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ABSTRACT

Information technology (IT) continues to play an increasingly important role in today's businesses. As such, understanding IT and measuring its effect are imperative for the expansion and profitability of any business. This paper attempts to address the question - how to measure IT effectiveness - according to the CIO's perspective. In this research-in-progress, we provide a review of the pertaining literature, focusing on the definitions, the measurements, and the nomological networks of IT effectiveness. Our ultimate research goal is to learn the CIO's perspective on measuring IT effectiveness in their organizations, so that we can develop an improved model for the measurement of IT effectiveness. This improved model can help current and future IT managers and business executives improve their abilities to measure IT effectiveness in their organizations, enabling them to maximize the effectiveness of IT in aiding their respective organizations achieve their business objectives.

Keywords

IT effectiveness, measurement, CIO

INTRODUCTION

Information technology (IT) consists of all the hardware and software that an organization utilizes in order to achieve its objectives, reach its goals, and accomplish its missions (Laudon & Laudon, 2015). Businesses today are under increased pressure as a result of global competition, changing marketplace, amplified complexity, economic uncertainty, and efficient innovation. As a result, IT has become ubiquitous, and it has taken a prominent role within the business "as a means to achieve not only operational efficiencies, but increased firm productivity, and sustained competitive advantage" (Ness, 2005, p. 1). A recent Forrester study reports that 87% of US-based businesses admit that they cannot operate without IT (Shields & Nolan, 2013).

As businesses are spending tremendous amounts of money and other resources on IT, the following question frequently emerges: To what extent does an organization's IT affect its business? In other words, what is the effectiveness of IT in helping an organization achieve its business objectives? An InformationWeek article, titled "*CEO-to-CIO mandate: Quantify business value of IT*," states that "CIOs face relentless pressure from CEOs to prove, in financial terms, the business value of the IT team and the IT budget" (Evans, 2009, p. 8). In practice, effective management relies on effective measurement. One top-ranking maxim in the business world says, "If you can't measure it, you can't manage it." As such, it is critical that we continue to improve the ways that we use to measure IT effectiveness.

Assessing the effectiveness of IT has long been an important issue to IT executives; however, according to Huff et al. (2006), there is an IT attention deficit in the board of directors, and the CIOs have repeatedly requested boards to pay more attention to IT-related issues, especially IT effectiveness. While there exist metrics and instruments to assess specific IT sub-functions and specific IT subareas, the results generated with these metrics and instruments typically cannot be aggregated in any meaningful way. This limits their usefulness as the basis for identifying the sources of improving the overall business effectiveness. All businesses are measuring their IT effectiveness. In practice, however, each is doing it differently. For instance, Ness (2005) measured IT effectiveness with three dimensions: overall quality of service, users' satisfaction with IT, and helpfulness of IT staff to users. Some use standard financial and technical measures; while others use cost reduction, customer service-level agreement attainment, fiscal responsibility, security, and project excellence (see data samples in Appendix A).

The objectives of this research are to shed light on the following two research questions: (1) How do businesses measure their IT effectiveness? (2) What are the most widely used metrics for IT effectiveness?

For several years, each issue of the magazine *InformationWeek* (the world's most trusted community for business technology professionals) contains a column of CIO Values or CIO Profiles. On that page, each CIO has to write a paragraph or two on "How I measure IT effectiveness" in his or her organization. To address the two research questions described above, we plan to collect the CIO's perspective on how to measure IT effectiveness from all the relevant issues of the magazine *InformationWeek*. We will then analyze these perspectives, either manually or using some text mining software such as NVivo (a piece of powerful software for qualitative data analysis), and ultimately develop an improved model for the measurement of IT effectiveness.

Our research goal is to learn the CIO's perspective on measuring IT effectiveness in their organizations. Based on this knowledge, what we hope to accomplish is to develop a tool (i.e., an improved model for the measurement of IT effectiveness), that will help current and future IT managers and business executives improve their abilities to measure IT effectiveness in their organizations, enabling them to maximize the effectiveness of IT in aiding their respective organizations achieve their business objectives.

We believe that such a model will have important implications to both knowledge and practice. It will help both IT managers and business executives better understand the concept of IT effectiveness as well as the best practices of measuring IT effectiveness. Ultimately, by providing a more effective tool to work with, we hope this research will make the CIO a more effective manager, and make the IT department a more effective department. This, in turn, will facilitate organizations to achieve their objectives, reach their goals, and accomplish their missions.

The paper proceeds as follows. In the next section, we review the literature, focusing on the definitions, the measurements, and the nomological networks of IT effectiveness. After that, we describe our research design and method. [When the paper is completed, the following two sections will be added to the paper.] We then present our research results. Finally, we conclude our paper with a discussion of implications of our findings and future research directions.

LITERATURE REVIEW

Definitions of IT Effectiveness

IT effectiveness is also known as "IS effectiveness" or "IS success" in the US, and "IT evaluation" or "IS evaluation" in the UK (Seddon et al., 2002). It has been defined in many different ways, each with distinct focuses and dimensions. In prior studies, the effectiveness of IT has been considered at both the operational level and the strategic level (Bradley et al., 2012). At the operational level, the impact of IT has been classified as operational IT effectiveness, which has a focus on the improvement of business operations (Avison et al., 2004). At the strategic level, the strategic impact of IT has been referred to as enterprise agility, which is defined as "an organization's ability, as enabled by IT, to sense environmental changes and respond readily" (Bradley et al., 2012, p. 103).

Kurien et al. (2004) define IT effectiveness as "a measure of how well an IT organization develops the right technology components of business solutions for its customers" (p. 29). They have identified five key elements of IT effectiveness, including IT blueprint, IT measurement framework, core IT, active business case, and rigorous change management. Specifically, they maintain that there are four key areas which collectively deliver IT solutions and operations to a business. The four areas are organizational effectiveness, delivery effectiveness, applications effectiveness, and infrastructure effectiveness. They also suggest that these four areas should be balanced and optimized among them.

By incorporating the work of Tallon et al. (2000), Chebrolu and Ness (2013) define IT effectiveness as "how well IT delivers products and services based on the needs and the requirements of the business" (p. 2). Avison et al. (2004) maintain that operational IT effectiveness focuses on the improvement of business operations. Bradley et al. (2012) regard IT effectiveness as "the impact of use," and they continue to explain that "[use] is not the use of IT itself... but the impact or success of that use on or within the organization" (p. 102).

After analyzing all the available definitions of IT effectiveness (see Table 1), we define IT effectiveness as "a measure of how well an IT organization delivers products and services to improve business operations and enterprise agility, based on the needs and the requirements of the business, its internal users, and its core customers."

Definition of IT Effectiveness	Source
"How well IT delivers products and services based on the needs or requirements of the business."	Chebrolu & Ness, 2013, p. 2 (by incorporating the work of Tallon et al. 2000)
"The impact of use...it is not the use of IT itself... but the impact or success of that use on or within the organization."	Bradley et al., 2012, p. 102

"Operational IT effectiveness focuses on the improvement of business operations."	Avison et al., 2004
"A measure of how well an IT organization develops the right technology components of business solutions for its customers."	Kurien et al., 2004, p. 29

Table 1. Definitions of IT Effectiveness

Measurements of IT Effectiveness

Determining the effect of IT is imperative for the expansion and profitability of any business. Measuring IT effectiveness, however, is a fairly difficult task to accomplish since IT departments enable the functionality of other departments in the organization by correlating interrelated tasks. IT effectiveness within an organization improves the efficiency of both organizational needs and personal productivity. The increased efficiency from the IT systems can have a favorable impact on an organization's effectiveness. Furthermore, measuring the effectiveness of IT used to be about the availability of infrastructure components, but is now about the reliability of business services and the end user experience. There are numerous measurements available for IT effectiveness, as shown in Table 2.

Measurement of IT Effectiveness	Source
Information quality, systems quality, service quality, intention to use & use, user satisfaction, and net benefits	DeLone & McLean, 2003
User-satisfaction	Remenyi & Money, 1991
Systems performance, information effectiveness, and service performance	Chang & King, 2005
Overall quality of service, user's satisfaction with IT, and helpfulness of IT staff to users	Chebrolu & Ness, 2013; Ness, 2005; Tallon et al., 2000
Governance, project delivery, support and maintenance, availability, and innovation	Shields & Nolan, 2013
Overall IT portfolio, individual projects and applications, and IT function	Seddon et al., 2002
Improved effectiveness, improved communications, improved decision making, improved organizational responsiveness, and information systems as a whole	Gupta et al., 2007

Table 2. Measurements of IT Effectiveness

In the updated DeLone & McLean IS Success Model, the following six interrelated dimensions are used to reflect IS success: information quality, systems quality, service quality, intention to use and use, user satisfaction, and net benefits (DeLone & McLean, 2003). Numerous studies have only used one or two of the six dimensions to measure IT effectiveness. For instance, Remenyi and Money (1991) used user-satisfaction, which is based on the gap between users' beliefs of what is important and their perceptions of what is delivered by the IS department, as a surrogate for IT effectiveness. In a research study by Chang and King (2005), IS effectiveness is measured by systems performance, information effectiveness, and service performance. All three studies, Chebrolu and Ness (2013), Ness (2005), and Tallon et al. (2000), used three elements to measure IT effectiveness: overall quality of service, user's satisfaction with IT, and helpfulness of IT staff to users.

Organizations must measure the effectiveness of IT by looking at data related to the performance of information systems being used within an organization. This deals with performance of IT for users within the organization. According to Shields and Nolan (2013), IT effectiveness is based on the perceived value surrounding five key components of IT delivery. These components include governance, project delivery, support and maintenance, availability, and innovation. Increased strategic alignment of these five components could lead to exponential returns on IT investments or corporate performance. In order to be a truly IT effective organization, customer expectations must be taken into consideration.

IT evaluation can be done by evaluating the overall IT portfolio, evaluating the individual projects and applications, and evaluating the IT function (Seddon et al., 2002). According to Gupta et al. (2007), IT effectiveness is influenced by the following five factors: top management, IT management, user satisfaction, organizational culture, and IT use. In their research, IT effectiveness is measured by improved effectiveness, improved communications, improved decision making, improved organizational responsiveness, and improved information systems as a whole.

Nomological Networks of IT Effectiveness

Organizations have continuously been driven to streamline IT across departments. This allows for improved data sharing, enhanced security, and superior transparency. The ultimate goal of achieving a high degree of IT effectiveness is to contribute

positively to the profitability of business by enhancing functionality in business operations. This particular approach improves IT across departments in an organization, enabling a high level of performance by considering IT effectiveness of individual units instead of general applicability of IT.

Numerous research studies have examined IT effectiveness in its nomological networks. Some use it as an independent construct/variable, some use it as a dependent construct/variable, while others use it as a mediating construct/variable. One of the most important aspects that deal with the effectiveness of IT is enterprise architecture. Enterprise architecture is "a well-defined practice for conducting enterprise analysis, design, planning, and implementation, using a holistic approach at all times, for the successful development and execution of strategy. Enterprise architecture applies architecture principles and practices to guide organizations through the business, information, process, and technology changes necessary to execute their strategies" ("Enterprise Architecture," n.d., para. 1). Enterprise architecture focuses primarily on process standardization and data transparency. As process standardization and data transparency increase, so does IT effectiveness.

In their research on the business value of IT, which we think is part of IT effectiveness, Tallon et al. (2000) maintain that IT business value is reflected by boosting the performance in the following six business areas: process planning and support, supplier relations, production and operations, product and service enhancement, sales and marketing support, and customer relations. They found that management practices such as strategic alignment and IT investment evaluation contribute to higher perceived value of IT business value.

Bradley et al. (2012) found that enterprise architecture maturity directly influences IT effectiveness for achieving strategic goals. They also found that an increase in operational IT effectiveness leads to an increase in enterprise agility. At the individual level, IT impacts a person's work process (productivity, innovation, customer satisfaction, and management control) and decision-making process (intelligence, design, selection, and implementation) (Antonelli et al., 2013). The research results of Ness (2005) indicate that both strategic alignment and IT flexibility positively influence IT effectiveness, and that IT flexibility has a stronger relationship with IT effectiveness in comparison to strategic alignment.

Aligning business and IT strategies is critical if a firm wants to be competitive and successful. Avison et al. (2004) found that strategic alignment positively influences IT effectiveness, which in turn increases the margin of business profitability. Lu and Ramamurthy (2011) studied the link between IT capability and organizational agility. They conceptualized and measured IT capability in three dimensions: IT infrastructure capability, IT business spanning capability, and IT proactive stance. They also conceptualized two types of organizational agility: market capitalizing agility and operational agility. Their findings suggested that more IT spending to enhance and foster IT capability leads to greater organizational agility. In a study of IT impact on organizational flexibility, Batra (2006) found that IT has an impact on all three types of organizational flexibility: operational flexibility, structural flexibility, and strategic flexibility. The combination of these three types of flexibility (i.e., the overall organizational flexibility) impacts organizational performance, which in turn improves the organizational effectiveness.

IT effectiveness is also related to how the CIO is perceived according to his or her analytical, leadership, and managerial skills inside an organization. According to Earl and Feeny (1994), the CIO's ability is determined by whether IT is viewed as an asset or a liability, and how it adds value to the organization. Strategic management of technological assets within a company is critical for IT effectiveness (Ness, 2005) and for leveraging IT towards sustained competitive advantage (Broadbent & Weill, 1993). Ingevaldson (2006) found that implementing a system of audits after an IT project has been implemented helps show the effect that IT systems have on the end-user.

In summary, as shown in Figure 1, the following constructs/variables positively influence IT effectiveness: enterprise architecture, business/IT strategic alignment, IT investment evaluation, enterprise architecture maturity, IT flexibility, IT spending, and strategic management of technological assets. Also as shown in Figure 1, the following constructs/variables are positively influenced by IT effectiveness: enterprise agility, individual's work process and decision-making process, organization agility, organizational flexibility, and sustained competitive advantage.
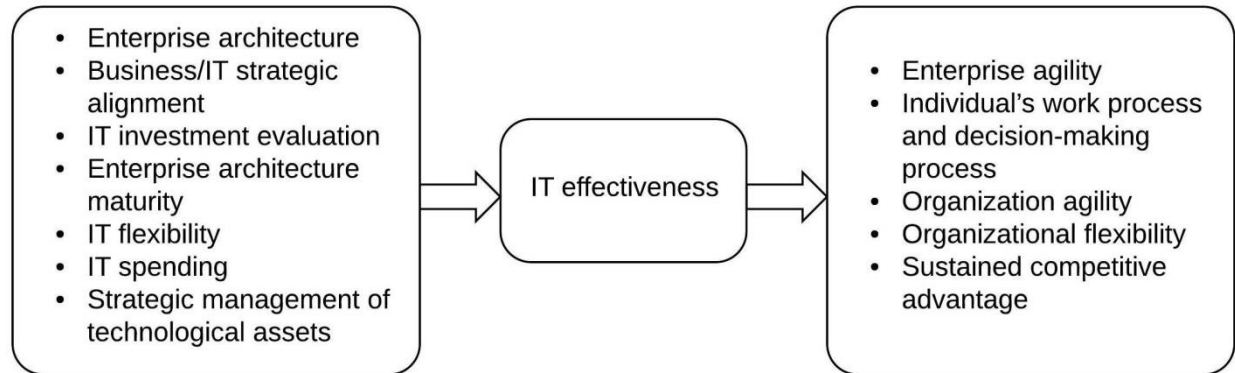
Figure 1. Nomological Networks of IT Effectiveness

RESEARCH DESIGN AND METHOD

The CIO's perspective on how to measure IT effectiveness will be collected from the magazine *InformationWeek*. As mentioned in the Introduction section, for several years, each issue of the magazine *InformationWeek* contains a column of CIO Values or CIO Profiles. On that page, each CIO has to write a paragraph or two on "How I measure IT effectiveness" in his or her organization (see data samples in Appendix A).

We have collected 59 CIO Values and 109 CIO Profiles from the magazine *InformationWeek*. We plan to analyze these perspectives, either manually or using some text mining software such as NVivo (a piece of powerful software for qualitative data analysis). We will ultimately develop an improved model for the measurement of IT effectiveness.

We believe that by the time for the 2016 SAIS Annual Conference, we should have completed the research and be ready to present our newly developed model for the measurement of IT effectiveness.

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APPENDIX A: DATA SAMPLES

Issue	CIO Name	Organization	How I Measure IT Effectiveness
September 15, 2008	Avid Modjtabai	Wells Fargo	We have the standard financial and technical measures, but also try to manage perception. We instituted an internal partner survey to get feedback, which is critical to help us drive alignment with the business we support.
August 3, 2009	Bob Sarnechi	Phoenix Children's Hospital	We use standard defined hospital metrics, such as customer satisfaction, performance against budget, etc. Another true effectiveness measure that's less tangible (yet equally important) is the delivery of technology in a way that helps our patients and the people who care for them. Our metric for this is the response from individual physicians.
May 3, 2010	David R. Guzmán	Acxiom	Cost reduction - expense as a percentage of revenue by line of business; Customer service-level agreement attainment; Fiscal responsibility - consistently beat budget; Security - external and internal vulnerabilities reduced, independent audit confirmation; Project excellence - on time, within budget, goals achieved.
February 14, 2011	Ajay Waghray	Verizon Wireless	Both return on investment and a superior customer experience are paramount. To ensure that we're delivering real value, we stay focused on how our work affects our customers, our employees, and our shareholders.
March 12, 2012	Tim Theriault	Walgreens	Walgreens measures company goals and divisional goals annually. This past year, the IT department also implemented a customer satisfaction survey measuring IT effectiveness as a primary goal. We use a series of metrics to measure effectiveness. They focus on human resources, hardware and software utilization, and operating effectiveness. For example, our average hourly cost for app development and maintenance has been reduced by 37% in the past two years.