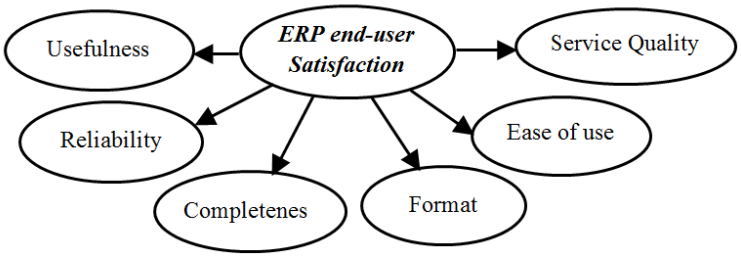


Figure 1: Conceptual model of ERP end-user satisfaction

4. Research methodology

4.1 Field of research

This research is a part of post-implementation evaluation of the success of an ERP system by the end-user. The reasons for choosing an ERP as the technological context include the unique nature of this type of IS compared to the traditional information systems it has replaced, the importance of investments in this type of system, and finally because of the great interest in IS research in evaluating the success of ERP systems.

The study was carried out in four industrial groups of great importance in the Tunisian economy. They are operating in the areas of food, services, chemicals and electronics. They have implemented a number of modules of an ERP system in their subsidiaries to consolidate and integrate their management systems at Headquarters in order to improve reporting procedures and structure operations. Apart from size and turnover criteria, the choice of these groups (Table 1) was made according to the following elements: (1) Scale of the solution: the size and the diversity of functions supported by ERP system, especially when the ERP implemented integrates in a single application the financial accounting, consolidation and group reporting functions. (2) Solution Maturity: The evaluation of satisfaction with a computer application requires that it be used that is why we have chosen groups that have been using more than the two traditional ERP modules of finance and accounting for more than one year. This condition is important as a period of one year allows users to have enough experience with the system and thus make valid judgments regarding their level of satisfaction. (3) Homogeneity of organizational contexts: The organizational contexts of studied groups (mainly agrifood) are very close to avoid any impact on the conceptual model validation conditions. All these criteria lead us to adopt a voluntary, non-probabilistic sample.

Table 1: Field of research.

	Poul Group	Hac Group	Del Group	Sla Group
Sector	Agri-food Industry Service	Food Chemicals Electronics Information technology	Agri-food industry	Agri-food industry Real estate development International trade
Subsidiaries/ERP	3/40	5/15	3/3	2/9
Number of responses	33	68	35	38
ERP	MFG/PRO	Oracle applications	E-one	Adonix

4.2 Data collection

An exploratory study was first conducted in each of the subsidiaries of the four industrial groups. Semi-structured interviews were conducted with information systems and/or ERP managers as well as selected key informants to identify the determinants of their perceived satisfaction. Interviewees were selected on the basis of their seniority within the group, their degree of ERP application utilization, and their involvement in the ERP's implementation. Several employees were also observed at their work stations in order to assess their ease of use of the tools to obtain and process information necessary to perform their duties. This exploratory phase highlighted some specific and hidden aspects of perceived ERP success which were subsequently taken into account in questionnaire design in the second phase (Mekadmi, 2009).

The various components of satisfaction included in the questionnaire were subjected to pre-testing with key users to ensure adequate comprehension of the questions and their five point scale ranging from strongly disagree to strongly agree. An electronic version of the questionnaire was given to each key informant that participated in the exploratory phase to facilitate user involvement in the project. A total of 900 questionnaires were addressed via the corporate intranet to all users in the different operational departments of the subsidiaries. It was accompanied by a note from top management to explain the nature, the relevance and the importance of the research for the company. It should be noted that a paper version of questionnaire was administered "face-to-face" in some subsidiaries to overcome initial resistance to the project.

A total of 190 completed responses were received of which 16 were excluded due to a high percentage of non-response. There were 174 valid responses and the response rate was 21.11%. The relatively low response rate can be attributed to the fear of some employees to be judged on the quality of their responses as well as the low number of employees using ERP software in these organizations since integration of the system is not yet generalized to all subsidiaries.
Table 2 shows descriptive data of the sample. Men constitute a majority of respondents (82.8%) as compared to women (17.2%). The respondents are well educated (44.8% holding bachelor's degree and 29.9% master's degree or above). The job position of respondents included non-management employees (25.9%), middle managers (44.2%), and top-level managers (29.9%). Most of the participants had an administrative profile (40.8%) such as accounting, finance, management control and computing, followed by those who had an industrial profile (26.4%) like production, inventory management and logistics, a commercial profile (21.9%) such as marketing and front-office, and the remaining 10.9% had others profiles like quality management and maintenance. This result can be explained by the nature of ERP modules that were implemented in the studied groups.

Table 2: Profile of the respondents (n = 174).

Characteristic	Frequency	Percent
Gender		
Male	144	82.8%
Female	30	17.2%
Educational level		
Secondary School	14	8.1%
Diploma/certificate	30	17.2%
Bachelor's Degree	78	44.8%
Master's Degree or above	52	29.9%
Work Position		
Non-Management Staff	45	25.9%
Middle-level management	77	44.2%
Top –level management/ Executives	52	29.9%
Business Profile		
Administrative	71	40.8%
Industrial	46	26.4%
Commercial	38	21.9%
Others	19	10.9%

4.3 Data Analysis

To explore and validate the combination of items measuring ERP satisfaction into scales and evaluate their measurement of distinct underlying constructs, we used two complementary approaches for statistical data analysis. The first method of data analysis that uses a Principal Component Analysis (PCA) to validate the measure of satisfaction is referred to as more descriptive than explanatory. It is used to empirically validate the

constructs of variables, and is justified to test the hypothesis of structure of first order factors. The PCA using a Varimax rotation was run on a set of 24 items in total, with the number of factors determined by consulting the Kaiser's 'eigenvalue > 1' criterion.

This study is confirmatory in nature and the proposed research model in Fig. 1 is based on findings of previous empirical research. Therefore, the Structural Equation Modeling (SEM) is the second method of data analysis. The measurement model was estimated using a Confirmatory Factor Analysis (CFA) to test its reliability and validity and to confirm the relationships between latent constructs and observed variables. The CFA was also used to validate the two hypothetical structures, "global and dual", for satisfaction and the hypothesis of the superiority of one or the other. The structural equation analysis was performed using AMOS 16.0 software.

5. Results

5.1 Exploratory Factor Analysis

The PCA conducted on the correlations among the items measuring the generic concept of satisfaction shows the existence of a factor structure consisting of five independent factors instead of the postulated six factors. Thus, although conceptually different, the two dimensions namely "ease of use" and "output format" were merged into a single factor. In fact, the construct "ease of use" includes certain items related to interface clarity. It is precisely through this interface that the reports (system output) are displayed. The simplicity of an ERP is therefore operationalized in terms of ease of use and the simplicity of reading the screen as "output format". With respect to our empirical data, the two dimensions "ease of use of the system" and "screen format" form a single dimension called "ease of use of the ERP". In the end, after the removal of three items measuring "format" to avoid redundancy, a clear five factor solution was found from the remaining 21 items (Table 3). Bartlett's test of sphericity was significant: 0.000 < 0.5 and KMO's test gave a value of 0.867 > 0.6, therefore we can conclude the accuracy and reliability of PCA results. The five factors together explain 76,670% of variance and empirically constitute the multidimensional concept of satisfaction. The factor loadings were all significant (> 0.5).

Table 3: Exploratory factor analysis for satisfaction with an ERP.

	Components & factor loadings				
Items	Ease of Use	Service quality	Useful ness	Reliability	Complete ness
Reliable Information (*RELIA1*)				0.848	
Always correct (*RELIA2*)				0.839	
Consistently up-to-date (*RELIA3*)				0.763	
Accurate ERP system (*RELIA4*)				0.884	
Information that responds to my professional needs (*UTIL1*)			0.902		
Personalized analysis necessary for my work (*UTIL2*)			0.774		
Information which is essential for me (*UTIL3*)			0.853		
Relevant information for problem solving (*UTIL4*)			0.889		
Sufficient information generated by the used module (*COMP1*)					0.898
Complete information (*COMP2*)					0.821
Detailed information (*COMP3*)					0.769
Structured and easy to comprehend information (*FORM3*)	0.751				
Easy to learn how to work with ERP system (*EASE1*)	0.812				
User-friendly interface of the ERP system (*EASE2*)	0.842				
Clear interface of the ERP module used (*EASE3*)	0.792				
Easy to use ERP system (*EASE4*)	0.814				
No bugs or downtime (*SQUAL1*)		0.664			
No access problems to the applications (*SQUAL2*)		0.736			
Quick response time to a request or report printing (*SQUAL3*)		0.837			
Screen display without any delay (*SQUAL4*)		0.844			
Satisfactory speed of execution of commands (*SQUAL5*)		0.789			
Eigen value	7.716	3.454	1.917	1.673	1.341
Explained variance	36.743	16.448	9.129	7.966	6.384

5.2 Confirmatory factor analysis

The empirical data extracted from the preceding analysis is subjected to the method of structural equation modeling (SEM). First, it aims to check the existence of a latent variable "ERP satisfaction" towards which the five dimensions converge. Second, if it is possible, it proposes an alternative model that reflects more End-User Satisfaction with ERP.

To justify data validity and reliability, the composite reliability, convergent validity, discriminant validity, and validity of the second-order construct were analyzed. As shown in Table 4, all the values of Cronbach's α for constructs ranged from 0.878 to 0.916 and exceeded the 0.70 cutoff level, demonstrating satisfactory internal consistency (Nunnally, 1978; Gefen *et al.*, 2000). Moreover, the range of values of composite reliabilities was 0.875-0.911, leading to say that the model has adequate reliability. For convergent validity, the measurement model was evaluated based both on the factor loadings coefficients and the average variance extracted (AVE), as suggested by Fornell and Larcker (1981). As illustrated in Table 4, relatively high factor loading coefficients mean a high interpretative power of indicators within the construct. Furthermore, AVE estimates for all the dimensions were above 0.50, indicating reasonably adequate convergent validity (Hair *et al.*, 1998).

Table 4: Measurement model: factor loadings, reliability and validity

Latent variable	Indicators	Construct reliability and validity				
		Factor loadings	Convergent validity (t-value)	Cronbach's alpha	Composite reliability (CR)[b]	Average variance extracted (AVE)[c]
Ease of use	EASE1	0.908[a]	---			
	EASE2	0.848***	15.688			
	EASE3	0.879***	14.718	0.916	0.910	0.672
	EASE4	0.876***	16.899			
	FORM3	0.625***	9.514			
Service quality	SQUAL1	0.561[a]	---			
	SQUAL2	0.513***	7.120			
	SQUAL3	0.910***	8.176	0.878	0.875	0.672
	SQUAL4	0.887***	7.503			
	SQUAL5	0.909***	8.143			
Usefulness	UTIL1	0.880[a]	---			
	UTIL2	0.722***	11.564			
	UTIL3	0.860***	15.202	0.907	0.912	0.723
	UTIL4	0.905***	16.596			
Reliability	RELIA1	0.825[a]	---			
	RELIA2	0.843***	13.433			
	RELIA3	0.774***	11.857	0.906	0.911	0.721
	RELIA4	0.926***	15.054			
Completeness	COMP1	0.863[a]	---			
	COMP2	0.848***	13.902	0.878	0.876	0.701
	COMP3	0.817***	13.182			

*** Significance level: p<0.001

[a] Loadings are specified as fixed to make the model identified.

[b] $CR = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum Var(\varepsilon_i)]$, where λ_i is the standardized factor loadings for the indicators for a particular latent variable i, $Var(\varepsilon_i)$ is the indicator error variances (Fornell & Larcker, 1981).

[c] $AVE = \sum \lambda_i^2 / [\sum \lambda_i^2 + \sum Var(\varepsilon_i)]$

Finally, the discriminant validity of the measurement model was evaluated. Following the suggestion of Fornell and Larcker (1981), a comparison between the square root of the AVE for each construct and the correlations between constructs in the model was done. In Table 5, the diagonal elements represent the square roots of the AVEs. Off-diagonal elements are the correlations among constructs. As shown in the table, the square root of an AVE of each construct is greater than the correlations between the construct and all other constructs, indicating satisfactory levels of discriminant validity. We found that all the items are proper measures of the corresponding constructs.

Table 5: Factor correlations and discriminant validity for the measurement model

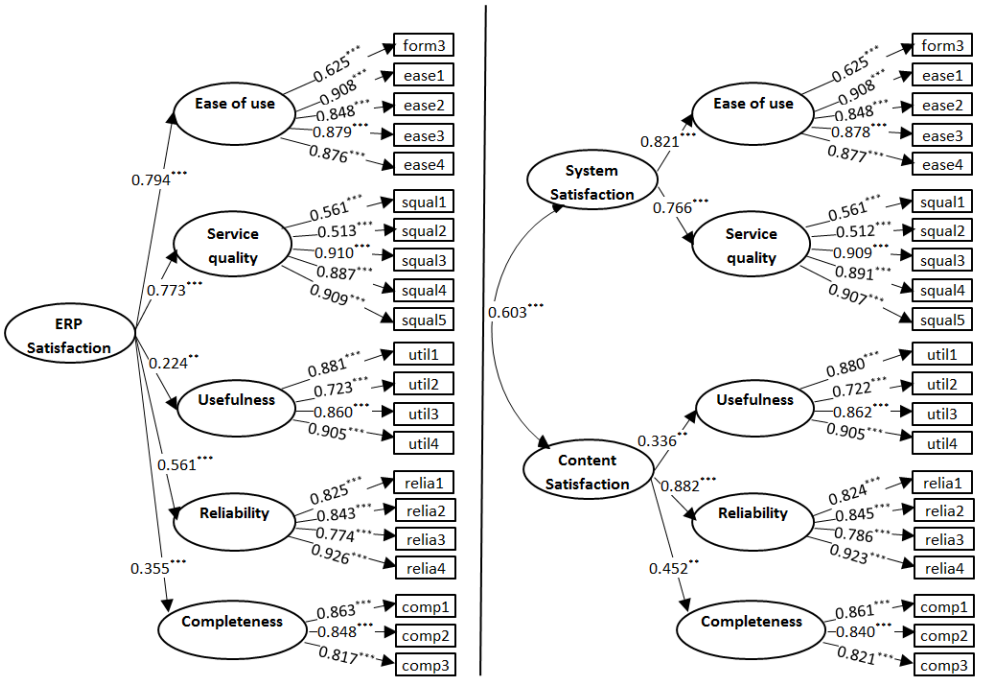
Construct	Ease of use	Service quality	Usefulness	Reliability	Completeness
Ease of use	0.820				
Service quality	0.612	0.772			
Usefulness	0.214	0.139	0.850		
Reliability	0.466	0.410	0.239	0.849	
Completeness	0.401	0.219	0.508	0.405	0.837

Note: diagonals represent square roots of the average variance extracted from observed variables (items); off-diagonals are correlations between constructs

Table 6 shows the fit indices for the measurement model of ERP satisfaction. The Chi-Square value is the traditional measure for evaluating overall model fit and assessing the magnitude of discrepancy between the sample and fitted covariance matrix. However, due to the restrictiveness of the Model Chi-Square and its sensitivity to sample size, researchers have suggested alternative indices to assess model fit. The goodness-of-fit indices recommended by Bentler & Bonett (1980), Jöreskog & Sörbom (1984), Hair et al. (1998) and Segars & Grover (1993) were used: the normed chi-square (χ^2/d.f), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Normalized Fit Index (NFI) and Comparative Fit index (CFI). As indicated in Table 6, the measurement model of ERP satisfaction as a global construct (Fig. 2) displayed a reasonable model fit to the data (χ^2/d.f = 1.280, GFI = 0.893, AGFI = 0.855, RMSEA= 0.040, NFI = 0.925, and CFI = 0.982).

Table 6: Fit Indices for the measurement model and the respecified measurement model

Fit indices	Recommended Value	Measurement Model	Respecified measurement model
Chi-square/degrees of freedom (χ^2/d.f)	≤3.0	1.280	1.207
Goodness-of-Fit Index (GFI)	≥0.90	0.893	0.902
Adjusted Goodness-of-Fit Index (AGFI)	≥0.80	0.855	0.866
Root Mean Square Error of Approximation (RMSEA)	≤0.08	0.040	0.035
Normalized Fit Index (NFI)	≥0.90	0.925	0.929
Comparative Fit index (CFI)	≥0.90	0.982	0.987



Model 1. ERP satisfaction evaluation as a global construct

Model 2. ERP satisfaction evaluation as a dual construct

Figure 2: Confirmatory Factor Analysis results – Global and dual models of satisfaction

5.3 Model respecification

To enhance model fit, researchers frequently tend to change relationships between constructs or indicators in their original model (Chou & Hong, 2013). However, to be done, respecification of paths should be theoretically justified (Anderson & Gerbing, 1988; Shook *et al.*, 2004). This investigation uses theory-based respecification to justify changes in our research model. Indeed, some previous studies have approached the concept of satisfaction in a "dual" manner, distinguishing between satisfaction with intrinsic qualities of an application (system quality) and with its contents (information quality). McKinney *et al.* (2002) considered system quality and information quality as two facets of satisfaction with websites. This approach was also suggested by Doll & Torkzadeh (1988) and Etezadi-Amoli & Farhoomand (1996), even though it has not been directly used in their models. Deltour (2004) conducted an empirical study on 424 users of an intranet system in France to test the multidimensional structure of satisfaction. Results of the confirmatory factor analysis first validated dimensions of satisfaction as a global construct, and then the dual structure of user satisfaction towards an intranet showing the existence of two major aspects of satisfaction. The first aspect called "satisfaction toward content" includes dimensions of reliability, usefulness and completeness of content. The second aspect named satisfaction toward system involves dimensions of organization, design, technical qualities and ease of use of the intranet system (Deltour, 2005). More recently, Chou & Hong (2013) have modified their original ERP success model to confirm that user satisfaction is dependent on two major determinants of quality, which are "information and system quality" and "service quality" of the ERP system.

Based on the approach adopted by Deltour (2004) in the context of intranet, our purpose was to determine whether these dual aspects of satisfaction apply in the particular case of an ERP with respect to our empirical data. We have therefore proposed an alternative model to the global and unified approach to satisfaction. This verification is firstly performed by running a second Principal Component Analysis (PCA) with Promax rotation on the five extracted factors. The results in Table 7 show two major components of satisfaction. The first component regroups the dimensions "ease of use of the ERP system" and "service quality". On the whole, these two dimensions describe "system quality" of the ERP solution. The second component consists of the dimensions "reliability", "usefulness", and "completeness". A content analysis of this component leads us to name it "ERP informational content".

A Confirmatory Factor Analysis (CFA) is then used to validate this dual hypothetical structure of satisfaction and to test the hypothesis of its superiority on the global approach of satisfaction.

Table 7: Second order factor solution.

1st order factors	2nd order factor components	
	System quality	***Informational content***
Ease of use	0.836	
Service Quality	0.852	
Usefulness		0.851
Reliability		0.552
Completeness		0.812
Eigen value	2.344	1.082
Explained variance	46.872	21.637
Cumulative variance	46.872	68.509

A review of fit indices in Table 6 illustrates a good quality fit between the measurement model of ERP satisfaction as a dual construct (Fig. 2) and empirical data (χ^2/d.f = 1.207, GFI = 0.902, AGFI = 0.866, RMSEA= 0.035, NFI = 0.929, and CFI = 0.987). Furthermore, the correlation (ρ = 0.603) between the two components of satisfaction evaluating System quality and Informational content is significant and important (Fig. 2).

The comparison of indices obtained in the two models shows the superiority of the second model. Thus, in addition to having a fit that meets the thresholds of recommended acceptability, the second model possesses a higher degree of parsimony. Ultimately, the review of indices of two models revealed that the dual structure of satisfaction is stronger than a unified one.

The analysis of empirical data supports the idea that satisfaction can be conceptualized differently, depending on whether it relates to the attributes of the system or the information it produces. The intrinsic qualities of an application refer in particular to the absence of bugs, its ease of use and learning through such qualities as

user-friendly interface, easy to use features and the presentation quality of screens. The quality of information content concerns the reliability, relevance, accuracy, updating, and completeness of the information obtained.

6. Conclusion

Theoretical and methodological research on user satisfaction in IS has kept pace with IT development. A review of the literature on this multidimensional concept revealed the significant weight of cognitive and emotional dimensions of user attitude in the IS evaluation process and a lack of consensus that still exists today among researchers and practitioners on the significance of this construct (Au et al., 2002; Zviran & Erlish, 2003; Hou, 2012; Chou & Hong, 2013; Kanellou & Spathis, 2013; Nwankpa & Roumani, 2014). The literature review also stressed the predominance of the work of Bailey & Pearson (1983) and that of Doll & Torkzadeh (1988) as the fundamental basis for the construction of new measurement tools. The fundamental difference between these two streams of research, according to Livari (1997), is the object under evaluation. One assesses satisfaction with the IS function, while the other evaluates satisfaction vis-à-vis a particular IS application.

If Bailey & Pearson's (1983) instrument appears obviously inappropriate in today's IT context of decentralized enterprises deploying direct access multi-user applications, the EUCS instrument developed by Doll & Torkzadeh (1988) and the studies that have mobilized it in the specific context of ERP systems (Somers *et al.*, 2003; Zviran *et al.*, 2005; Law & Ngai, 2007; Wu & Wang, 2007; Hou, 2012; Kanellou & Spathis, 2013) are especially relevant and have been drawn on for a conceptual analysis of satisfaction. This analysis allows us to suggest a measure of six dimensions of satisfaction of which five are empirically validated. The results of an exploratory study helped adapt the measures and validate them in a technological and organizational context.
Enterprise systems are tools for breaking down organizational barriers and consolidating information systems in enterprises designed to improve the quality of information particularly in terms of reliability and accuracy and to ensure greater accessibility to data. An examination of the five dimensions of the EUCS instrument reveals its pertinence for evaluating the success of an ERP. Some users may perceive an ERP as a lever to enhance their efficiency by providing accurate and timely information. The lack of reliable or clear information can have disastrous consequences leading to forecasting demand errors, poor production planning, low visibility into order status causing non-compliance with delivery deadlines and quantities, and a false assessment of capacity acquisition.

Moreover, this research has helped to validate a model of satisfaction that distinguishes between two major components of satisfaction, namely satisfaction with technical attributes of the system and satisfaction with its content. The importance of this distinction lies in being able to identify more pragmatic elements that sustain user judgments of an ERP system and further refine the assessment of user satisfaction. By recognizing that a user can have different attitudes while considering the contents of the system or its technical characteristics, it is possible to act separately on these two elements to improve overall satisfaction.

The aim of the present study was to investigate the dimensions explaining ERP user satisfaction. Furthermore, this study tried to conceptualize satisfaction differently, by identifying two facets of satisfaction related to the technical attributes of the system and its content. Although satisfaction has been widely studied in IS, its scope remains limited to the attributes of the system and its information contents (DeLone & Mclean, 1992; McHaney et al., 2002; Khalifa & Liu, 2004; Deltour, 2004; Aljabri, 2015). The evaluation of satisfaction should also include the service quality of IS as an attribute (Kettinger & Lee, 1994; Pitt et al., 1995; DeLone & Mclean, 2003; Chou & Hong, 2013; Hsu et al., 2015). The instrument traditionally used (Ives et al., 1983) to measure satisfaction certainly includes this dimension disregarding all of the characteristics of the services that an IS function provides nowadays to its customers. It was also the subject of numerous critics related to its theoretical foundations as well as to its conceptualization (Au et al., 2002). These various limitations imply that the concept of satisfaction should be studied with care, and that the choice of dimensions must be dependent on the context of the study and the technology under evaluation.

This study is not without its own limitations, the first being that we used variables that have already been mobilized in previous models. While our study has involved rearranging previously identified variables, its interest lies in adapting them to the particular case of ERP systems that are characterized by their strong information content and high technological complexity. In this paper, we propose a respecification of the EUCS instrument developed by Doll & Torkzadeh (1988) and an adaptation/adjustment to the particular case of ERP in order to further refine the assessment of user satisfaction. In fact, no model in the literature clearly distinguishes between the content and the intrinsic characteristics of ERP systems. The real contribution of this

research lies in the examination of a model that clearly distinguishes these two concepts and that is adapted specifically to ERP systems. From a theoretical perspective, this dual structure of ERP user satisfaction confirms results of previous research conducted by Deltour (2004) in the context of intranet system. From a managerial perspective, this distinction can help IT managers and directors to choose the appropriate ERP to their organizations and to guarantee user's satisfaction and acceptance and in turn success of the system. Indeed, technical characteristics of the system, related to its format and content, constitute an important criterion of choice among others, and user participation in this phase of choice is also considered a key success factor. In that sense, it is essential to take into account these dimensions of user satisfaction from the onset of the project's preliminary stages. Managers should consider, on the one hand, the intrinsic attributes of the system such as user-friendly interface, easy to use features and presentation quality of the screen and, on the other hand, the quality of information content and its fit with the task supported.

A second limit of this research is related to the sample size and the voluntary nature of the sample. It is certainly appropriate to perform SEM using Amos with 174 observations. However, when the aim is to validate a measurement tool, such sample size could be insufficient. Moreover, non-probabilistic sampling method provides data that are not broadly representative of an entire population. Therefore, our findings should be considered with caution and we call for future studies to test the same instrument on different samples.

Moreover, the fact that the ERP systems addressed in this study are eventually under-utilized due to their lack of integration in all firms' subsidiaries and the reduced number of licenses available is reduced, has led us to address the issue of utilization. In fact, the evaluation of satisfaction towards a computer application requires that it be used. However, since these ERP systems seem to be relatively under-utilized in the firms studied, the evaluation of satisfaction should be approached with caution and supplemented by other methods of evaluation. The assessment of an ERP's success from an end-user perspective risks also confining itself if evaluated following a relatively limited understanding of success. Taking into account the point of view of ERP project managers and those of IT managers should contribute to enriching this assessment.

Finally, as a future research direction, several authors have presented and validated models for implementing and assessing on-premise ERP success from a user perspective, but there is little understanding of how today's cloud-based IT environment such as cloud ERP also called ERP on-demand or Software as a Service (SaaS) would affect these models. It should be noted that most Tunisian companies are still reticent to the adoption of cloud ERP due primarily to the lack of top management support, little confidence in provider service quality and data security concerns (Smaoui-Hachicha & Mezghani, 2018). Most researches published on cloud ERP systems are focused on factors facilitating their adoption in enterprises (Johansson & Ruivo, 2013; Seethamraju, 2015; Gupta et al., 2018). Evaluating success of cloud ERP is a new challenge for researchers and practitioners. From user perspective, future research is necessary to explore whether existing dimensions and metrics of user satisfaction toward on-premise ERP are still appropriate or should be reexamined/extended to capture specificities of this modern ERP context. We think that the distinction between system quality and content quality could be applied to evaluate user satisfaction toward cloud ERP systems, since dimensions like ease of use, service quality, perceived usefulness, reliability and completeness of content could be also determinants for effective use of this type of systems. Notwithstanding this, future studies should take into account the "service" dimension which is very important in Cloud Computing environment because of concerns including data security, network and system availability (Peng & Gala, 2014).

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