

Information System Performance and Evaluation: A Theoretical Review

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Abstract: *The need to evaluate the performance of Information Systems has arisen due to the significance of Information Technology in enhancing the productivity and efficiency of an organization's operations. This has resulted in a rapid increase in demands for better performance from Information System resources. The purpose of this theoretical study is to thoroughly examine the topic of companies adopting information systems and assessing their effectiveness. A spotlight is shone on the performance of these systems and how companies utilize technology. Our analysis leads us to propose the following central hypothesis: "The intention to use and user satisfaction contribute to information system performance".*

Keywords: Information system, Organizational and Individual use, Evaluation, Appropriation, Performance

I. INTRODUCTION

This paper focuses on studying the success factors of information system's performance. Our aim through this theoretical overview is to frame the question of information system evaluation.

Information Systems have a significant impact on both society and organizations, greatly affecting the performance of both managers and organizations on a global scale. Information Technology has revolutionized international trade and will continue to be a crucial and evolving aspect in the coming centuries. The driving forces behind this Information Systems revolution include electronic commerce, the exchange of electronic data, e-government, and advancements in telecommunications. Currently, nearly every sector of activity, including manufacturing, services, trade, and government, utilizes Information Systems.

Information Systems offer numerous benefits and advantages, including increased productivity, improved security, enhanced efficiency, heightened reliability, and cost savings in the long run.

In this paper, we investigate the key factors to measure information system performance in organizational settings from a theoretical perspective. Therefore, we highlight the different theoretical approaches to the acceptance and appropriation of information systems in companies and we shed light on the key dimensions that help determine the performance of an information systems. Our analysis leads us to identify the Delone and McLean model (2016) as a comprehensive framework to identify the successfulness factors to evaluate the performance of an information system.

II. Why do organizations implement and use information systems?

The concept of an information system is seen as a collection of subsystems that are interconnected throughout the organization in a network-like manner. It is a cross-functional division of the organization, often defined by its departments. The examination of a company's information systems involves analyzing the techniques used for information acquisition, storage, processing, and exchange for each subsystem. At every hierarchical level, there is a repeating pattern of decision-making, information management, and operation. Every information area within the

company must be linked to the central memory to either retrieve information or contribute new data gathered from the operational level. The information and the overall knowledge and memory of the company is organized into a increasingly specialized network as it moves towards its outer edges. Therefore, information, decision-making, and actions are interdependent and constantly influencing each other. The information system relies on actors, methods, procedures, and tools that are increasingly computer-based, although not exclusively. The information system can be seen as the system responsible for transmitting and processing information needed for management purposes.

III. Information systems' research: atheoretical framework

The theory of transaction costs as an explanatory framework

Ciborra (1981) was the first scholar to propose the use of Transaction Cost Theory (TCT) as a framework for understanding the design of computer information systems. He asserts that this theory brings together various concepts that have historically been utilized to analyze the impact of information and communication technologies (ICTs) on organizations and clarifies the transactional aspect of economic transactions. This encompasses the idea of rational behavior by organizational actors, the economic perspective on organizational structures such as teams and hierarchies, the concept of mediating technologies, and the utilization of ICTs to support markets, hierarchies, and teams. By emphasizing the transactional aspect of economic exchanges, TCT explores various organizational structures as alternative methods to tackle the problem of efficient resource allocation. Consequently, ICTs are viewed as a way to decrease transaction costs. Based on these ideas, Ciborra considers the design of information systems to be closely related to the design of an efficient economic system.

Ciborra (1993) puts forward a concept that adapts Williamson's (1985) analytical model on the optimization of task coordination in production through the joint effect of technology and organizational forms. The model compares different organizational structures and the impact of Information and Communication Technologies (ICT) on them, taking into account the combined influence of factors that contribute to transaction costs and the impact of ICT on these factors. According to Ciborra (1993), the impact of ICT on transaction costs should be analyzed not only quantitatively but also qualitatively, as ICT can bring about changes in organizational paradigms, such as from hierarchies to markets or from clans to hierarchies, that could have associated costs or benefits. Laudon K. C. and Laudon J. P. (2005) view ICT from an economic perspective as a factor of production that can replace capital or labor, with a tendency to substitute labor as the cost of ICT decreases.

The utilization of Information and Communication Technologies (ICT), particularly networks, can result in decreased participation costs in markets, making it attractive to engage with external entities such as suppliers, business partners, or distributors rather than relying on internal sources within the company or resorting to traditional methods.

The agency theory to explain the use and adoption of Information Systems:

Tirole (1986) and other scholars, such as Strausz (1997), Baliga (1999), and Faure-Grimaud et al. (2003), have expanded the traditional two-tier principal-agent model by incorporating a third tier, the supervisor, into their analysis framework. In this setup, the principal hires a supervisor to monitor and report the performance of an agent who has incomplete information about their own performance. However, research from both agency theory and sociology (Dalton, 1959; Cyert and March, 1963) suggests that this three-tier hierarchy can result in another information distortion, as the supervisor may collude with the agent and not reveal their true performance to the principal. For instance, a health inspector may make a prior phone call to a restaurant before conducting an inspection (Dalton, 1959), or an accounting auditor may fail to report accurate financial information to the board of directors and shareholders of a company (Baliga, 1999).

In this three-tier setup, the agent may offer a bribe to the supervisor to either provide false information about their performance or to withhold information from the principal. The bribe can take the form of monetary compensation (Gouldner, 1961; Tirole, 1986), or personal favors exchanged for hiding performance information (Tirole, 1986). Tirole's (1986) theoretical models and Faure-Grimaud et al. (2003) analyze the reasons behind the supervisor's motivation to falsify performance information and suggest a "proof-of-collusion contract" as a solution. In this contract, the principal offers sufficient compensation to the supervisor to deter them from colluding with the agent.

These models demonstrate that the motivation to distort information is dependent, among other things, on the supervisor's ability to accurately assess the agent's performance. The more accurate the performance evaluation, the greater the incentive for the supervisor to hide the true information, and therefore the greater the amount of bribes the agent can offer. The same logic applies to the proof-of-collusion contract, where the principal must offer higher salaries to the supervisor to ensure more comprehensive and accurate evaluations. If the supervisor is able to observe the agent's performance, their discovery is always accurate (Tirole, 1986). If they cannot observe the performance, they have no information about it. In cases of uncertain information (Faure-Grimaud et al., 2003), the supervisor's discovery may be inaccurate. However, with the use of digitized processes and integrated databases, which produce performance information, the supervisor is more likely to discover accurate performance information (Tirole, 1986), or to find more accurate performance information in cases of uncertain information (Faure-Grimaud et al., 2003).

The adoption of information systems under the lens of the Resource-Based Theory

The Resource-Based Theory of Management has been proposed by researchers as a solution to the contradictory relationship between Information Technology (IT) and productivity (Humphreys et al., 2014; Davis et al., 1996). This theory is centered on the inimitability, non-substitutability, and rarity of resources, which are critical to a company's sustained competitive advantage. Grant (1991) recognized three types of resources as capabilities: human resources, intangible resources, and tangible resources. In the IT literature, tangible resources are defined as human resources and IT infrastructure, while intangible resources are defined as IT skills (such as customer orientation, knowledge richness, and synergy) and technical and managerial skills in Information Technology (Bharadwaj, 2000).

According to research by Crook et al. (2008) that analyzed 125 studies, simply acquiring information technology infrastructure and implementing IT plans does not guarantee an improvement in performance. A high level of performance is dependent on various specific factors related to resource management and avoiding potential misuse.

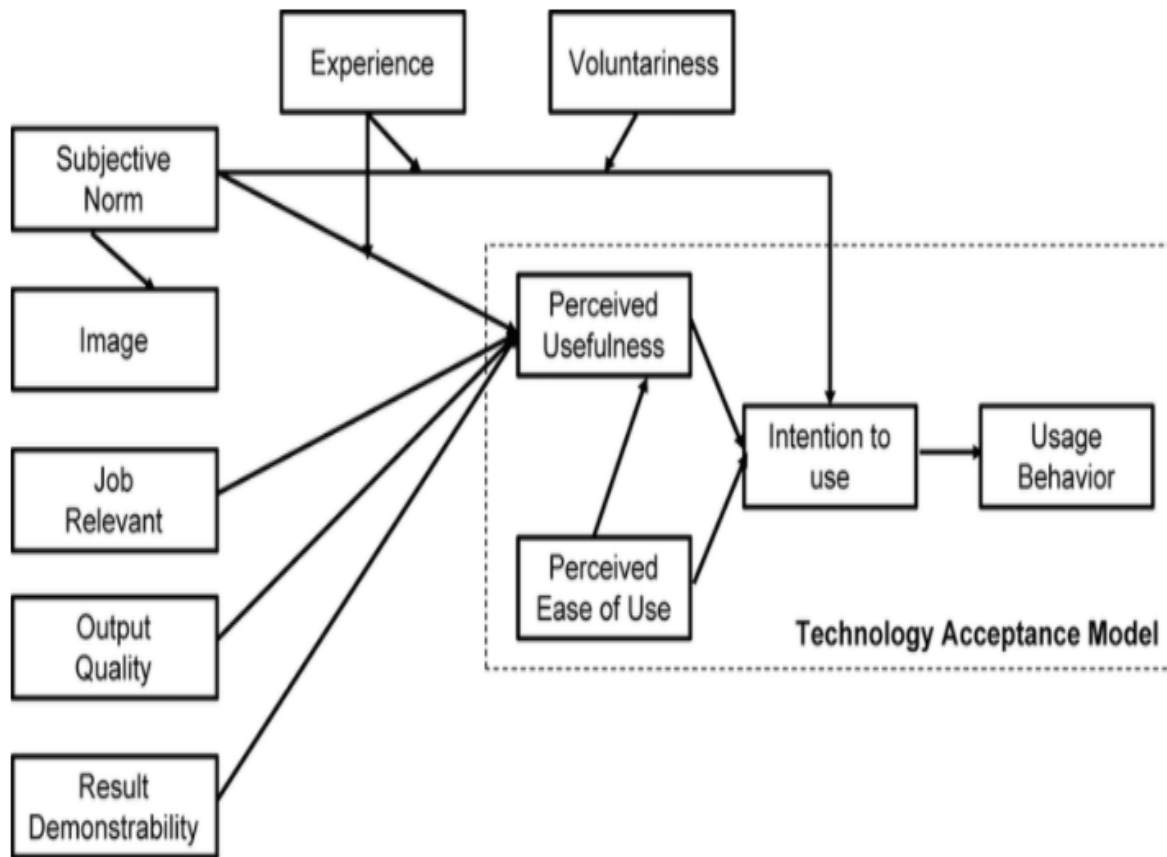
Several studies have proposed that the knowledge of an information system and the related skills, including ICT, make up the information technology capacities, which can be categorized into three categories: technology, business, and behavioral. Lee et al. (1995) stated that the knowledge of an information system and the skills associated with it consist of five elements: technological advancement, managerial aptitude, business operations, interpersonal connections, and management. Another study by Feeny and Willcocks (1998) identified nine capabilities of an IS operation, while Heijden (2000) only recognized three of these capabilities that integrate the IT department with other organizational structures. These three areas encompass information/IT governance, which serves as the administrative link between the IT management and business management. Moreover, previous research highlights that certain organizational factors have a significant impact on the choice of IT governance mode (Yudatama et al., 2017). IT governance is a crucial concept for information systems and can answer many of the important questions being asked by experts in the field today (Aourik&Bouaziz, 2020).

IV. The Unified Theory of Acceptance and Use of Technology (UTAUT)

In recent decades, the design, development, and adoption of Information Technologies have garnered substantial interest from researchers. Numerous theoretical models have been proposed to explain user acceptance behavior, with the most recent being the unified theory of acceptance and use of technology (UTAUT) by Venkatesh et al. (2003). This theory has been applied and tested empirically in various domains and has been found to be more robust than the technology acceptance model in predicting technology acceptance (Venkatesh et al., 2003). Since its introduction, several empirical studies have been conducted using the UTAUT.

The evolving of the Technology Acceptance Model (TAM)

The Technology Acceptance Model, developed by Davis (1989) based on the theory of reasoned action, aims to identify the factors that drive individuals to accept or reject information technology. According to Davis, the two most significant beliefs of individuals regarding the use of information technology are perceived usefulness and perceived ease of use. Perceived usefulness is defined as the extent to which a person believes that using a particular system would improve their job performance (Davis, 1989, p.320), while perceived ease of use is defined as the extent to which a person believes that using a system would require no effort (Davis, 1989, p.320). These two behavioral beliefs then influence an individual's intentional behavior and actual behavior. Davis argues that perceived usefulness is the best predictor of an individual's intention to use or not use information technology.

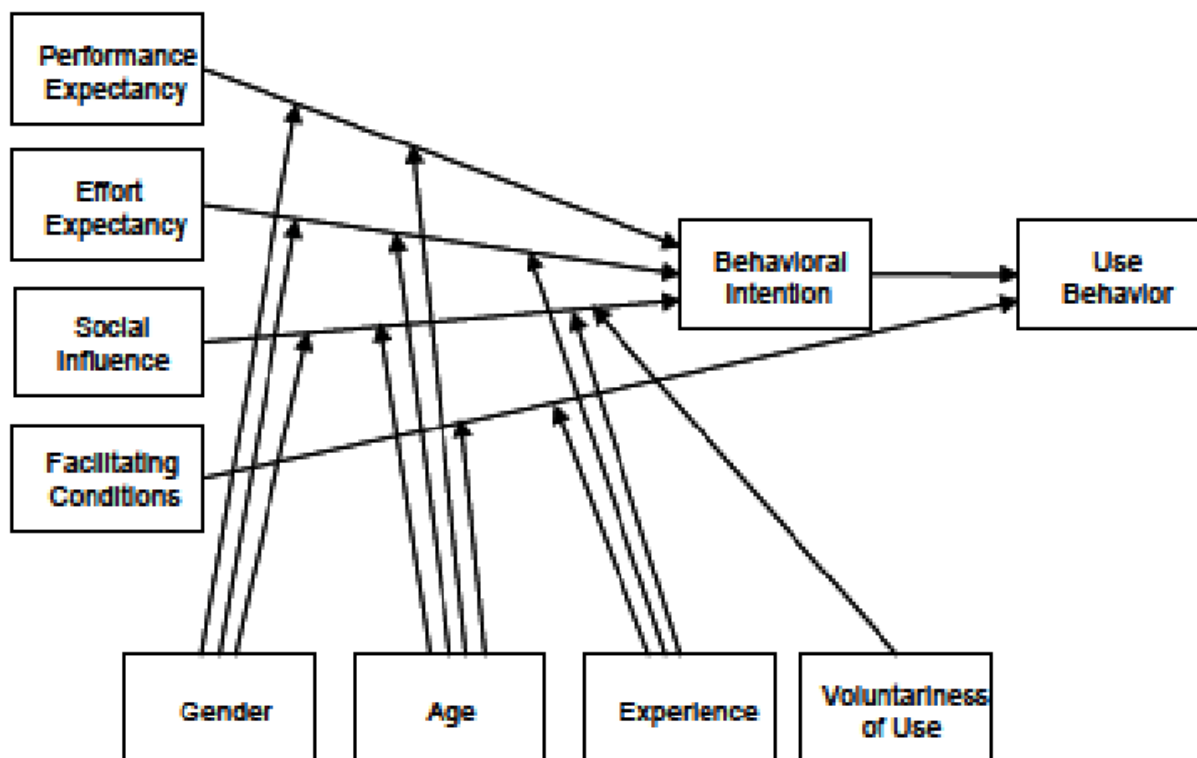


The Technology Acceptance Model, developed (TAM) (Venkatesh & Davis, 2000)

According to the Technology Acceptance Model, there are four cognitive factors that impact perceived usefulness: job relevance, output quality, result demonstrability, and perceived ease of use. The model posits that perceived ease of use has a direct impact on perceived usefulness (Venkatesh and Davis, 2000, p 191). Additionally, the model suggests that output quality positively impacts perceived usefulness, and that result demonstrability also has a positive impact on perceived usefulness.

Unified Theory of Acceptance and Use of Technology (The UTAUT)

UTAUT (Unified Theory of Acceptance and Use of Technology) is a unified model proposed by Venkatesh et al. (2003) that integrates eight different research models on information technology acceptance based on social cognitive theory. According to UTAUT, the three main factors that influence an individual's intention to use information technology are perceived performance, effort expectancy, and social influence. Venkatesh et al. (2003) also found that the impact of facilitating conditions, defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support system use (p. 453), depends on the individual's age and experience.



Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003)

While some research has indicated that the four predictive factors outlined in the UTAUT theory predict the intention and behavior of technology usage, the results of other studies do not support these hypotheses. For example, in a study on the use of online community weblog systems, Li and Kishore (2006) found that the degrees of performance expectancy, effort expectancy, social impact, and facilitating conditions had a consistent effect on real scores, but only across some subcategories. The authors therefore warned of the need to interpret the UTAUT theory with caution. In a structured conceptual model, Tibenderana and Ogao (2008) concluded that performance expectancy and social impact are not factors that significantly contribute to predicting the intention to use electronic library services at universities in Uganda. In a separate study on the acceptance of an interface robot and on-screen agent by elderly users, performance expectancy, effort expectancy, and social impact were found to be unimportant in predicting intention (Heerink, Kroese, Wielinga, and Evers, 2009).

V. Technology Appropriation Theory (TAT)

Theories on the dynamics of adoption (by Vaujany et al., 2003, 2005) provide an excellent framework for understanding how businesses adopt ICTs. Vaujany has focused on the adoption of management tools in the context of technology. In this discussion, we mainly focus on his reinterpretation of Ciborra's work on the use and integration of information and communication technologies in businesses, particularly his contributions in this area. Based on the concepts of improvisation and bricolage, Ciborra was able to challenge the strategic alignment model of Henderson and Venkatraman (1993), which bases the strategic value of an information system on the quality of its alignment with three variables.

- The information systems strategy,
- The general strategy of the company,
- The organizational infrastructure.

With the aim of promoting the actual creation of value, De Vaujany (2009) reinterprets Ciborra's (1994) key suggestions based on this consideration¹ :

¹Cited by De Vaujany (2009).

Table 1: framing the notions of improvisation and Bricolage /tinkering/DIY byCiborra (1994)

Ciborra's recommendations (1994)	Interpretation of De Vaujany(2009)
«Value bricolage strategically»	Bricolage/tinkering should not be devalued and systematically denigrated by management
« Design tinkering»	We must create organizational arrangements that promote tinkering
«Establishsystematicserendipity»	The boundary between design and use processes must be as blurred as possible
«Thrive or gradualbreakthrough»	All kinds of breakthroughs and innovations can be envisaged in the organization
«Practiceunskilledlearning»	A person can practice and develop learning in areas for which his initial legitimacy (through his degrees, titles, status in the organization) is weak.
«Strive for failure»	Failure must be accepted by individuals as a learning path
«Achieve collaborative inimitability»	This is reminiscent of aspects of resource theory in strategy..

Source : (De Vaujany (2009), p.12)

In light of the concepts of bricolage and improvisation affecting the adoption of technology by businesses within the realm of information systems, De Vaujany (2009) put forward suggestions which are outlined in the following table. Drawing inspiration from Ciborra's guidelines, De Vaujany (2009) reinterpreted the uptake of management tools, including Information and Communication Technologies (ICTs), by enterprises. By doing so, he demonstrated how Ciborra's perspective of organizations as sites of bricolage and improvisation has influenced the understanding of the adoption of ICTs as management tools from a distinct viewpoint.

VI. Information system evaluation and information system performance:

The use of information systems has become increasingly prevalent and has been shown to provide numerous benefits, including improved operational efficiency, enhanced competitiveness, and increased customer satisfaction. However, it is important to evaluate the impact of these systems on various aspects of the business, such as financial performance, guest satisfaction, and employee morale, to ensure that they are providing the intended benefits. Overall, the literature suggests that information systems have a positive impact and will likely continue to play an important role in the future.

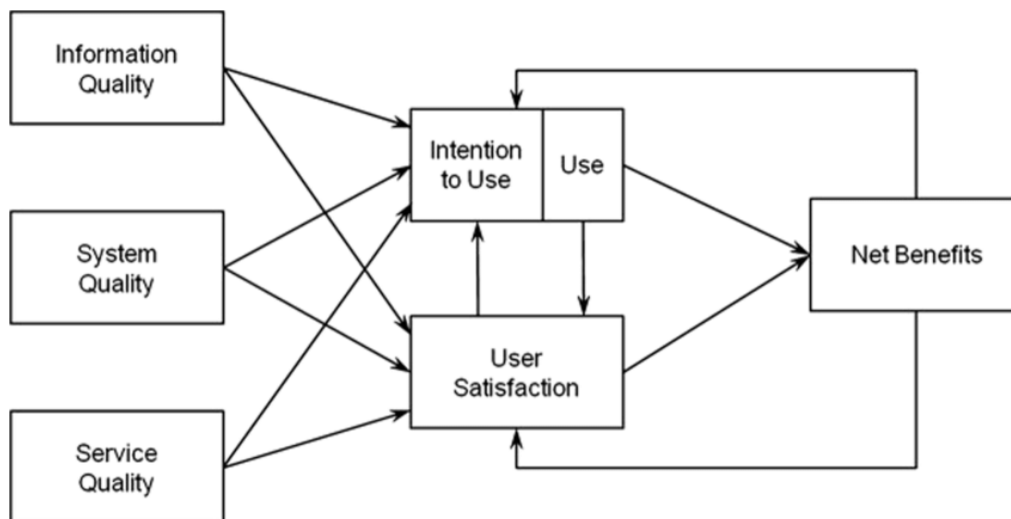
Evaluating the performance of an Information System (IS) within a company is an important aspect of ensuring its continued relevance, effectiveness, and success. The following are some of the key factors to consider when evaluating information systems in companies:

- User satisfaction: One of the most important metrics for evaluating the success of an IS is user satisfaction. User feedback can be collected through surveys, interviews, or focus groups to understand how well the IS is meeting the needs and expectations of its users.
- System availability and reliability: The IS should be available and functional when it is needed, with minimal downtime.

The Mclean et Delonemodel:

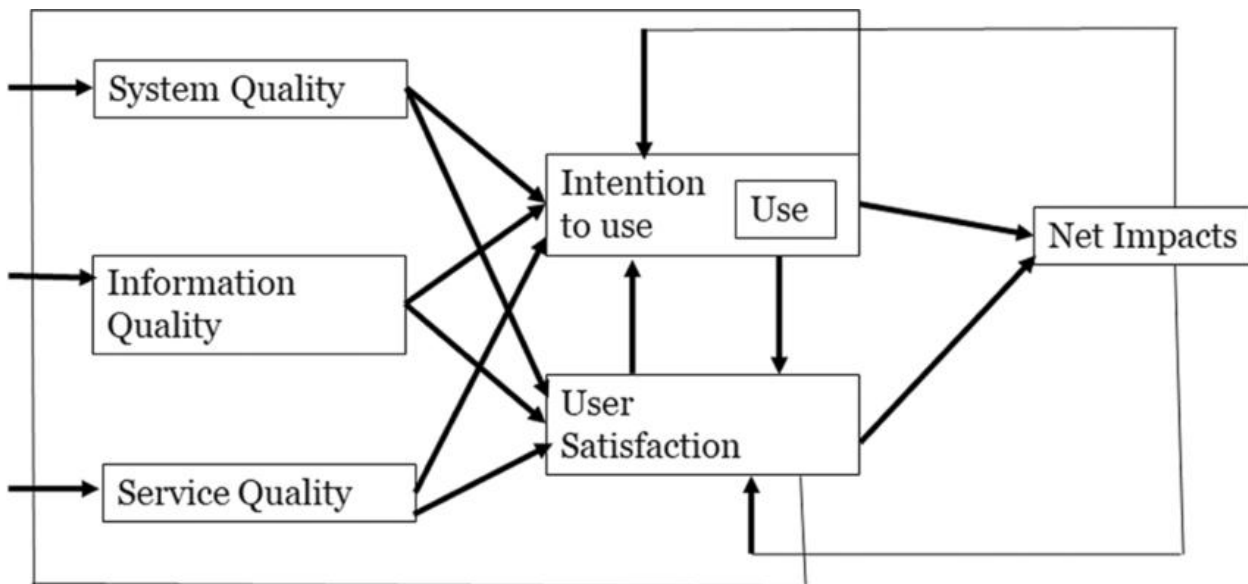
The attempts to define the success of information systems in the early stages were flawed because of the complex, interdependent, and multi-dimensional nature of IS success. To tackle this problem, William DeLone and Ephraim McLean conducted a review of research published during 1981 to 1990 and established a taxonomy of IS success based on Shannon and Weaver's communication theory from 1949. The authors characterized the technical level of a communication system as the accuracy and efficiency of the message-producing system, the semantic level as the system's ability to transmit the intended meaning, and the effectiveness level as the impact of the information on the recipient. By utilizing Mason's information system taxonomy, they identified six dimensions for measuring the success of an IS: system quality (technical level), information quality (semantic level), and use, user satisfaction, individual impact, and organizational impact (influence level).

DeLone and McLean created the D&M model based on these six success indicators. Despite being over ten years old, this model remains highly popular among researchers and has received more than 8,000 citations in published works, according to Google Scholar. Figure 6 displays the original IS success model introduced by DeLone and McLean in 1992. After considering the numerous advancements made in the field, the duo updated their measurement model for the success of information systems ten years after their initial publication (William H. Delone& Ephraim R. McLean, 2003).



Updated DeLone & McLean model (2003)

The 2003 update to the D&M model recognized the fact that information systems can have an impact beyond just individual and organizational levels. To better reflect the way that the success of an IS can affect work groups, industries, and even entire societies, D&M replaced the variables "Individual Impact" and "Organizational Impact" with "Net Benefits," which encompasses gains at multiple levels of analysis. This allowed the model to be applied to any level of analysis deemed most relevant by the researcher (Petter et al., 2008). Additionally, the authors suggest adding another dimension called "Service Quality," which relates to the quality of support provided to the system's users by the IT department and internal or external support staff. This includes factors such as responsiveness, accuracy, reliability, technical competence, and the empathy of support personnel.



Re-update of DeLone et McLean model (2016)

The DeLone and McLean model, updated in 2016, has been supported by studies. This model encompasses six categories of variables that likely contribute to the success of Information Systems (Figure 8): system quality, information quality, service quality, intention to use and actual use, user satisfaction, and the net impact of the IS. Empirical research has revealed numerous key implications for using this model in both academia and practice. It has also encouraged organizations to assess the quality of information, the quality of the system, the quality of service, system utilization, user satisfaction, and perceived net advantage in determining the success of their IS (Wang et al., 2008; Wu et al., 2006). The "Net Impacts" aspect was added in the latest version of the DeLone and McLean model, taking the place of two previous dimensions (organizational impact and personal impact). DeLone and McLean believe the most critical aspect in evaluating success for administrators, designers, and users is to quantify the final outcome of the IS deployment and usage. The "net impact" measurement evaluates the system's performance against its intended goals, making it the most context-specific, dependent, and diverse of the six success dimensions in the DeLone and McLean model. Hence, the D&M model remains the most comprehensive approach for evaluating the success and performance of an Information System, as demonstrated by this review of the literature.

CONCLUSION

Since 1992, the Delone and McLean Information System Success Evaluation Model (D&M) has been considered a benchmark in its discipline. The model is a taxonomy of IS success measures that is divided into six dimensions: system quality, information quality, service quality, use and intention to use, user satisfaction, and net impact. The original version of the D&M model has been extensively studied, validated, or rejected by a number of researchers who have provided critiques, expanded, or improved upon the model, leading the authors to release a second version in 2003 and a third version in 2016.

The D&M model, despite its criticisms and limitations, remains a highly powerful and commonly used model for measuring the success of information systems due to its strong theoretical base and ability to explain success from multiple technical, human, and organizational perspectives.

Based on this literature review, the central hypothesis is formulated.

The intention of use and user satisfaction contribute to information system performance

This continuous effort to improve the model by many researchers, including Delone and McLean, indicates that the model will remain relevant and useful for a long time to come, as they work to adapt it to the new demands and constraints posed by advancements in information technology and shifts in organizations' internal and external environments.

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