Journal of Electronic Commerce in Organizations
Volume 15 • Issue 2 • April-June 2017

Framing ERP Success from an Information Systems Failure Perspective:
A Measurement Endeavor

Pierluigi Zerbino, University of Pisa, Department of Energy, Systems, Territory, and Construction Engineering, Pisa, Italy
Davide Aloini, University of Pisa, Department of Energy, Systems, Territory, and Construction Engineering, Pisa, Italy
Riccardo Dulmin, University of Pisa, Department of Energy, Systems, Territory, and Construction Engineering, Pisa, Italy
Valeria Mininno, University of Pisa, Department of Energy, Systems, Territory, and Construction Engineering, Pisa, Italy

ABSTRACT

To the best of our knowledge, extant definitions of Enterprise Resource Planning (ERP) success are not comprehensive, and they do not address all of the most relevant dimensions of this complex issue. Consequently, current ERP success models may lead to deceptive evaluations. Through a rigorous logical shift starting from IS failure, and diverging from classical project management approaches, this paper attempts to define ERP success by means of four factors: Process, Correspondence, Interaction, and Expectation. Results formally integrates the literature gaps and enable the future definition of appropriate measurement items that could steer management practices towards a sounder approach to ERP success.

KEYWORDS

Conceptual Model, Enterprise Resource Planning, Failure, Information Systems, IS, Measurement, Success

INTRODUCTION

To our best knowledge, empirical and theoretical ERP literature lacks a formal, shared, and comprehensive definition of success. In order to cope with this shortage, ERP success has often been defined and measured by means of proxies like User Satisfaction (i.e. Law & Ngai, 2007; Wu & Wang, 2006). In other cases (i.e. Bento & Costa, 2013; Ifinedo, 2006; Zhang, Lee, Huang, Zhang, & Huang, 2005), ERP success models do not consider all the typical dimensions (technological, organizational, project) as a whole, different points in time (i.e. Häkkinen & Hilmola, 2008), and / or pertinent stakeholders. Empirically, ERP success has often been measured through the achievement of some benefits (i.e. Panorama Consulting Solutions 2014). Nevertheless, such an approach is misleading because it focuses on the outcomes of an ERP implementation and not upstream, on what ERP success is. Kronbichler, Ostermann, and Staudinger (2010) found that some of the most important measurement models of ERP success "might be limited in scope and do not suit for every practical case". In fact, ERP success models have often been borrowed, partially or totally, from the context of Information Systems (ISs) without an adequate contextualization. Such a contextualization

DOI: 10.4018/JECO.2017040103

is mandatory due to several ERP systems peculiarities, detailed and classified by Markus and Tanis (2000). A direct merger of existing approaches to ERP success could fill up some of the single gaps above, but it would result in an ineffective and too much broad solution.

From a theoretical perspective, we aim to provide a sound, comprehensive, and compact definition of ERP success that could overcome these gaps. We want to handle this definition to steer the construction of an ERP success framework. From a practitioners' perspective, the ERP success framework could increase the control of on-going and future implementations by enhancing management capabilities in driving them to success. Then, the multidimensionality of success must be addressed through controllable and integrated measures. The ERP success framework could explain what variables define success and what mechanisms perform its achievement. In addition, the integration of the framework with determinants and impacts of ERP success may delimit better what could be an input for success and what success could likely imply.

In this paper, we develop a definition of ERP success and the corresponding construct within an ERP systems success architecture. The structure of this work is: theoretical background and justification for the work; objectives and methodology; literature review; definition and modeling of the ERP success within the broader ERP success architecture; discussion of the resulting ERP success construct; conclusions and future implications.

THEORETICAL BACKGROUND

In this section, we provide an overview about ERP systems and their implementation project. Then, we review and discuss the concept of ERP success, eliciting the justification for this work.

ERP Systems

Enterprise Resource Planning (ERP) systems, also called Enterprise Systems (ESs), are ISs with a modular integrated architecture that supports business processes, by a seamless integration, drawing from a shared database. ERP systems perform and support business processes according to best practices that are implemented within each module. Then, even though small customizations can be selected among some default configurations, some firms deem such systems to be too rigid. On the other hand, the most widespread reasons companies state for implementing an ERP are to rationalize and to standardize their systems or to replace their legacy system, independently of the dimension of the firm (Mabert, Soni, & Venkataramanan, 2003). In fact, information and communication technologies (ICTs), like ERP, are a known enabling factor of Business Process Reengineering (BPR) (i.e. Attaran, 2004; Lee, Chu, & Tseng, 2011).

Typically, an IS implementation involves technological, organizational, and strategic elements but, in the ERP environment, traditional project management challenges are amplified: the implementation is more difficult, expensive, and failure prone (Markus, Tanis, & van Fenema, 2000). The increased complexity is due to some peculiarities of the ERP systems, deepened and gathered by Markus and Tanis (2000) in five categories:

- **Financial Costs and Risks:** ERP implementations require high costs to perform the necessary technological and business changes. On average, the failure rate is so high that "nonacademic studies have questioned the financial and business payoffs from enterprise system projects";
- **Technical Issues:** Enterprise modeling; software configuration tools and techniques; reference models; integration strategies; system and software architectures; data migration; management of legacy systems;
- **Managerial Issues:** Business process management; additional project management efforts; change management; human resources management; implications on business model; transversal impact on the organization; management of different involved parties;

- **IT Adoption / Use / Impacts:** How ERP systems have large potential impacts at all the levels (individual, work system, organizational, interorganizational); "[…] how extensively they are used within the organizations, how faithfully they are used, and how effectively they are used";
- **Integration:** The extent to which ERP systems are bound up in restructuring organizations; integration with external actors in a long-term IT development; internal integration on information and system level.

ERP Implementation Project

Most implementations are late, over budget, and they often fail to meet the business case or to achieve promised benefits. In order to readdress the ERP path towards success, literature has investigated different implementation models that typically split implementations into phases and suggest a methodology to structure and manage each stage.

Table 1 is a critical discussion of some of the most relevant ERP implementations models in literature. For each model (see Figures 1-4), we analyzed, we highlighted the relationship between the progressive development of the implementation and the meaning of success in each stage.

ERP Success

Success in ISs is a multidimensional concept and its complexity increases in the ERP environment due to the aforementioned features and issues. Usual project management hurdles and challenges become tougher and a general approach to IS implementation may not be appropriate. Given such a challenging context, Markus and Tanis (2000) recommended to assess the success of ERP implementations on different dimensions (financial, technical, and human) in different points of the project lifecycle through a set of balanced metrics that should include, at least: project metrics; early operational metrics (shakedown); longer-term business results (onward / upward).

Markus, Axline, Petrie, & Tanis (2000) gathered data, results, problems, and outcomes of ERP implementations from 16 ERP-adopting organizations, finding that the adopting companies differed in the definition of success. They noticed that some companies achieved an early success but resulted in a failure on subsequent measures. They also found early failure that turned into later success. Moreover, due to different reasons, several companies were unable to say if they have achieved business benefits in the onward and upward phase.

Table 2 depicts further ERP success evidences in literature, according to the three main logics of analysis by which scientific literature approaches ERP success.

EVIDENCE FROM THE LITERATURE

According to our literature review, we found out some points of weakness in extant analysis of ERP success:

- Often, there is a substantial overlap between what ERP success is and what a successful implementation could imply, and this leads to ambiguous and misleading evaluations. In our opinion, the ERP success dimensions should unravel and measure how the transition to success may occur. Consequences and outcomes of an ERP implementation, that we label as ERP impacts, are an aftermath of such transition and, then, they are an indirect and imprecise measure of success. The information they could witness is not sufficient to shed light on ERP success, which still remains a black box. For example, US is sometimes considered as an ERP success dimension (i.e. Gable, Sedera, & Chan, 2003; Moalagh & Ravasan, 2013) but this may be a flawed approach. Adequate US (ERP positive impact) could be caused by using an ERP that did not change at all the previous way of working, but this may happen due to generally undesirable decisions that could undermine ERP success, i.e. too many customizations or absence of BPR.

Table 1. Literature review about ERP implementation models

Reference	Phases of the Model	Discussion
Markus and Tanis (2000)	See Figure 1	Building upon a previous work by Soh and Markus (1995), Markus and Tanis structured the Enterprise System Experience Cycle (ESEC) in four phases (Figure 1). We took it into account as, in all probability, it is the most spread ERP implementation model. The authors developed the whole work by defining enterprise system success as "a multidimensional concept, a dynamic concept, and a relative one (to the concept of "optimal success", representing the best an organization can hope to achieve with enterprise systems)" (p. 184). For each phase, they also suggested activities, common problems or errors, possible outcomes, conditions and recipe for success. The chartering phase encompasses all the decisions that lead up to the funding of the ERP system, for instance: ERP package selection; identification of a project manager; approval of budget and schedule. Success in this phase is the choice to proceed with the implementation, according to sound business case and decision making. The project phase includes all the activities needed for building the system up and running, ready for the go-live, for example: software installation and configuration; system integration; data conversion; training. Project success means to develop the system within reasonable time and schedule. In addition, the system should fit the business needs, and the firm should be prepared to accept it and to interact with it. The shakedown phase starts with the go-live, and it ends when the system comes back, hopefully, to normal operations. Main activities aim to fix all the causes that yield, or could yield, business disruption and / or decreased productivity. Success in this phase corresponds to a quick and effective return to normal operation within reasonable cost. Furthermore, the quality of the enterprise system should be sufficient to meet business needs. The onward / upward phase goes from the point in time in which normal operation is achieved again until the system is replaced with another one. In this last phase, the firm should be finally able to harvest the potential benefits obtainable through the implementation, if any. Success is achieved if the organization meets the expected benefits from use, if it improves its competitive position, and if it manages the system and the infrastructure well in order to maintain "technological and business flexibility for future developments".
Parr and Shanks (2000)	See Figure 2	The authors developed the Project Phase Model (PPM, Figure 2) that "is concerned with the concept of project 'success' [which…] simply means bringing the project in on time and on budget" (p. 291). We chose to analyze is because it is one of the first ERP-specific implementation model. The planning phase covers typical activities like: ERP package selection; definition of the scope and of the needed resources; implementation approach; all the decisions about the composition of the steering committee and of the project team. According to the aim of the PPM, the project phase is the most relevant to the authors. It consists in five sub-phases, which extend "from the identification of ERP modules through to installation and cut-over". The last phase, the enhancement, starts with the cut-over and includes system repair, extension, and transformation. Given the temporal length of such activities, it may last several years. According to the above description, the PPM mostly focuses on project success. Moreover, it does not distinguish the transient period of an ERP system from the subsequent potential steady state.

continued on following page

Table 1. Continued

Reference	Phases of the Model	Discussion
Rajagopal (2002)	See Figure 3	In order to develop a causal model to understand ERP implementations, the author applied the six-stages model by Kwon and Zmud (1987) to the ERP context (Figure 3). Through a case analysis in six manufacturing firms, he found that all the examined implementations followed the stage model. Then, we considered the work by Rajagopal as relevant because it is grounded upon a sound extant model and empirical evidences. Neither Rajagopal nor Kwon and Zmud directly analyzed the ERP success perspective. Yet, by combining the definition of the six stages provided by Cooper and Zmud (1990) with the elements that stem from the ERP case studies by Rajagopal (2002), we elicited specific success definitions as follows: • **Initiation:** To achieve the best match between the ERP system and its potential application within the firm. • **Adoption:** To ensure organizational support for the implementation in terms of commitment, resources, user involvement / participation, project championship. • **Adaptation:** The ERP system has to be developed, implemented, and ready for a full use in the organization. Fundamental activities involve BPR and user training. • **Acceptance:** Users utilize the system after having directly evaluated both its characteristics and the way it affects their performance. • **Routinization:** The ERP system is no longer perceived as something out of the usual work routine and it becomes part of the daily practice. • **Infusion:** Utilization of the ERP system enhances organizational effectiveness.
Marnewick and Labuschagne (2005)	See Figure 4	Starting from the 4P marketing model and adapting it according to relevant aspects of ERP implementations, the authors developed a conceptual model for ERP systems (Figure 4). Although it is not a detailed step-by-step approach to ERP implementations, we considered it relevant because it summarizes the most important phases of an ERP implementation in general and easy-to-understand terms. Marnewich and Labuschagne did not analyze the ERP success phenomenon within their methodology. Thus, we extrapolated it from the description they provided for each phase, and from how they logically built the model: • **Pre-Implementation:** Definition of sound scope and objectives related to the ERP implementation, and of the benefits expected from it. • **Analysis:** Definition of consistent and comprehensive functional and technical requirements through analysis of as-is business processes, organizational culture, and workforce skills. • **Design:** Definition of the to-be desired state on the basis of the previous phases. • **Construction:** Realization of the tangible to-be state trying to achieve the best match between the business process model and the information system. • **Implementation:** Final changes to business processes, policies, procedures, and system build for a smooth transition to the go-live. The go-live occurs when the ERP solution is used to perform all the processes as intended by the design phase. Results of the implementation phase must be measured against aims and goals of the pre-implementation phase (dashed line).

Figure 1. The ESEC (adapted from Markus & Tanis, 2000)

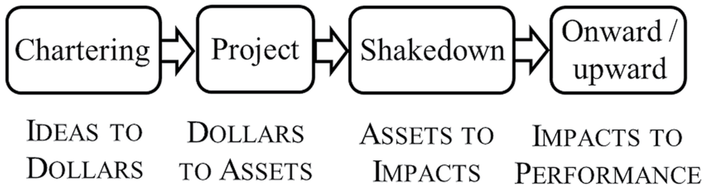


Figure 2. The PPM (adapted from Parr & Shanks, 2000)

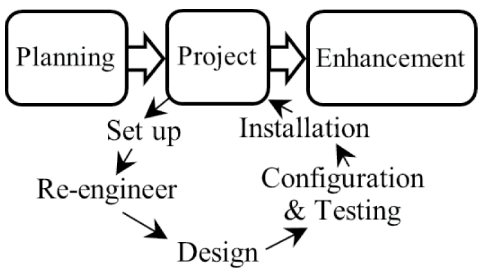


Figure 3. The ERP model (adapted from Rajagopal, 2000)

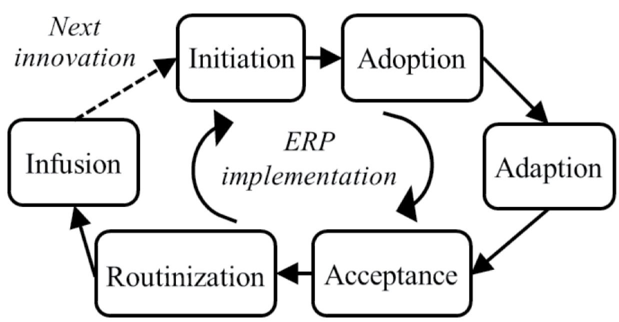


Figure 4. The ERP conceptual model (adapted from Marnewick & Labuschagne, 2005)

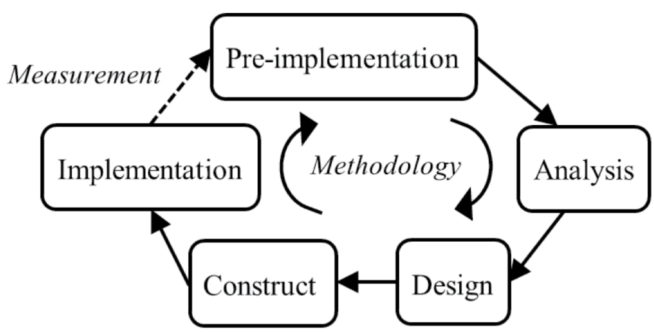


Table 2. Evidences from literature about ERP success

Logic of Analysis	References	Evidences
ERP success theories developed according to the phases of an ERP implementation	Markus and Tanis (2000)	Fully discussed in the body of the paper and in Table 1.
	Bento and Costa (2013)	They enriched the IS success model by D&M (2003) and contextualized it in the ERP environment. They developed four versions of the model, one for each phase of an ERP life cycle they suggested: selection / acquisition, implementation / use, stabilization, decline.
Empirical perceptions of ERP success according to different stakeholders and points in time	Larsen and Myers (1997)	They found that an ERP implementation could results in an early success and a later failure; they highlighted how the meaning of success can change if examined from different points of view or in different points in time.
	Markus, Axline, Petrie, and Tanis (2000)	Fully discussed in the body of the paper.
Explaining ERP success by means of proxies	Hong and Kim (2002)	They considered ERP success as the extent of the achievement of expected project goals, i.e. compliance with budget and scheduling, system performance targets, expected benefits. About 24% of the implementation success variance was explained by the organizational fit.
	Gable, Sedera, and Chan (2003, 2008)	Gable et al. (2003) found that ERP success might be a second order factor, measured by four first order factors: IQ, SQ, InI, and OI. Gable et al. (2003, 2008) questioned the utility of both U and US in explaining ERP success.
	Ifinedo (2006)	He extended the model by Gable et al. (2003) adding two further dimensions: Vendor / Consultant Quality and Workgroup Impact. He found that ERP success could be a third order factor.
	Chien andTsaur (2007)	They developed a partial extension and re-specification of the D&M's model in the ERP context. They tested the framework involving three high-tech firms in Taiwan. They found that the most relevant constructs in explaining ERP success are SQ, Service Quality (SrQ), and IQ.
	Law and Ngai (2007)	They measured ERP success through US. They found that ERP success and the extent of business process improvement (BPI) have a mutual influence and positive association with the organizational performance.
	Moalagh and Ravasan (2013)	They drew and tested a fuzzy approach considering the six dimensions by Ifinedo (2006). They found SQ and IQ as the most important dimensions in explaining ERP success, while OI ranked least.

ERP success is often measured even through individual or organizational impacts (i.e. Hong & Kim, 2002; Ifinedo, 2006) or by benefits from use (i.e. Chien & Tsaur, 2007). Actually, such factors are ERP impacts, which are subsequent to an ERP implementation. An implementation implies impacts, likely positive if the implementation has been a success: thus impacts, similarly to US, cannot be a dimension of ERP success but only a possible consequence;

- Frequently, the multidimensionality of ERP success is not challenged adequately. In fact, the assessment of ERP success through a snapshot from a single perspective is partial and little useful: in the best case, such an approach may only highlight a local sub-optimization. Most works we analyzed (Table 1 and Table 2) do not catch the whole complexity of the problem. For example, ERP success is often conceptualized as a trade-off: pleasing only some stakeholders (usually management and users); aiming to the best possible outcome in a specific point in time and not in an overall perspective (i.e. Parr & Shanks, 2000); simply ignoring relevant aspects of an ERP implementation (i.e. adequacy of business processes). Consequently, failure or partial success are the most frequent judgments about ERP implementations;

- Markus and Tanis (2000) classified the management of stakeholders like vendors, consultants, internal human resources, as a necessary condition for ERP success in the project phase. Instead, we believe that the stakeholders' management could be a success dimension and not a success factor, if adequately extended to the whole implementation and to each relevant stakeholder that has a legitimate interest towards the implementation. For instance, even expectations of a partner or a provider may be involved in the mechanisms that explain ERP success. In fact, Markus, Axline, Petrie, and Tanis (2000) included "success as viewed by ERP-adopting organization's customers, suppliers, and investors" as a dimension in their assessment of ERP success. They provided a matchless empirical overview about ERP adopters' experience on almost all the relevant aspects about ERP success, integrating the ERP success model by Markus and Tanis (2000). Nevertheless, literature still lacks an ERP success model that encompasses all the shortages we identified above, and that formalizes them within a thorough framework.

OBJECTIVES AND METHODOLOGY

This section consists of the formal definition of the objectives of this work, and the expected managerial contributions which should likely enabled by the achievement of the scientific goals. Coherently, we define the pertinent methodology.

Objectives

On the basis of gaps highlighted in the theoretical background, this research aims to three main objectives:

1. To determine a comprehensive, integrated, and sound definition of ERP success;
2. To formalize an ERP success framework;
3. To structure an ERP success construct within the framework.

"In general, companies that do not deliberately set out to achieve measurable business results do not obtain them (or do not realize that they have obtained them)" (Markus, Axline, Petrie, & Tanis, 2000, p. 259). We believe that this is true for ERP success too: if you do not set out a measurable success, you may not achieve it. Thus, practitioners need for a framework that should explain how ERP success is formed during time and that should measure ERP success according to the above objectives. Such measures of ERP success of on-going or completed implementations may enhance the control of future ERP projects, like rollouts, and may improve the occurrence of the possible impacts. Then, we set out four kinds of expected contributions the ERP success framework should enable: (a) to define when measuring what for evaluating ERP success; (b) to address ERP implementations toward success; (c) to allow objective comparisons among ERP implementations; (d) to exert a control function under a learning perspective, linking results to performed actions.

Methodology

According to the three main objectives, we followed a two-step methodology:

1. An in-depth literature review was performed in order to clarify boundaries and position of ERP Success within a determinants-impacts success architecture. Then, assumptions for developing both the ERP success definition and a raw basis of the construct were argued;
2. The ERP Success construct was refined according to the success chain's structure.

Literature Review

We started the literature review from the general concepts of IS success and failure. Since we already discussed the ERP success topic in the theoretical background, the review was integrated with a theoretical and empirical perspective on ERP failure. Most important evidences are in Table 3. Then, the analysis was briefly extended on the fit between processes and technology because it is a known relevant aspect within ERP implementations.

IS Success and Failure

IS success has been challenged in different ways by academics, in order to catch up its complexity and multidimensional nature. DeLone & McLean (henceforth D&M, 2003) analyzed criticisms and recommendations suggested in literature about their 1992's work and they proposed an update of their IS success model. D&M (2003) explained IS success through specific relationships among System Quality (SQ), Information Quality (IQ), Service Quality (SQ), Intention to use / Use, User Satisfaction (US) and Net Benefits. Respectively, these constructs describe quality on a technical and semantic level, attitude toward using the system / use (behavior) of the system, users' reaction to the use of IS output, net benefits from using the system. D&M applied a holistic approach to Net Benefits and Use (U): benefits should be identified for the various stakeholders through a multi-cause and multi-effect perspective; U includes frequency measures but further evaluations too, i.e. who uses the system, nature and appropriateness of use.

Table 3 shows further pertinent evidences from the literature.

IS failure has not been investigated as deeply as IS success. Lyytinen and Hirschheim (henceforth L&H, 1987) proposed the most complete and widespread empirical taxonomy of IS failure consisting in four major failure domains. (I) Process failure: the planned IS is not workable at all, often due to

Table 3. Evidences from literature about IS success and failure

Stream	References	Evidences
IS success	Raymond (1990)	He conceptualized IS success as a combination of US and online/offline system Usage; IS success is hypothesized as directly influenced by organizational context, on one side, and managerial and technical sophistication in implementing/using the IS, on the other side.
	D&M (1992)	They developed an IS success model on the basis of a comprehensive review of the IS success measures used in literature. Within the model, SQ and IQ affect Use (U) and US. U and US are linked by a mutual influence and they are direct antecedents of Individual Impact (InI). Finally, InI could yield some Organizational Impact (OI).
	Seddon (1997)	He questioned formalization of constructs and nature of relationships of the D&M (1992)'s model. So, he built up a re-specification and extension of the model, clarifying the role of IS Use and of IS benefits.
	D&M (2003)	Fully discussed in the body of the paper.
	Petter, DeLone, and McLean (2008)	They reviewed 180 papers about IS success for the period 1992-2007. They examined 90 empirical studies for verifying pairwise associations among the IS success constructs by D&M (2003), highlighting not univocal findings.
	DeLone (2009)	He evaluated the support of determinants of success on the IS success model by D&M (2003) through a literature review on 600 studies and a deep data analysis. He found a strong support for task-technology fit, user attitudes, user involvement.
IS failure	L&H (1987)	Fully discussed in the body of the paper.
	Sauer (1993)	He criticized the IS failure model by L&H (1987) due to its plurality. Differently, he argued that an IS results in a failure if a development termination occurs. An already operating IS turns into a failure if it does no longer attract commitment and resources.
	Flowers (1996)	He stated that an IS is a failure if at least one of the following conditions occurs: (I) the system does not perform as intended or there is a gap between the overall desired performance and the effective performance; (II) the IS is rejected or underutilized by the users due to its hostility; (III) development costs are higher than the benefits achievable with the system during its whole useful life; (IV) the IS development is prematurely abandoned due to the complexity of the system or problems in managing of the project.

problems in IS design, implementation, or configuration; or, more frequently, the system development process exceeds budget and / or time schedule; (II) correspondence failure: IS design objectives are not met; (III) interaction failure: users reject the system or do not use it as intended; (IV) expectation failure: the IS fails to meet requirements, expectations, or values of one or more of the stakeholders groups that are typically involved in IS development. Drawing upon this taxonomy, L&H (1987) built an IS failure framework consisting in sixteen IS failure classes that cover both the IS development and the IS use.

ERP Failure

As literature lacks models measuring the ERP failure, we addressed ERP failure through the analysis of implementations that have gone wrong (i.e. Barker & Frolick, 2003; Perepu & Gupta, 2008). Besides other relevant reasons, different ERP implementations failed mainly due to a low fit among system and business processes (CIO Magazine, 2004; Chen, Law, & Yang, 2009; Xue, Liang, Boulton, & Snyder, 2005) or reject of the system (Scott, 1999).

TECHNOLOGY ACCEPTANCE AND ORGANIZATIONAL FIT

ERP success and failure heavily depend on the organizational dimension. In fact, “it is often said that ERP implementation is about people, not processes or technology” (Bingi, Sharma, & Godla, 1999, p. 9). Thus, an ERP system can be rejected or underutilized by users whether or not it performs as hypothesized. For instance, people who do not have a positive attitude toward the ERP system will not likely use it; they could also hinder its use. In literature, perceptions that could shape the attitude toward using an IS have been addressed through the Technology Acceptance Model (Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 1996) and its evolutions (Venkatesh & Bala, 2008; Venkatesh & Davis, 2000). Despite the empirical importance of technology acceptance in ERP implementations, according to the literature we consider such perceptions as determinants of success and not as potential dimensions of success. Therefore, in this paper, their relevance is negligible.

Rejection, underutilization, or low performance of the ERP system may also be the result of a low fit between the package and the business processes of the adopting company: people could not be able to work and to perform tasks by means of the system. Such a scenario can undermine the whole implementation and could lead to severe business disruption. In order to optimize the organizational fit, performing a BPR is typical. A formalization of the organizational fit is the Task-Technology Fit (TTF) introduced by Goodhue and Thompson (1995) in their Technology-to-Performance Chain (TPC) model. The TPC model asserts that an IT could exert a positive impact on individual performance if: (I) the technology is utilized; and (II) the fit between technology and the tasks it supports is good. TTF describes the degree of correspondence among task requirements, individual characteristics, and the functionality of the technology that supports the specified tasks. The authors hypothesized TTF as a direct determinant of the individual performance impacts. They tested a simplified version of the model, finding a moderate support.

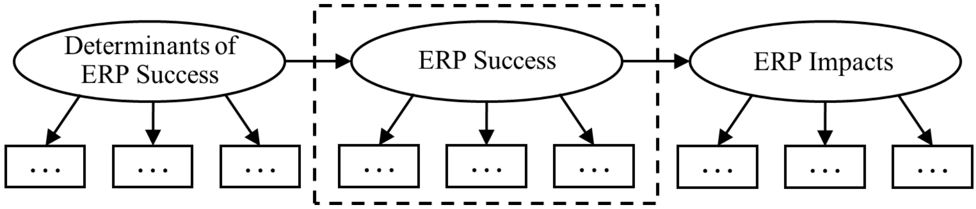
Defining and Modeling ERP Success

In this section, we present the structure of the ERP success chain that delimits the role of the success construct within the implementation process by pointing out three differences between the concepts of success and failure. Thus, in accordance with the premises, we argue two basic assumptions for modeling the ERP success construct.

Seeking for the Definition of ERP Success

According to the Structural Equation Modeling conventions (Ullman & Bentler, 2003), Figure 5 depicts the overall framework architecture.

Figure 5. Success chain of ERP systems



Determinants of ERP success gather critical success factors (CSFs). ERP success should explain how the transition to a positive judgment about the implementation occurs and how subsequent impacts may be generated in a holistic view. Its operationalization must measure the goodness of an on-going or a completed ERP implementation. ERP impacts define where, how, and how much an ERP implementation affects the adopting company, i.e. benefits from automation.

In general, ISs are not as pervasive and binding as an ERP system. Then, the implementation of a generic IS hardly results in a partially positive outcome. Instead, empirical evidences show that the coexistence of success and failure in the ERP context is quite frequent: ERP partial success is typical. Despite this, failure and success are not totally specular, even in the ERP environment. First, while it is possible to "reconstruct a systematic pattern of events that led to the failure" (L&H, 1987), this is not necessarily true for success. Second, CSFs and Critical Failure Factors (CFFs) are not always dual. For example, poor top management support is a well-known CFF in ERP implementations, but an excessive or unreasonable support can result in a dangerous escalation, i.e. FoxMeyer Drugs (Scott, 1999). Third, failure is more dynamic than success: it may propagate in a gradual domino effect (L&H, 1987), while success does not.

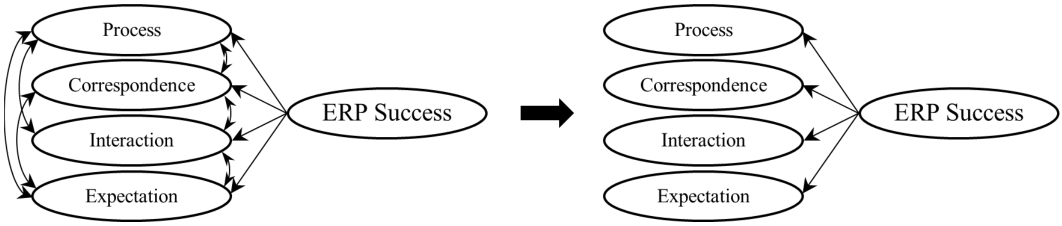
On this basis, we argue two basic assumptions:

1. The status of an ERP implementation is a combination of success and failure. Such a combination is dynamic because it changes continuously depending on the progress of the implementation. L&H (1987) pointed out that, in a continuous domain, the transition from IS failure to success is a gradual shift. Instead, in the ERP context an early success (failure) can result in a later failure (success): i.e. in a specific point in time, failure can overcome success but such a configuration could capsize afterwards. We conceptualize these dynamics as a fluctuation of the status of an on-going ERP implementation between two extremes: complete failure, which excludes any form of success; flawless success, an ideal and theoretical situation that excludes any failure;
2. The above dynamic behavior is defined by a set of dimensions operationalized by some variables. Then, these variables are able to describe both ERP success and ERP failure. Depending on the determinants in input, such variables behave and interact among them differently, realizing the dynamic combinations of success and failure.

L&H (1987) empirically built their IS failure taxonomy through the declension of four dimensions: Process, Correspondence, Interaction, and Expectation. A declension within the success environment is possible too; in fact, most existing ERP success dimensions fall into those categories, for instance: compliance with budget and / or scheduling (i.e. Hong & Kim, 2002) in the process dimension; SQ and IQ (i.e. Chien & Tsaur, 2007; Ifinedo, 2006) in the correspondence dimension; U (i.e. Bento & Costa, 2013) in the interaction dimension; success viewed by different stakeholders (i.e. Markus, Axline, Petrie, & Tanis, 2000) in the expectation dimension.

Then, in our opinion, an adequate declension of the four dimensions above is able to define ERP success too (Figure 6), but with some peculiarities respect to the failure environment. First, L&H recognized the existence of a strong correlation among the four failure notions, which justifies the

Figure 6. Raw basis of the ERP success construct



potential domino effect among them. For instance, if the ERP system does not comply with some explicit requirements (correspondence failure), it can be rejected because users cannot work as intended (interaction failure). However, empirical evidences show that this effect in success is not as probable as in failure, i.e. the ERP system can still be rejected due to interaction problems even if it complies with all the explicit requirements. Therefore, we set out the simplifying hypothesis of no correlation among the four dimensions (Figure 6). Second, the four dimensions do not have the same weight. Nevertheless, setting general weights can be misleading because they are context-specific, according to the differences among ERP implementations.

MODELING THE ERP SUCCESS ARCHITECTURE

According to Figure 6, we have contextualized each construct within the ERP success environment. The Process construct requires that: (I) there are not irresolvable problems in designing, implementing, or configuring the ERP system; (II) the ERP project does not exceed budget and / or time. The first requirement is typically challenged upstream through an adequate management of determinants of success (Figure 5). We have formalized the second requirement as a dichotomy: time and / or budget overrun does / does not occur. Within the project phase, delays and / or additional expenses could hinder compliance with time or budget. Often, success on project metrics is forced through inappropriate actions, like the cut of end-user training, implying negative effects downstream on measures concerning the shakedown phase. Then, project and shakedown metrics should be integrated, and not assessed independently from each other.

According to the Correspondence construct, system / design explicit objectives, requirements, and specifications have to be met. We have operationalized this construct according to SQ and IQ by D&M (2003). SQ represents the technical quality of the ERP system. IQ describes the characteristics of the system outputs. A comparison between measures of SQ and IQ on one side and system objectives / specifications on the other side provides the extent of the correspondence.

The Interaction construct requires that the ERP system is not rejected by its users. Hence, the system is used as intended and users' attitude toward it is positive. Such a positive attitude is explained through the technology acceptance, which can be managed upstream through the determinants of success (Figure 5). We have operationalized Interaction by means of TTF, Output Quality (OQ), and Use.

Finally, the Expectation construct requires that the ERP system meets requirements, expectations, or values of the stakeholders' groups. Expectations can refer to technical, political, economic, personal, or social dimensions (L&H, 1987) and they are often not verbalized or explicitly expressed / identified. Stakeholders are people interested in the implementation and that are not considered within other constructs. Then, a stakeholder is someone that has a legitimate interest in the ERP, even if s/he does not interact with the system either directly or indirectly: i.e. a shareholder, a provider, a partner, an operational manager, a project sponsor. The choice of relevant stakeholders is critical. It is function of the implementation scope and of characteristics of the adopting firm. The decision-making process may show that no other stakeholders are relevant besides direct users, management, and project team, which are considered within other constructs.

DISCUSSION

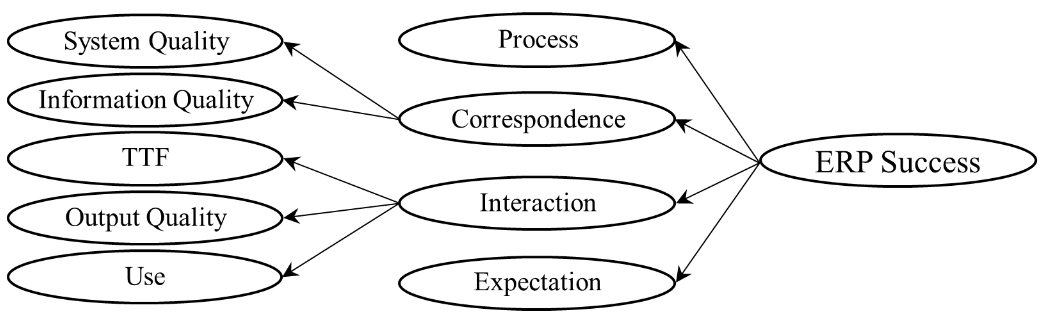
The ERP Success construct we propose (Figure 7) does not include US because we consider US as a possible ERP impact (Figure 5). However, the Interaction construct comprehends several drivers of US: if TTF is fine, if the user utilizes the ERP system adequately, and if s/he perceives a good OQ, then s/he could be satisfied. In addition, a user might be even more satisfied if s/he is aware about success on other dimensions, i.e. correspondence success and so on. We consider the probable achievement of benefits as part of ERP Impacts (Figure 5) and not of ERP Success because they are the most desirable consequence of a good management of the success mechanisms we have defined.

Instead, according to Smyth (2001) and unlike Hong & Kim (2002), we consider the organizational fit of ERP, that is the TTF, as a success dimension and not as a determinant. Empirically, BPR is linked to the dynamics of an ERP implementation so deeply that the organizational fit cannot be an enabling factor. TTF was formalized as the fit among characteristics of the tasks in their theoretical to-be version, characteristics of the ERP package – including its best practices –, and characteristics of individuals that will perform tasks by means of the system. An appropriate TTF measures a positive alignment among technological, process, and individual dimensions. We believe that a high value of TTF exerts an effect on some impacts, but only if utilization is objectively adequate and not at any given level of use. No benefits can be achieved if the system is not used and is not used appropriately, even if it does perform an acceptable organizational fit.

OQ is a user's judgment about the effective quality of the system. Thus, it differs from Perceived Output Quality by Davis (1985) and from Output Quality by Venkatesh and Davis (2000). Measures of OQ should be repeated in different points in time.

Use describes how (i.e. dependence from use; appropriateness and purpose of use) and how much users utilize the ERP system. Frequency of use is secondary because a low level of use can be used as a proxy for failure, but a high level of use does not measure success. Degree of use should be measured only to assess if it is high enough to deny underutilization. In our opinion, ERP systems are so tightly linked to business processes that a distinction between mandatory and voluntary use is not relevant: not using the system means to not perform business processes. Perceptions of constraints in using the ERP system could be overcome upstream through success determinants, i.e. organizational readiness or change management.

Figure 7. The ERP success construct



CONCLUSION

On a theoretical level, this paper meets the objectives we set out:

1. We define ERP success as success in the four following dimensions, contextualized within the ERP environment: process, correspondence, interaction, and expectation. This definition accurately delimits what ERP success is and is not; it combines an empirical and a theoretical approach; it dynamically considers all the most relevant dimensions of success in different points in time; it keeps into account ERP peculiarities; it gathers, integrates, and formally improves the extant definitions of ERP success;
2. The ERP success chain we have built shows a clear role of ERP success, distinguishing it from what causes it and from what it could imply;
3. ERP Success was depicted as a third order factor.

On a managerial level, these results enable the future expected benefits we have hypothesized: (a) once appropriate measurement items for each construct we propose will be defined, practitioners should be able to measure ERP success in a complete and holistic view, distinguishing the time frame of each measure; (b) the ERP Success construct defines a goal which each ERP implementation should tend to, focusing on what is ERP success and, consequently, potentially reducing the waste of resources; (c) the comprehensive nature of the framework could allow a complete comparison of punctual measures concerning different ERP implementations; (d) the integrated sets of measures may identify weak points and both local and global sub-optimizations of an ERP implementation. Linking the management of the determinants of success to the mechanisms that form success might reduce the variability of the ERP potential impacts: in a nutshell, it may enhance the results of an ERP implementation, especially in a roll-out perspective.

Even though this work is based on sound scientific premises, its theoretical nature is a limitation per se. Therefore, in order to refine and strengthen our findings, future research steps may be to: (I) validate the theory-building through a case study; (II) define and validate reliable measurement items for each construct; (III) empirically test and validate the framework.

REFERENCES

Attaran, M. (2004). Exploring the relationship between information technology and business process reengineering. *Information & Management*, *41*(5), 585–596. doi:10.1016/S0378-7206(03)00098-3

Barker, T., & Frolick, M. N. (2003). ERP Implementation Failure: A Case Study. *Information Systems Management*, *20*(4), 43–49. doi:10.1201/1078/43647.20.4.20030901/77292.7

Bento, F., & Costa, C. J. (2013). ERP measure success model; a new perspective. *Proceedings of the 2013 International Conference on Information Systems and Design of Communication ISDOC '13*. doi:10.1145/2503859.2503863

Bingi, P., Sharma, M. K., & Godla, J. K. (1999). Critical Issues Affecting an ERP Implementation. *Information Systems Management*, *16*(3), 7–14. doi:10.1201/1078/43197.16.3.19990601/31310.2

Chen, C., Law, C., & Yang, S. (2009). Managing ERP implementation failure: A project management perspective. *IEEE Transactions on Engineering Management*, *56*(1), 157–170. doi:10.1109/TEM.2008.2009802

Chien, S. W., & Tsaur, S. M. (2007). Investigating the success of ERP systems: Case studies in three Taiwanese high-tech industries. *Computers in Industry*, *58*(8-9), 783–793. doi:10.1016/j.compind.2007.02.001

Cooper, R. B., & Zmud, R. W. (1990). Information Technology Implementation Research: A Technological Diffusion Approach. *Management Science*, *36*(2), 123–139. doi:10.1287/mnsc.36.2.123

Davis, F. D. (1985). A Technology Acceptance Model for empirically testing new end-user information systems: theory and results. Unpublished doctoral dissertation, Sloan School of Management, Massachusetts Institute of Technology.

Davis, F. D., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003. Retrieved from doi:10.1287/mnsc.35.8.982

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*, *3*(1), 60–95. doi:10.1287/isre.3.1.60

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success : A Ten-Year Update. *Journal of Management Information Systems*, *19*(4), 9–30. doi:10.1073/pnas.0914199107

Gable, G. G., Sedera, D., & Chan, T. (2003). Enterprise systems success: a measurement model. *ICIS 2003 Proceedings*, 576–591. doi:10.1.1.95.2176

Gable, G. G., Sedera, D., & Chan, T. (2008). Re-conceptualizing information system success: The IS-impact measurement model. *Journal of the Association for Information Systems*, *9*(7), 377–408.

Goodhue, D. L., & Thompson, R. L. (1995). Task-Technology Fit and Individual Performance. *Management Information Systems Quarterly*, *19*(2), 213–236. doi:10.2307/249689

Häkkinen, L., & Hilmola, O. P. (2008). ERP evaluation during the shakedown phase: Lessons from an after-sales division. *Information Systems Journal*, *18*(1), 73–100. doi:10.1111/j.1365-2575.2007.00261.x

Hong, K. K., & Kim, Y. G. (2002). The critical success factors for ERP implementation: An organizational fit perspective. *Information & Management*, *40*(1), 25–40. doi:10.1016/S0378-7206(01)00134-3

Ifinedo, P. (2006). Extending the Gable et al. enterprise systems success measurement model: a preliminary study. *Journal of Information Technology Management, 17*(1), 14–33. Retrieved from http://www.hajarian.com/e_IT_Management/article22.pdf

Kronbichler, S., Ostermann, H., & Staudinger, R. (2010). a Comparison of Erp-Success Measurement Approaches. *JISTEM Journal of Information Systems and Technology Management*, *7*(2), 281–310. doi:10.4301/S1807-17752010000200003

Kwon, T. H., & Zmud, R. W. (1987). Unifying the fragmented models of information systems implementation. In *Critical issues in information systems research* (pp. 227–251). Retrieved from http://portal.acm.org/citation.cfm?id=54905.54915

Larsen, M., & Myers, M.D. (1997). BPR success or failure?: a business process reengineering project in the financial services industry. *ICIS1997 Proceedings of the Eighteenth International Conference on Information Systems*, 367–382.

Law, C. C. H., & Ngai, E. W. T. (2007). ERP systems adoption: An exploratory study of the organizational factors and impacts of ERP success. *Information & Management*, *44*(4), 418–432. doi:10.1016/j.im.2007.03.004

Lee, Y.-C., Chu, P.-Y., & Tseng, H.-L. (2011). Corporate performance of ICT-enabled business process re-engineering. *Industrial Management & Data Systems*, *111*(5), 735–754. doi:10.1108/02635571111137287

Lyytinen, K., & Hirschheim, R. (1987). Information systems failures - a survey and classification of the empirical literature. *Oxford Surveys in Information Technology*. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Information+Systems+Failures:+A+survey+and+Classification+of+the+Empirical+literature#0

Mabert, V. A., Soni, A., & Venkataramanan, M. A. (2003). The impact of organization size on enterprise resource planning (ERP) implementations in the US manufacturing sector. *Omega*, *31*(3), 235–246. doi:10.1016/S0305-0483(03)00022-7

Markus, M. L., Axline, S., Petrie, D., & Tanis, C. (2000). Learning from adopter's experiences with ERP: Problems encountered and success achieved. *Journal of Information Technology*, *15*(4), 245–265. doi:10.1080/02683960010008944

Markus, M. L., & Tanis, C. (2000). The Enterprise System Experience — From Adoption to Success. In *Framing the Domains of IT Management: Projecting the Future Through the Past* (pp. 173-207).

Markus, M. L., Tanis, C., & van Fenema, P. C. (2000). Enterprise resource planning: Multisite ERP implementations. *Communications of the ACM*, *43*(4), 42–46. doi:10.1145/332051.332068

Marnewick, C., & Labuschagne, L. (2005). A conceptual model for enterprise resource planning (ERP). *Information Management & Computer Security*, *13*(2), 144–155. doi:10.1108/09685220510589325

Moalagh, M., & Ravasan, A. Z. (2013). Developing a practical framework for assessing ERP post-implementation success using fuzzy analytic network process. *International Journal of Production Research*, *51*(4), 1236–1257. doi:10.1080/00207543.2012.698318

Parr, A., & Shanks, G. (2000). A model of ERP project implementation. *Journal of Information Technology*, *15*(4), 289–303. doi:10.1080/02683960010009051

Perepu, I., & Gupta, V. (2008). *Implementation Failure at Hershey Foods Corporation.*

Petter, S., DeLone, W., & McLean, E. (2008). Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems*, *17*(3), 236–263. doi:10.1057/ejis.2008.15

Rajagopal, P. (2002). An innovation - Diffusion view of implementation of enterprise resource planning (ERP) systems and development of a research model. *Information & Management*, *40*(2), 87–114. doi:10.1016/S0378-7206(01)00135-5

Raymond, L. (1990). Organizational Context and Information Systems Success: A Contingency Approach. *Journal of Management Information Systems*, *6*(4), 5–20. doi:10.1080/07421222.1990.11517869

Scott, J. E. (1999). The FoxMeyer Drugs' Bankruptcy: Was it a Failure of ERP? *Proceedings of the Americas Conference on Information Systems* (pp. 223–225).

Seddon, P. B. (1997). A Respecification and Extension of the DeLone and McLean Model of IS Success. *Information Systems Research*, *8*(3), 240–253. doi:10.1287/isre.8.3.240

Smyth, R. W. (2001). Challenges To Successful Erp Use. *Proceedings of the 9th European Conference on Information Systems* (pp. 1227–1231).

Soh, C., & Markus, M. L. (1995). How IT Creates Business Value: A Process Theory Synthesis. In *Proceedings of the 16th International Conference on Information Systems (ICIS '95)* (pp. 29–41).

Ullman, J. B., & Bentler, P. M. (2003). Structural equation modeling. In Handbook of psychology: Research methods in psychology (Vol. 2, pp. 607–634). doi:<ALIGNMENT.qj></ALIGNMENT>10.1002/0471264385.wei0224

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*, *39*(2), 273–315. doi:10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. (2000). Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. doi:10.1287/mnsc.46.2.186.11926

Venkatesh, V., & Davis, F. D. (1996). A Model of the Antecedents of Perceived Ease of Use: Development and Test. *Decision Sciences*, *27*(3), 451–481. doi:10.1111/j.1540-5915.1996.tb01822.x

Wu, J.-H., & Wang, Y.-M. (2006). Measuring ERP success: The ultimate users view. *International Journal of Operations & Production Management*, *26*(8), 882–903. doi:10.1108/01443570610678657

Xue, Y., Liang, H., Boulton, W. R., & Snyder, C. (2005). ERP implementation failures in China: Case studies with implications for ERP vendors. *International Journal of Production Economics*, *97*(3), 279–295. doi:10.1016/j.ijpe.2004.07.008

Zhang, Z., Lee, M. K. O., Huang, P., Zhang, L., & Huang, X. (2005). A framework of ERP systems implementation success in China: An empirical study. *International Journal of Production Economics*, *98*(1), 56–80. doi:10.1016/j.ijpe.2004.09.004