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A taxonomy of players and activities across the ERP project life cycle

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Abstract

An important problem in probabilistic description is to understand who are the key players, which activities associated with enterprise system implementations are important, and when their effect is most prevalent across the IT development stages. Using an information theory approach, we analyze the fit between their importance, as noted in the current literature, and the experiences reported by a cross-section of 116 organizations that completed an enterprise system implementation experience. Our results suggest that the early literature- and case-based research on enterprise systems does not take into account the importance of several key variables. These findings provide guidance to managers on how best to utilize their limited resources by employing such factors at the stage in the project's life cycle when they will have the greatest impact.

Keywords: Systems implementation; Enterprise resource planning; Packaged software; Implementation of IT innovations; Critical success factors; Change management

Successful implementation of information systems continues to be a source of great managerial concern and frequent frustration [71].

1. Introduction

Enterprise resource planning (ERP) systems have been considered an important development in the corporate use of information technology in the 1990s, enhancing organizational cross-functional efficiency and effectiveness through the seamless integration of all the information flowing through a company [23]. Major business drivers behind ERP implementations are: improving productivity, providing competitive advantage, and satisfying customer demands. With ERP penetration at 67%, the ERP market is the largest segment of a company's applications budget (34%) and is expected to remain so through 2004 [80].

ERP systems are complex pieces of software. Consequently, many such implementations have been difficult, lengthy and over budget, were terminated before completion, and failed to achieve their business objectives even a year after implementation [64]. The significance and risks of ERP make it essential that organizations focus on ways to improve ERP

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implementation. Combining the factors view of implementation with a process perspective, we have examined a comprehensive framework that allows us to investigate the issues that should dominate each implementation stage. Specifically, we explored the following important questions:

- Which key players and activities are playing a pivotal role in an organization's experience with the ERP implementation?
- At which stage of the implementation process is it critical for an organization to introduce a key player or activity in order to derive major benefits?

Based on an extensive review of the practitioner and research literature we classified a number of critical success factors using the Markus and Tanis [56] framework into key players and typical activities. We also examined the importance of each player and activity using Cooper and Zmud's [21] six-stage model of IT implementation to determine when key players and activities need to be given higher priority than others. We then used an information theoretic approach to analyze the information discrepancy between the hypothesized literature-based importance of each player and activity across stages and their actual importance derived from a survey of medium to large organizations that completed their ERP implementation.

2. Theoretical background

2.1. A factors view of ERP implementations

A number of factors that affect the implementation process and the probability of conversion success have been identified in the literature [48,50,52]. The study of ERP systems and the factors that impact their success have been the subject of empirical investigation only recently. Success factors identified in the literature include support and commitment of senior management, redesign of business processes to fit the software, investment in user training, avoidance of customization, use of business analysts and consultants with both business knowledge and technology knowledge, integration of ERP systems with other business IS, and ability to build key in-house IT capabilities [31,87]. A review of the nonacademic literature suggests other important factors, such as careful software and vendor selection, standardization, transition planning and data conversion, upfront business changes, and ongoing vendor support. In summary, our review of the academic and non-academic literature, which included descriptions and analyses of ERP implementations at 111 companies, yielded 22 players and activities that are considered critical for such implementations (see Appendix A).

2.2. A process view of ERP implementations

While a factors view identifies which issues are critical to the implementation process, a process approach, which has historically been neglected in the IS field, sees implementations as a sequence of stages and seeks to explain how outcomes develop over time [12,57]. Researchers have described ERP transition with models having three to six stages (e.g. Deloitte Consulting's [26] three-stage model, Ross and Vitale's [75] five-stage model). Rajagopal [68] frames ERP implementations in terms of the six-stage model of IT implementation consisting of initiation, adoption, adaptation, acceptance, routinization, and infusion. A strength of this model is in the last two phases, which represent post-adoption behavior.

2.3. Integrated model of the ERP implementation experience

Success factors can, of course, be temporal, i.e. their relative importance changes with the stage of the project life cycle [72]. We therefore integrate the factors approach with the six-stage IT implementation stage model and provide the more comprehensive research model of ERP implementations shown in Fig. 1 to determine the significance of players $(P_1, \ldots, P_n)$ and activities $(A_1, \ldots, A_n)$ in the implementation process for a particular period of time.

3. Key players and activities across the ERP project life cycle

3.1. Key players

3.1.1. Top management

Sustained management support, cited as the most relevant factor in implementation projects, is needed

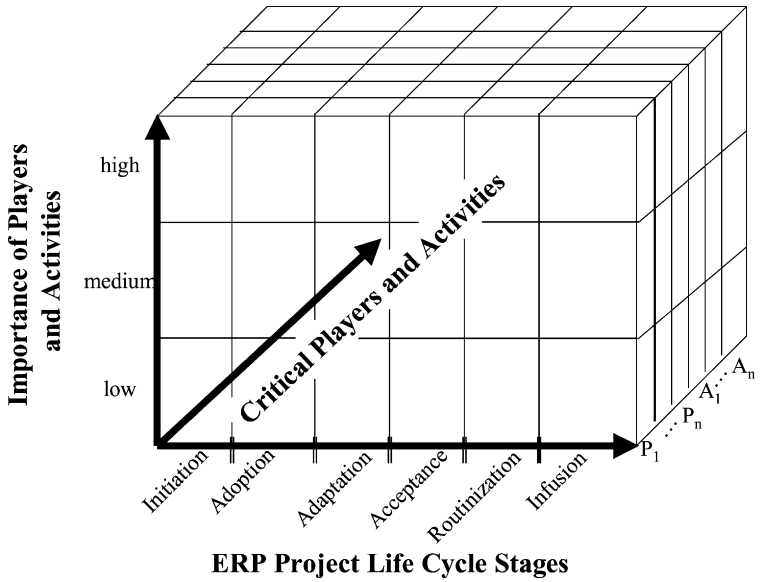

Fig. 1. Research model.

throughout the implementation project [29,62], No single factor is as predictive of ERP project success [10,78,84]. As the project progresses, active involvement of management remains critical in terms of constantly monitoring the progress of the project and providing direction to the implementation teams [11].

3.1.2. Project champion

The success of technological innovations has often been linked to the presence of a champion who performs the crucial functions of transformational leadership, facilitation, and marketing the project to the users [9,59]. As such, championship should also be considered a critical enabling factor. Project champions play a critical role in acceptance of the technology and, to a lesser extent, during its use and incorporation into the organization.

3.1.3. Steering committee

A project management structure with a steering committee, consisting of senior management from different corporate functions, senior project management representatives, and ERP end users, represents an effective means of ensuring appropriate involvement and making ERP succeed [17,83]. Steering committees are usually involved in system selection, monitoring during implementation, and management of outside consultants. As such, their impact is expected to be highest during the initiation, adoption, adaptation, and acceptance stages of implementation.

3.1.4. Implementation consultants

Organizations frequently use outside consultants for setup, installation, and customization of their software [27] availing themselves of the consultants' experience, comprehensive knowledge of certain modules, and experience with the software application [66]. Consultants who perform requirements analysis, recommend a suitable solution, and manage implementations [88] appear to play an essential role that diminishes during the latter stages of implementation when the system is operational.

3.1.5. Project team

A decisive element of ERP implementation success or failure is the project team's business and technological competence [60,91]. The skills and knowledge of the project team are important in providing expertise in areas where team members lack knowledge [8,19]. As a project team usually disbands after installation, its role is significant in the earlier stages and less important during post-installation.

3.1.6. Vendor–customer partnerships

As a better fit between the software vendor and user-organization is positively associated with packaged software implementation success [42], vendor–customer partnerships are important to successful ERP projects [86]. The relationship between the software buyer and vendor should be strategic in nature, with the ERP provider enhancing an organization's competitiveness and efficiency [15]. This partnership seems critical during the earlier stages of implementation.

3.1.7. Vendors' tools

Rapid implementation technologies and programs provided by the vendors play a pivotal role during adoption and adaptation. Accelerators provided by vendors include business process modeling tools, templates for industry-specific business practices, bundling of server hardware with ERP software, and combined packages of software, services, and support [32,34,61]. They can significantly reduce the cost and time of deploying ERP systems, and are important for transferring knowledge about the use of the software, understanding the business processes within the organization, and recognizing best practice.

3.1.8. Vendor support

ERP systems, a lifelong commitment for many companies [24], require continual investment in new modules and upgrades to add functionality, achieve better fits between business and system, and realize their strategic value [2]. Consequently, vendor support, in the form of extended technical assistance, emergency maintenance, updates, and special user training, is an important factor with packaged software during the post-implementation stages [46,82].

3.2. Key activities

3.2.1. User training and education

The role of training to facilitate software implementation is well documented in the MIS literature [63,77]. Lack of user training and failure to understand how enterprise applications change business processes frequently appear to be responsible for many problem ERP implementations and failures [22,92]. Computer-based training via Intranets has been found to facilitate ERP implementations [53]. Given the complexity of ERP systems, training is essential through the acceptance stage. Training takes on a moderately important role during the latter stages, when training on a continuous basis is required to meet the changing needs of the business and enhance employee skills.

3.2.2. Management of expectations

Successful system implementations are related to successful management of user expectations [33]. ERP systems that are oversold may fail to meet expectations despite positive contributions to the organization [14]. Management of expectations appears to be highly important from the development of the business case to training people in the use of the finished system [39], i.e. from the initiation through the adaptation stage.

3.2.3. Careful selection of the appropriate package

The choice of the right package during the initiation and adoption phases involves important decisions regarding budgets, time-frames, goals, and deliverables that will shape the entire project. The greater the effort involved in ERP selection, the greater the chance of overall success [90].

3.2.4. Project management

Project management activities span the first four stages of the ERP life cycle from initiating the project to closing it. The contingency approach to project management suggests that project planning and control are a function of the project's characteristics, including project size, experience with the technology, and the stability and experience of the IT development group [4]. Since the combination of hardware and software and the organizational, human and political issues make many ERP projects huge, complex, and risky, effective project management is crucial from initiation to acceptance, but less so during routinization and infusion.

3.2.5. Customization

The decision to accept or reject the assumptions about business processes built into the system occurs in the early stages of the implementation process [74] and affects the amount of customization needed to the software and/or the organization. Successful ERP implementations are often the result of minimal customization as customization is usually associated with increased IS costs, longer implementation time, the

inability to benefit from vendor software maintenance, and upgrades, etc. [25].

3.2.6. Data analysis and conversion

A fundamental requirement for the effectiveness of ERP systems is the availability and timeliness of accurate data. The management of data entering the system is a critical issue throughout system implementation [44]. Data-related challenges include finding the proper data to load into the system and converting disparate data structures into a single, consistent format before system use. As the system is operational, feedback from system users is needed when corrupt system data are detected [47]. Thus, data issues are critical from initiation through adaptation of the system and are moderately important during system acceptance and use.

3.2.7. Business process reengineering

An issue with packaged software is the potential for incompatibility with the organization's needs and business processes [51]. The literature suggests that improvements in organizational performance requires the restructuring of organizational business processes to fit the software [37,38]: indeed, business process reengineering (BPR) plays a particularly crucial role in the early stages of implementation, from initiation through adaptation; it is moderately important in the acceptance stage, and tends to be less important once the technology becomes routine and infused.

3.2.8. Defining the architecture

Architecture choices and planning deserve thorough consideration during the procurement phase [30]. Key architectural considerations, which are particularly important during initiation and adoption and somewhat less important during adaptation, revolve around additional software, such as data warehouses [85].

3.2.9. Dedicating resources

Lack of resources represents a major concern in ERP implementation [35,58]. Sufficient resources are crucial [55]. Resource requirements need to be determined early in the project to avoid dooming project efforts [69]. Thus, dedicated resources are particularly critical early in the process and continue to have an affect, to a lesser degree, during later stages.

3.2.10. Change management

ERP systems introduce large-scale change that can cause resistance, confusion, redundancies, and errors if not managed effectively. Many ERP implementations fail to achieve expected benefits possibly because companies underestimate the efforts involved in change management [5]. Such activities appear to be important from the early stages of the project [20], and continue throughout the adaptation and acceptance stages.

3.2.11. Establishing clear goals and objectives

Effective project implementation requires a well-articulated business vision that establishes the goals and the business model behind the implementation project [40]. Clear goals and objectives, which were the third most CSF in a study of MRP implementations [3], should be specific and operational and indicate the general directions of the project [18]. The underlying purpose of the project must remain clear and important through all stages of the project life cycle [65].

3.2.12. Education on new business processes

Implementation coupled with BPR requires that managers educate and communicate their goals and long-term perspectives in order to win support of all members of the organization affected by the changes [54]. This activity should be performed in parallel to BPR and appears to be particularly important during adoption, adaptation, and acceptance of the technology.

3.2.13. Interdepartmental communication

Communication [79] provides an appropriate network and necessary data to all key actors in the project implementation. Many organizations have developed a communication plan and issue regular reports to keep users well informed and ensure that they are aware of the system's impact on their responsibilities [16]. Communication is viewed as having a high impact from initiation to system acceptance, as it helps to minimize possible user resistance.

3.2.14. Interdepartmental cooperation

As ERP systems cross-functional and departmental boundaries, cooperation and involvement of all people involved is essential [70]. The system's potential

Table 1
Expected importance of players and activities across implementation stages[a]

Players and activities		ERP implementation stages					
		Initiation	Adoption	Adaptation	Acceptance	Routinization	Infusion
P	Top management	H	H	H	H	H	H
P	The project champion	H	H	H	H	M	M
P	The steering committee	H	H	H	H	L	L
P	Implementation consultants	H	H	H	M	L	L
P	The project team	H	H	H	H	L	L
P	Vendor–customer partnership	H	H	H	H	M	L
P	Vendors' customization tools	L	H	H	L	L	L
P	Vendor support	L	L	L	M	H	H
A	User training and education	H	H	H	H	M	L
A	Management of expectations	H	H	H	H	M	L
A	Careful package selection	H	H	L	L	L	L
A	Project management	H	H	H	H	M	L
A	Customization	H	H	H	L	L	L
A	Data analysis and conversion	H	H	H	M	L	L
A	Business process reengineering	H	H	H	M	L	L
A	Architecture choices	H	H	M	L	L	L
A	Dedicating resources	H	H	H	H	M	L
A	Change management	L	H	H	H	M	L
A	Clear goals and objectives	H	H	H	H	H	H
A	Education on new business processes	L	H	H	H	M	L
A	Interdepartmental communication	H	H	H	H	M	L
A	Interdepartmental cooperation	H	H	H	H	M	L

[a] Assessment of expected importance based on literature review: high (H) 0.60; medium (M) 0.30; low (L) 0.10.

cannot be assured without strong coordination of effort and goals [93]. Like interdepartmental communication, this activity is important from initiation through the acceptance.

3.3. Summary

Table 1 summarizes this discussion and shows our assumptions about their importance in each stage of the implementation process.

4. Research method

4.1. Sample and data collection

Data for this study was collected by means of a mail questionnaire from (1) Fortune 500 firms, and (2) a random sample of 200 organizations using ERP systems selected from the *East Edition* of the *Directory of Top Computer Executives Directory, 1999* [6]. Since past research suggested that senior IS executives would be the most suitable informant [43,73], our questionnaire was addressed personally to a senior level IS executive who would know details of the organization's enterprise system experience. A short one-page questionnaire was mailed to the executive, accompanied by an informational letter stating the purpose of the research, ensuring confidentiality, and enclosing a postage-paid return envelope.

The questionnaire, as shown in Appendix B, listed the 22 players and activities discussed above and implementation stages for each player and activity along with clear, short definitions of each stage. Respondents were asked (1) to indicate the importance of each player and activity in their enterprise system implementation using a 5-point Likert scale, and (2) to indicate the stages in which they considered each player and activity to be important. Respondents could also specify additional factors they considered relevant in their implementation and the stage(s) during which these factors were important. Our survey was

pre-tested with IS executives from six firms in Michigan who had an enterprise system.

The initial mailings and one follow-up reminder resulted in a total response of 133 usable questionnaires. We checked to determine if there was any early versus late response bias. The Chi-square test comparing the categories for total number of employees across the two groups revealed no significant biases existed ($\chi^2 = 8.2$; $\chi^2_{0.05,4d.f.} = 9.48$) were examined. The 19% response rate is comparable to past surveys of similar populations with projected response rates of between 10 and 20% [67,89,95]. We used only those companies who reported that: (1) their organization's ERP implementation was completed the previous year or, (2) the implementation was completed over 1 year ago. By excluding organizations in the early to mid implementation or those nearing completion, a smaller sample of 116 firms remained for our analysis. Two calculated chi square tests, one for non-respondents of Fortune 500 firms and another for non-responding companies selected from the Top Computer Executive Directory did not reveal any non-respondent bias in terms of total number of employees. A wide variety of industries were represented in the responses. Characteristics of the respondents and their organizations are shown in Table 2.

Table 2
Sample demographics

Industry sector	Number of companies
Manufacturing and services	37
Banking	24
Diversified finance	11
Insurance	7
Retail	6
Transportation	10
Utilities	5
Education	6
Health service	5
Federal government	3
State government	1
Local government	1
Total	116
Title of respondent	
Chief executive officer	2
Chief information officer	25
President	6
Vice-president of IS/IT	48
Director of MIS/IS/IT	35
Total	116
Number of employees	
Over 10000	22
5001–10000	15
1001–5000	24
501–1000	21
251–500	34
Total	116

4.2. Data analysis strategy: the information theoretic approach

The information theoretic approach, based on Shannon's work [81] and later formalized by Jaynes [40] provides an elegant design for comparing the current state of knowledge, i.e. the *expected* importance of players and activities across the ERP project stages with their *actual* importance obtained from the empirical data. The difference between the current knowledge and the actual outcome constitutes the information content of the event, which is termed the entropy of the system and which provides a feedback mechanism for updating prior knowledge. Shannon adapted the concept of entropy from engineering thermodynamics to measure the information content of a message. He referred to entropy as "a measure of the uncertainty of agreement" between the message sent and the message received. Information theory bridges research and practice, because it is applicable even in those situations in which there is only partial or even conflicting information available about the random variables (the key players and activities). Practical applications of the concept involve its use to study management decision making [49], decision support systems [13], organizational adoption of MIS planning, [36], market research [41], and process control [1].

The concept of entropy as a measure of uncertainty is closely related to that of probability as representing a description of imperfect knowledge. Maximum entropy should involve maximum uncertainty (minimum information content), subject to representing the current knowledge that one does possess. When prior knowledge involves knowing the expected value of a

known function of the unknown state of nature, then the maximum can easily be found.

The quantification of information content is grounded on the supposition, that there exists possible outcomes, A_i for $i = 1, 2, \ldots, N_n$ to which probability values $Pi = (p_1, p_2, \ldots, p_n)$ may be assigned. The following probability distribution of prior beliefs is then:

$$P_i = (p_1, p_2, \ldots, p_n); \qquad \sum_{i=1}^{n} p_i = 1, \quad p_i > 0 \qquad (1)$$

The original probabilities are transformed when information is received. The changes in the probability values can be measured and are the reduction in uncertainty. When a message is characterized by a certain outcome and is reliable, its expected information content can be measured. The discrete entropy model involves maximizing the ''entropy'' function of a distribution, p:

$$\text{maximize } H_n(p_1, p_2, \ldots, p_n) = \sum_{i=1}^{n} p_i \ln[p_i], \qquad (2)$$

The H_n is recognized as entropy of the message. When it is ''non-definite'' and is no longer certain that a particular outcome will take place, it transforms the original set of probabilities $P_i = (p_1, p_2, \ldots, p_n)$ to $Q_i = (q_1, q_2, \ldots, q_n)$, and the entropy of the message is:

$$I(q, p) = \sum_{i=1}^{N} q_i \ln\left(\frac{q_i}{p_i}\right), \qquad (3)$$

where

$$\sum_{i=1}^{n} q_i = \sum_{i=1}^{n} p_i = 1 \qquad (4)$$

Eq. (3) provides the information inaccuracy or degree of divergence between the prior expectations and later observed importance of players and activities. The variable notations are shown in Table 3. We developed a bivariate classification probability matrix using implementation stages (Y's) and players/activities (X's). The distribution, shown in Table 4, has m rows and n columns. The mn joint fractions P_{ij} $(i = 1, \ldots, m; j = 1, \ldots, n)$, where i and j correspond to players/activities and implementation stages, respectively, are all nonnegative values and sum to one, as do the m marginal fractions of the row $(p_{i\cdot})$ and the n marginal fractions of the columns $(p_{j\cdot})$. The values of q_i were obtained in a similar manner. For example, p_{11} represents the expected importance

Table 3
Variable notation

Variable symbol	Key players and activities
X_1	Top management
X_2	Project champion
X_3	Steering committee
X_4	Use of consultants
X_5	Project team/competence
X_6	Vendor–customer partnerships
X_7	Use of vendors' development and customization tools
X_8	Vendor support
X_9	User training and education
X_{10}	Management of expectations
X_{11}	Careful selection of the appropriate package
X_{12}	Project management
X_{13}	Customization
X_{14}	Data analysis and conversion
X_{15}	Business process reengineering
X_{16}	Defining the architecture choices
X_{17}	Dedicated resources
X_{18}	Change management
X_{19}	Clear goals and objectives
X_{20}	Education on new business processes
X_{21}	Interdepartmental communication
X_{22}	Interdepartmental cooperation
	Stages of implementation
Y_1	Initiation
Y_2	Adoption
Y_3	Adaptation
Y_4	Acceptance
Y_5	Routinization
Y_6	Infusion

Table 4
Classification of data

ERP implementation stages					
Players and activities					
p_{11}	p_{12}	P_{13}	$\cdots$	p_{1n}	$p_{1\cdot}$
p_{21}	p_{22}	p_{23}	$\cdots$	p_{2n}	$p_{2\cdot}$
p_{31}	p_{32}	p_{33}	$\cdots$	p_{3n}	$p_{3\cdot}$
p_{41}	p_{42}	p_{43}	$\cdots$	p_{4n}	$p_{4\cdot}$
$\vdots$	$\vdots$	$\vdots$		$\vdots$	$\vdots$
p_{m1}	p_{m2}	p_{m3}	$\cdots$	p_{mn}	$p_{m\cdot}$
$p_{\cdot 1}$	$p_{\cdot 2}$	$p_{\cdot 3}$	$\cdots$	$p_{\cdot n}$	1.0

Table 5
Expected and observed importance of players and activities across implementation stages

Players and activities			ERP implementation stages					
			Initiation Y_1	Adoption Y_2	Adaptation Y_3	Acceptance Y_4	Routinization Y_5	Infusion Y_6
X_1	Top management support	Expected[a]	0.60	0.60	0.60	0.60	0.60	0.60
		Observed	0.64	0.71	0.58	0.58	0.53	0.39
X_2	Project champion	Expected	0.60	0.60	0.60	0.60	0.30	0.30
		Observed	0.65	0.62	0.59	0.46	0.33	0.26
X_3	Steering committee	Expected	0.60	0.60	0.60	0.60	0.10	0.10
		Observed	0.83	0.68	0.51	0.80	0.41	0.13
X_4	Implementation consultants	Expected	0.60	0.60	0.60	0.30	0.10	0.10
		Observed	0.53	0.61	0.61	0.34	0.13	0.57
X_5	Project team/competence	Expected	0.60	0.60	0.60	0.60	0.10	0.10
		Observed	0.58	0.63	0.60	0.44	0.25	0.21
X_6	Vendor–customer partnerships	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.60	0.59	0.55	0.37	0.28	0.40
X_7	Use of vendors' customization tools	Expected	0.10	0.60	0.60	0.10	0.10	0.10
		Observed	0.72	0.72	0.51	0.34	0.40	0.21
X_8	Vendor support	Expected	0.10	0.10	0.10	0.30	0.60	0.60
		Observed	0.78	0.71	0.68	0.45	0.35	0.28
X_9	User training and education	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.67	0.60	0.63	0.47	0.67	0.22
X_{10}	Management of expectations	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.53	0.55	0.44	0.48	0.23	0.17
X_{11}	Careful selection of appropriate package	Expected	0.60	0.60	0.10	0.10	0.10	0.10
		Observed	0.73	0.56	0.32	0.21	0.12	0.04
X_{12}	Project management	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.58	0.66	0.60	0.49	0.38	0.24
X_{13}	Degree of customization	Expected	0.60	0.60	0.60	0.10	0.10	0.10
		Observed	0.57	0.52	0.58	0.39	0.24	0.28
X_{14}	Data analysis and conversion	Expected	0.60	0.60	0.60	0.30	0.10	0.10
		Observed	0.37	0.63	0.59	0.23	0.06	0.03
X_{15}	Business process reengineering	Expected	0.60	0.60	0.60	0.30	0.10	0.10
		Observed	0.60	0.70	0.59	0.55	0.28	0.22
X_{16}	Defining the architecture choices	Expected	0.60	0.60	0.30	0.10	0.10	0.10
		Observed	0.72	0.51	0.37	0.23	0.10	0.06
X_{17}	Dedicated resources	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.57	0.64	0.44	0.54	0.11	0.06
X_{18}	Change management	Expected	0.10	0.60	0.60	0.60	0.30	0.10
		Observed	0.66	0.73	0.77	0.65	0.32	0.17
X_{19}	Clear goals and objectives	Expected	0.60	0.60	0.60	0.60	0.60	0.60
		Observed	0.71	0.66	0.62	0.53	0.35	0.14
X_{20}	Education on new business processes	Expected	0.10	0.60	0.60	0.60	0.30	0.10
		Observed	0.48	0.57	0.65	0.57	0.23	0.12

Table 5 (*Continued*)

Players and activities			ERP implementation stages					
			Initiation Y_1	Adoption Y_2	Adaptation Y_3	Acceptance Y_4	Routinization Y_5	Infusion Y_6
X_{21}	Interdepartmental communication	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.68	0.59	0.64	0.63	0.55	0.41
X_{22}	Interdepartmental cooperation	Expected	0.60	0.60	0.60	0.60	0.30	0.10
		Observed	0.53	0.65	0.65	0.67	0.55	0.47

[a] Assessment of expected importance based on literature review: high (H) 0.60; medium (M) 0.30; low (L) 0.10.

of top management support in the initiation stage divided by the total probabilities of all players/activities for all stages; similarly, p_1 represents the total probability of top management support across all stages divided by the total of the probabilities of all players/activities.

The overall total bivariate information inaccuracy, obtained by analyzing the responses of each of the 22 players and activities for their "expected" (p_i) and "observed" (q_i) importance is:

$$I(X,Y) = \sum_{i=1}^{m}\sum_{j=1}^{n} q_{ij} \ln\left(\frac{q_{ij}}{p_{ij}}\right) \tag{5}$$

Similarly, the information inaccuracies in rows (i.e. differences in importance of players and activities) and columns (i.e. differences in implementation stages) are:

$$I(Y|X_i) = \sum_{j=1}^{n} \frac{q_{ij}}{q_{i\cdot}} \ln\left[\frac{q_{ij}/q_{i\cdot}}{p_{ij}/p_{i\cdot}}\right] \tag{6}$$

and

$$I(X|Y_j) = \sum_{i=1}^{m} \frac{q_{ij}}{q_{\cdot j}} \ln\left[\frac{q_{ij}/q_{\cdot j}}{p_{ij}/p_{\cdot j}}\right] \tag{7}$$

The average conditional measures for all rows and all columns are given by

$$I(Y|X) = \sum_{i=1}^{m} q_i \sum_{j=1}^{n} \frac{q_{ij}}{q_i} \ln\left[\frac{q_{ij}/q_{j\cdot}}{p_{ij}/p_{i\cdot}}\right] \tag{8}$$

and

$$I(X|Y) = \sum_{j=1}^{n} q_{\cdot j} \sum_{i=1}^{m} \frac{q_{ij}}{q_{\cdot j}} \ln\left[\frac{q_{ij}/q_{\cdot j}}{p_{ij}/p_{\cdot j}}\right] \tag{9}$$

Kapur [45] suggested that the expressions $(P = p_1, p_2, \ldots, p_n)$ to $(Q = q_1, q_2, \ldots, q_n)$ need not be considered as probability distributions nor as a measure of uncertainty. Within our context, the variation between the expected and observed importance of players and activities would be analogous to the entropy. We concluded that the set of prior knowledge was realistic and, hence, generalizable to other organizations, if the hypothesized importance distribution of Table 5, based on theory, agreed with the observed importance distribution.

The development of the probability distribution of prior beliefs, p_i, is based on the hypothesized importance of players and activities for each project stage:

- a probability as 0.60 is assigned where the literature supports the "expected" importance of the player or activity as high in the implementation process;
- a probability of 0.30 is assigned where the information accumulated from prior literature indicates a player or activity to be of moderate importance in implementation, and;
- a probability of 0.10 is assigned where a player or activity is perceived to be of low importance in the implementation phase.

5. Results

Table 5 shows the observed importance of players and activities q_i, for each implementation stage. The numbers indicate the percentage of respondents who considered the factor important. Table 6 shows the observed importance of players and activities in

Table 6
Importance of players and activities across life cycle stages[a]

Initiation		Adoption		Adaptation	
Use of steering committee	0.83	Change management	0.73	Change management	0.77
Vendor support	0.78	Use of vendors tools	0.72	Vendor support	0.68
Careful selection of package	0.73	Top management support	0.71	Education on new BPR	0.65
Architecture choices	0.72	Vendor support	0.71	Interdepartmental cooperation	0.65
Use of vendors tools	0.72	Business process reengineering	0.70	Interdepartmental communication	0.64
Clear goals and objectives	0.71	Use of steering committee	0.68	User training on software	0.63
Interdepartmental communication	0.68	Clear goals and objectives	0.66	Clear goals and objectives	0.62
User training on software	0.67	Project management	0.66	Use of consultants	0.61
Change management	0.66	Interdepartmental cooperation	0.65	Project management	0.60
Project champion	0.65	Dedicated resources	0.64	Project team competence	0.60
Top management support	0.64	Data analysis and conversion	0.63	Business process reengineering	0.59
Business process reengineering	0.60	Project team competence	0.63	Data analysis and conversion	0.59
Partnership with vendor	0.60	Project champion	0.62	Project champion	0.59
Project management	0.58	Use of consultants	0.61	Minimal customization	0.58
Project team competence	0.58	User training on software	0.60	Top management support	0.58
Minimal customization	0.57	Interdepartmental communication	0.59	Partnership with vendor	0.55
Dedicated resources	0.57	Partnership with vendor	0.59	Use of steering committee	0.51
Interdepartmental cooperation	0.53	Education on new BPR	0.57	Use of vendors tools	0.51
Use of consultants	0.53	Careful selection of package	0.56	Dedicated resources	0.44
Management of expectations	0.53	Management of expectations	0.55	Management of expectations	0.44
Education on new BPR	0.48	Minimal customization	0.52	Architecture choices	0.37
Data analysis and conversion	0.37	Architecture choices	0.51	Careful selection of package	0.32
Acceptance		**Routinization**		**Infusion**	
Use of steering committee	0.80	User training on software	0.67	Use of consultants	0.57
Interdepartmental cooperation	0.67	Interdepartmental cooperation	0.55	Interdepartmental cooperation	0.47
Change management	0.65	Interdepartmental communication	0.55	Interdepartmental communication	0.41
Interdepartmental communication	0.63	Top management support	0.53	Partnership with vendor	0.40
Top management support	0.58	Use of steering committee	0.41	Top management support	0.39
Education on new BPR	0.57	Use of vendors tools	0.40	Minimal customization	0.28
Business process reengineering	0.55	Project management	0.38	Vendor support	0.28
Dedicated resources	0.54	Clear goals and objectives	0.35	Project champion	0.26
Clear goals and objectives	0.53	Vendor support	0.35	Project management	0.24
Project management	0.49	Project champion	0.33	User training on software	0.22
Management of expectations	0.48	Change management	0.32	Business process reengineering	0.22
User training on software	0.47	Partnership with vendor	0.28	Project team competence	0.21
Project champion	0.46	Business process reengineering	0.28	Use of vendors tools	0.21
Vendor support	0.45	Project team competence	0.25	Change management	0.17
Project team competence	0.44	Minimal customization	0.24	Management of expectations	0.17
Minimal customization	0.39	Education on new BPR	0.23	Clear goals and objectives	0.14
Partnership with vendor	0.37	Management of expectations	0.23	Use of steering committee	0.13
Use of consultants	0.34	Use of consultants	0.13	Education on new BPR	0.12
Use of vendors tools	0.34	Careful selection of package	0.12	Architecture choices	0.06
Architecture choices	0.23	Dedicated resources	0.11	Dedicated resources	0.06
Data analysis and conversion	0.23	Architecture choices	0.10	Careful selection of package	0.04
Careful selection of package	0.21	Data analysis and conversion	0.06	Data analysis and conversion	0.03

[a] Expressed as the percentage of respondents who considered the factor important in an implementation stage.

descending order of importance. During the adoption stage, over fifty percent of the respondents considered each player and activity as important. Patterns are similar for the initiation and adaptation stage. As the project progressed, the number of factors that were considered important diminishes considerably for the acceptance, routinization, and infusion stages.

Table 7
Entropy values for expected and observed importance of players and activities across implementation stages

Information inaccuracies in implementation stages, Y_i	
$I(X\|Y_1)$	1953
$I(X\|Y_2)$	579
$I(X\|Y_3)$	767
$I(X\|Y_4)$	778
$I(X\|Y_5)$	1792
$I(X\|Y_6)$	4198
Information inaccuracies in players and activities, X_i	
$I(Y\|X_8)$	6603
$I(Y\|X_7)$	2996
$I(Y\|X_4)$	1714
$I(Y\|X_{18})$	1695
$I(Y\|X_{13})$	1470
$I(Y\|X_{20})$	1410
$I(Y\|X_6)$	1085
$I(Y\|X_{22})$	1057
$I(Y\|X_{11})$	957
$I(Y\|X_{19})$	941
$I(Y\|X_{21})$	789
$I(Y\|X_3)$	738
$I(Y\|X_9)$	635
$I(Y\|X_{15})$	559
$I(Y\|X_5)$	536
$I(Y\|X_{16})$	416
$I(Y\|X_{14})$	352
$I(Y\|X_{17})$	330
$I(Y\|X_{12})$	307
$I(Y\|X_{10})$	179
$I(Y\|X_1)$	158
$I(Y\|X_2)$	80
Overall inaccuracy $(X, Y) = 1410$	
Average conditional inaccuracies for columns $I(X\|Y) = 1380$	
Average conditional inaccuracies for rows $I(Y\|X) = 1190$	

Notes: (1) The base of the logarithm in Eqs. (6)–(9) determines the unit of information. When logarithms to the base 2 are used, information is said to be measured in bits (binary digits). In case of natural logarithms, the information unit is a nit. $I(X|Y)$ is the information inaccuracy in the ith implementation stages. The values of information inaccuracy are measured in 10^{-4} nits. (2) The development of the probability distribution of prior beliefs, p_i, was based on a comprehensive literature review, which hypothesized the importance of players and activities for each project stage.

Using Eqs. (5)–(9), we analyzed the deviations between the hypothesized and observed importance of both players and activities. The entropy values, measuring the overall bivariate information inaccuracy $I(X, Y)$, conditional inaccuracies for each row (importance of players and activities), $I(Y|X_i)$, and for each column (implementation stages), $I(X|Y_j)$, are shown in Table 7.

Table 8
Inaccuracies between the expected and observed importance in implementation for players and activities

Degree of inaccuracy[a]	Factor
Very high (>2 S.D. above the mean)	Vendor support
	Use of vendors' tools
High (up to 2 S.D. above the mean)	Use of consultants
	Change management
	Minimal customization
	Education on new business processes
Medium (up to 1 S.D. above the mean)	Partnership with vendor
	Interdepartmental cooperation
	Careful selection of package
	Clear goals and objectives
	Interdepartmental communication
Low (up to 1 S.D. below the mean)	Use of steering committee
	User training on software
	Business process reengineering
	Project team competence
	Architecture choices
	Data analysis and conversion
	Dedicated resources
	Project management
Very Low (> 1 S.D. below the mean)	Management of expectations
	Top management support
	Project champion

[a] Based on mean and S.D. of inaccuracies (excludes vendor support and use of vendors' tools).

An examination of the average conditional inaccuracies to determine importance for all stages and all players and activities simultaneously indicates that implementation stage inaccuracies were higher than overall inaccuracies for players and activities. Not surprisingly, information inaccuracies are particularly high for the last implementation stage, infusion. Other major contributors to implementation inaccuracies are initiation, and routinization. The smallest implementation stage inaccuracies occurred for the adoption stage suggesting that players and activities are best understood during this stage.

The inaccuracies for individual players and activities suggest that the hypothesized importance

Table 9
Top inaccuracies for players and activities across implementation stage

	Initiation	Adoption	Adaptation	Acceptance	Routinization	Infusion
Observed importance > expected importance	Vendor support (0.68)	Vendor support (0.61)	Vendor support (0.58)	Minimal customization (0.29)	User training on software (0.37)	Use of consultants (0.47)
	Use of vendors tools (0.62)		Careful selection of package (0.22)	Business process reengineering (0.25)	Use of a steering committee (0.31)	Interdepartmental cooperation (0.37)
	Change management (0.56)			Use of vendors tools (0.24)	Use of vendors tools (0.30)	Interdepartmental communication (0.31)
	Education on new BPR (0.38)			Use of a steering committee (0.20)	Interdepartmental communication (0.25)	Partnership with vendor (0.30)
	Use of a steering committee (0.23)				Interdepartmental cooperation (0.25)	
Observed importance < expected importance	Data analysis and conversion (−0.23)			Partnership with vendor (−0.23)	Vendor support (−0.25)	Clear goals and objectives (−0.46)
					Clear goals and objectives (−0.25)	Vendor support (−0.32)
						Top management support (−0.21)

of a number of players and activities differ considerably from the empirical data. As can be seen in Table 8, two factors, vendor support (X_8) and use of vendors' tools (X_7) deviate considerably from our hypotheses. Other factors with high inaccuracies include use of consultants (X_4), change management (X_{18}), minimal customization (X_{13}), and education (X_{20}).

To understand the inaccuracies for stages and factors, we list factors with differences in expected versus observed importance $\geq|0.20|$ for each implementation phase in Table 9. Positive differences indicate that the empirical importance of a factor is greater than predicted; negative differences suggest that predictions overestimated importance.

The very high inaccuracies for vendor support stem from our considerably underestimating this player's influence in the first three implementation stages. We also somewhat overestimated its importance during the last two stages: routinization and infusion. The empirical data also show a much greater importance than expected for the use of vendors' tools in the initiation stage, as well as somewhat greater empirical importance during the acceptance and routinization stages.

The high inaccuracies for use of consultants are primarily due to underestimating this player's significance in the infusion stage, while the high inaccuracies for change management and education on new business processes can be due to greater empirical importance in the initiation stage than expected. Minimal customization played a greater role than expected during the latter implementation stages, particularly during acceptance.

Partnership with the vendor was considered more important than reality during the acceptance stage, and was later underestimated during the infusion stage. Both interdepartmental communication and cooperation were greater than expected during the last two stages of implementation. Contrary to our expectations, clear goals and objectives played a much smaller role during the latter two stages of implementation, particularly infusion. To our surprise, careful selection of the package was more important than expected during the adaptation phase.

Finally, our underestimation of user training during the routinization phase was noteworthy, plus our overestimation of data analysis and conversion during the initiation stage and of top management support during the infusion stage.

6. Discussion

Critical success factors appear to be well studied in ERP implementations [28]. However, our results suggest that the temporal nature of the key players and activities is less understood than their overall importance. The implementation stage inaccuracies suggest that the first and latter two stages of implementation are least well understood.

Apparently, some of the players and activities that are critical during any IT implementation play an equally crucial role in ERP implementations. The steering committee is a critical player throughout the first five stages of implementation. The fact that it was the most important player during initiation and acceptance ($\geq$80% of respondents considered this factor important) and the fourth most important factor during the routinization stage was somewhat surprising.

The majority of respondents view both top management support and clear goals and objectives as important during the first five and first four stages of implementation, respectively. Contrary to our expectations, however, we overestimated the importance of clear goals and objectives during the routinization and infusion stages. User training is also very important during the first three stages of implementation. To our surprise, this continued to hold in the routinization phase. It appears that ongoing skills enhancements represent an important post-implementation behavior that is needed for maximizing utility of the system.

Other players and activities are unique to ERP systems. Our data confirm the importance of interdepartmental cooperation and communication. However, the organizations in our sample strongly contradict our expectation that interdepartmental cooperation in the later stages (routinization and infusion) would be of low importance. The majority of respondents considered change management as well as BPR important across the first four life cycle stages. The much greater than expected importance of change management and education on business reengineering during the initiation stage was surprising. Vendor support and use of vendor tools are particularly important during the first three stages of implementation. We were surprised that it proved to be much more important in the earlier stages of implementation and less in the latter stages. Our respondents may, on the other hand, have interpreted this question as asking about vendor support. The lack of its importance may stem from the newness of the technology for many firms and the resulting lack of need for ongoing support. The importance of consultants was as high as expected in the first three stages of implementation, but unexpectedly high during the infusion stage. This is consistent with a recent AMR survey of companies that upgraded their ERP systems showing consultants to be involved in planning ERP upgrades, which take place during the latter stages of implementation [7].

In summary, our results for the latter stages of implementation are in consonance with the literature, even though such behavior is not fully understood [76]; this is true of some pre-adoption behaviors also. This is not surprising, since most IT implementation research has focused on the adoption and acceptance of IT in an organization [94].

7. Conclusions

The study adopted a temporal perspective on critical success factors in ERP implementations and investigated the importance of key players and activities across the enterprise system life cycle. As such, its contribution includes both theory advancement and insights to guide practice in implementing enterprise systems. A particular contribution is its focus beyond the adoption and acceptance stages of implementation to include both pre- and post-implementation behavior. This appears to be particularly important for ERP systems.

Acknowledgements

We are indebted to Professor E.H. Sibley and the two anonymous reviewers whose insightful comments enhanced the quality of this paper.

Appendix A

For descriptions and analyses of ERP implementations at 111 companies, see Table A.1.

Table A.1
Companies studied to develop critical success factors and their importance across stages

Identifying number	Company	ERP system	Reference source
1	A-dec Inc., Newberg, OR; a dental equipment maker	BAAN	[127]
2	Aerostructures Corp., Nashville, TE	BAAN	[99,100]
3	Allegiance Healthcare Corp., Mcgaw Park, IL	SAP	[101,107,111,119]
4	Allied Signal Turbocharging Systems Inc.; turbocharger manufacturer	SAP	[97,124]
5	Allied Waste Industries	SAP	[96]
6	Alza, Palo Alto, CA; maker of pharmaceutical skin patches and time-release tablets	QAD	[108]
7	American Safety Razor; Verona, VA	QAD	[115]
8	Anheuser Busch Co., St. Louis, MI; manufacturer of beer and related food products	SAP	[132]
9	Applied Materials	N/A	[105]
10	Baldor Electric Co., Fort Smith, AR	SAP	[125]
11	Bay Networks Inc.	SAP	[124]
12	Bell Canada	SAP	[101]
13	Black and Decker	SAP	[102]
14	Boeing Company	BAAN	[124]
15	Borders Group Inc.	PeopleSoft	[131]
16	Bristol-Myers Squibb	SAP	[101,122]
17	Brother Industries, Memphis	SAP	[106]
18	Burlington Chemical Co., Burlington, NC; a manufacturer of specialty chemicals	SSA and Unicenter TNG	[126]
19	Cable Systems International	SAP	[129]
20	Carolina Power and Light Nuclear Division	Tivoli	[113]
21	Cascade Designs; a Seattle based maker of camping and hiking equipment	J.D. Edwards	[127]
22	Champion Laboratories	J.D. Edwards	[100]
23	Chevron Products, El Paso, TX	SAP	[100]
24	Colgate Palmolive	SAP	[122,129]
25	Compaq Computer	N/A	[105]
26	Corning Inc., Corning, NY; maker of optical fibers, glass and other products	PeopleSoft	[128]
27	Coty US	N/A	[116]
28	Cultor Food Science, Ardsley, NY	SAP	[106]
29	Curwood Group, Oshkosh, WI; subsidiary of Bemis Co. Inc.; manufacturer of sophisticated flexible packaging for snack food, cheese and candy, meat products and other flexible packaging products	RAMCO	[127]
30	Cumberland Packing, Brooklyn, NY; maker and packager of the sugar substitute sweet and low, as well as sugar in the raw	ADAGE	[108]
31	Data Exchange Corp., Amarillo, CA; a provider of high-tech repair services	Oracle	[129]
32	Delavan Gas Turbine Products	J.D. Edwards	[109]
33	Dell Computer Corp.	SAP	[125]
34	Diebold Inc., North Canton, OH; global leader in providing integrated financial delivery systems and services	BAAN	[111]
35	Domino's Pizza Inc.	PeopleSoft	[126]
36	Eastman Kodak	SAP	[106,117]
37	Eaton Semiconductor Equipment Operations, Beverly, MA	Glovia International	[115]
38	Elf Atochem North America Inc., Philadelphia, PA; chemical company	SAP	[125]
39	Elmer's Products; manufacturer of adhesive related products	SAP	[author unknown]
40	Endo Pharmaceuticals Inc., Chadds Ford, Pennsylvania, PA	SAP ASP	[112]
41	E-Tek Dynamics, San Jose, CA; maker of components for optical networks	Oracle	[130]
42	Family Dollar, Matthews, NC	Retek	[120]
43	Ferrellgas Partners L.P.; second largest propane retailer in the nation	PeopleSoft	[103]
44	FileTek Inc., Rockville, MA; maker of software that tracks and manages highly granular data	Oracle	[108]
45	Florida Crystals Corp., Palm Beach, CA	SAP	[100]
46	GAF Materials	QAD	[133]

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Table A.1 (*Continued*)

Identifying number	Company	ERP system	Reference source
47	GATX Capital Technology Services, San Francisco, CA	SAP	[110]
48	GM	SAP	[114]
49	H.E. Butt Grocery Co., San Antonio, TX	Tivoli	[113]
50	Haworth Inc., Holland, MI; producer of contract office furnishings	Oracle	[111]
51	Heads and Threads, Northbrook, IL	SAP	[100]
52	Hershey Food; a 4 billion a year candy company	SAP	[117]
53	Hewlett-Packardery		[313]
43	Hewlett-Packardery MedictalPproduts, Grup,r,		[10,1014]

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Table A.1 (*Continued*)

Identifying number	Company	ERP system	Reference source
94	Snap-On Tool	BAAN	[135]
95	Southern Energy, Atlanta, GA; electric utility	Oracle	[118]
96	Steelcase Inc.	N/A	[122]
97	Superior Uniform Group, Seminole, FL	SAP	[116]
98	Teknion Corp., Toronto, Ont.; furniture maker	BAAN	[111]
99	Texas Instruments Inc. Dallas, TX	SAP	[119]
100	Ticona, Summit, New Jersey; a supplier of thermoplastics	SAP	[119]
101	Toro Co., Minneapolis, MN; a 1.1 billion maker of lawn mowers and snow throwers	SAP	[130]
102	Toshiba America Electronic Components, Sunnyvale, CA	Oracle	[131]
103	Turner Industries	N/A	[100]
104	United Technologies Automotive Inc., Dearborn, MI; subsidiary	QAD	[134]
105	VANS, Santa Fe Springs, CA	J.D. Edwards	[100]
106	Virginia Power	SAP	[98]
107	Visteon Automotive Systems	SAP	[106]
108	Waste Management Inc., Houston, TX	SAP	[96]
109	Wella Manufacturing; hair care products	SAP	[118]
110	Westell Technologies Inc., Aurora, IL; telecommunications equipment company	SAP	[111]
111	Westinghouse Electric Corp. (now CBS Corp.)	SAP	[124]

Critical success factor		Identifying company number from Appendix A.1
1	Top management support	3, 4, 8, 9, 13, 26, 27, 33, 36, 59, 64, 74, 80, 88, 101, 104, 105, 108
2	Project champion	3, 5, 9, 10, 25, 34, 69, 75, 102
3	Steering committee	8, 11, 36, 38, 39, 60, 83, 87, 92, 95
4	Use of consultants	55, 81, 86
5	Project team	4, 6, 19, 38, 39, 49, 50, 69, 87, 109
6	Vendor–customer partnership	2, 21, 31, 32, 69
7	Vendor tools	45, 46
8	Vendor support	2, 21, 30
9	User training and education	1, 3, 14, 22, 29, 31, 39, 50, 56, 69, 76, 92, 108, 110, 111
10	Management of expectations	25, 26, 53
11	Careful selection of appropriate package	3, 18, 23, 51, 60, 72, 97
12	Project management	6, 8, 12, 15, 28, 31, 36, 39, 48, 53, 57, 59, 65, 67, 69, 73, 79, 82, 87, 93, 98, 107
13	Degree of customization	11, 12, 17, 38, 40, 44, 52, 53, 63, 69, 79, 84, 87, 91
14	Data analysis and conversion	35, 47, 70, 78, 89
15	Business process reengineering	16, 53, 54, 58, 69, 91, 92, 94, 96, 106, 110
16	Defining the architecture choices	68, 69, 99
17	Dedicated resources	38, 46, 69, 79
18	Change management	6, 16, 61, 62, 69, 81, 91, 93, 100, 103
19	Clear goals and objectives	35, 42, 107
20	Education on new business processes	2, 16, 31, 53, 109
21	Interdepartmental communication	3, 7, 39, 69, 76, 90, 105
21	Interdepartmental cooperation	13, 24, 101, 109

Appendix B

Table B.1 listed the 22 players, implementation stages for each player and activity along with clear, short definitions of each stage.

Table B.1
Partial questionnaire

In which stage is your organization's ERP system installation? (Please check one).																	
Early to mid implementation			☐			Implementation completed last year							☐				
Late implementation (near completion)			☐			Implementation completed over a year ago							☐				
Please read the six descriptions of IT implementation phases below before answering Question 2.																	
Initiation	A match is found between an IT solution and its application in the organization.																
Adoption	A decision is reached to invest resources necessary for the implementation effort.																
Adaptation	The IT application package is installed and becomes available for use in the organization.																
Acceptance	Organizational members employ the IT application in organizational work.																
Routinization	The IT application is no longer perceived as something out of the ordinary.																
Infusion	The IT application is used within the organization to its fullest potential.																
			1. What was the degree of importance of each factor in your ERP implementation? (Please circle the proper response).							2. In which stage(s) of your ERP project was each factor important? (Please check all that apply).						
Factors			Low	Moderate	High	Very High	Critical	N/A		Initiation	Adoption	Adaptation	Acceptance	Routinization	Infusion
Architecture choices			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Business Process Reengineering			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Careful selection of package			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Change management			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Clear goals and objectives			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Data analysis and conversion			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Dedicated resources			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Education on new business processes			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Interdepartmental communication			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Interdepartmental cooperation			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Management of expectations			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Minimal customization			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Partnership with vendor			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Project champion			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Project management			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Project team competence			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Top management support			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Use of consultants			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Use of steering committee			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Use of vendors' tools			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
User training on software			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Vendor support			1	2	3	4	5	N/A		☐	☐	☐	☐	☐	☐
Other (please specify):															
			1	2	3	4	5			☐	☐	☐	☐	☐	☐
			1	2	3	4	5			☐	☐	☐	☐	☐	☐

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