CHARACTERIZATION OF CONSULTANT ACTIVITIES IN ERP PROJECTS

A Case Study

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Abstract: Enterprise Resource Planning (ERP) systems are very common worldwide, but their implementation and upgrade projects are expensive, complex and often unsuccessful. A great role in their implementation is played by the consultancy firms, which provide manpower and qualified knowledge. Often, IT managers, on the preparation stage, need to know how the project will be organized, how the resources will be distributed and which effort will be necessary from the employees to perform a successful project. Through a case study we aim to define a way to measure the business value of the consultancy and understand if it is possible to build a model to achieve this result.

1 INTRODUCTION

An Enterprise Resource Planning (ERP) system is an enterprise wide packaged application software with full integrated business processes for enterprise management. Today, ERP systems have become a basic business need for many organizations. Unfortunately, many implementations have terminated before completion and didn't achieve their business objectives even a year after the implementation. One of the reasons of this failures is the lack of competence on the ERP deployment and on the maintenance of the company. Typically, these activities are outsourced to external consultants and vendors and their contribution is crucial for implementing an ERP system. External expertise and internal competence are both critical resources. IT managers base their decision on existing benchmarks for the evaluation of proposals of ERP implementations that often emphasize the consulting services. Therefore, with this work we aim at defining a way to measure the business value of the activities of consultants and also to build a first model to achieve this result.

In section 2, we briefly review the literature on ERP implementations. Section 3 describes the research settings, question and methods, Section 4 introduces the findings. Discussion, limitations and future works are respectively described in section 5, 6, and 7.

2 LITERATURE REVIEW

ERP systems are very common platforms characterized by their modular structure; each module handles a specific set of business processes of the company (Bingi et al, 1999). The implementation of an ERP system is an extensive, lengthy and costly process, specifically in related services such as consulting, training and system integration (Parr et al, 2000; Parr and Shanks, 2000,Esteves and Pastor, 2001.)

Implementing ERP Systems is a complex process in technical and organizational aspects. Firms need experienced people for their process implementation (Esteves and Pastor, 2002). Often they didn't have enough resources in house, and so they outsource part of the implementation to external consultants. (Wang and Chen, 2006; Holland and Lightet al, 1999) Consultants are involved into ERP implementation projects to provide additional skills, knowledge, or simply manpower not available at the customer, (Haines and Goodhue, 2003). In this respect, Chan (1999) hypothesized that an ERP implementation should rely on a composite team that includes vendors, consultants and customers. In addition ERP maintenance might require a similar effort due to system complexity, and the large number of stakeholders involved (Salmeron and Lopez, 2010).

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2.1 Implementation and Maintenance Projects

The first projects implemented during the life cycle of an ERP system are Implementation and Maintenance Projects. The latter includes Enhancement, Roll-out and Upgrade projects.

In any of the representations of the lifecycle of an ERP system existing in literature (PuiNg et al, 2002), Implementation and Maintenance are clearly separate stages. Implementation projects are crucial for their impact on the company's organization because they introduce innovation and change in the overall asset of the business activities and involve the majority of the professional roles. Maintenance projects need significant investments and they must be carefully designed before being undertaken. Enhancement projects, present often a lower complexity, but they improve existing ERP systems.

The roll-out projects are often used to implement the same functionalities of the whole system, in further domains of the company. They are used to expand the company's business, using the same organizational model designed and tested for the implementation projects. The upgrade project concerns entire upgrade of the system that is modified to adapt it to new features implemented in the new software version, or to adapt them to new technologies or architectures, in order to improve business, competitive advantages, and system integration (SeePui et al., 2002). A key element of the implementation of these different types of projects in ERP consists in the activities of the consultants. Their expertises, their ability to interact with the project team, and the way they transfer their knowledge of the application to customers, have been identified as possible factors of success of the project.

Conversely, an upgrade project, in which, often, the software customizations, already developed during the previous release, have to be rewritten into the new version, could require a greater effort of software development activities and a lower customizing activity (parameter), because in these projects, usually, the processes are not modified.

2.2 Theoretical Model of ERP Life Cycle

In our work, we refer to the theoretical model proposed by Markus and Tanis (2000) organizing the various events that guide the completion of an ERP project in four stages (Chartering, Project, Shakedown and Onward & Upward), the same phases can be used in implementation projects and upgrade projects as described by Nah and Delgado (2006) in their work.

2.3 The Role of Consultants

Researchers have highlighted the prominent role of external consultants in technology implementation. (Kraemmergaard and Rose, 2002, Bingi et al., 1999, Plant and Willcocks, 2007). Resolving conflicts and smoothing the relationship with consultants is of foremost importance (Wang & Chen, 2006) as well as facilitating knowledge transfer from the consultant to the company (Al-Mashari et al., 2003) so as to decrease the dependency on the vendor / consultant. Much of the knowledge owned by the consultants concerns ERP customization. (Wu and Wang, 2006). Somers and Nelson (2004) identify key players and activities across the ERP project life cycle. External consultants, top management and end-users are the key people that will significantly impact the process and outcome of an ERP implementation (Wang & Chen, 2006, Wang et al, 2007).

Involving these people with both business and technical knowledge into the project team is essential to achieve success.(Tsai et al., 2010)

In this work, we differentiate between external and internal consultant meaning with the latter internal staff that act as consultant.

2.4 Critical Success Factors

The definition of success in Information System and specifically for ERP system is multidimensional and dynamic. It depends on so many factors that cannot be uniquely defined. Shanks et al., (2000) differentiate between success in the planning and implementation phase and success in stabilization and maintenance phase. In the former case, success refers to projects on time and on budget and in the latter to organizational performance.

To predict project success, research in IS has focused on factors influencing ERP success, called Critical Success Factors (CSFs) (Nah and Delgado, 2006; Nah et al, 2003, Razmi et al., 2009 Holland et al., 1999, Salimifard et al. 2010,Wu and Wang, 2007). Critical success factors have been defined as "those few critical areas where things must go right for the business to flourish" (Parr et al., 2000).

Nah and Delgado (2006) have identified seven categories of factors (Table 1).

Table 1: The Critical Success Factor for implementation and upgrade projects (Nah and Delgado, 2006).

Critical Success Factor	Implementation	Upgrade
ERP Team composition,	4.37	4.35
Top Management Support	4.31	4
Communication	4.17	4.12
Change Management	4.13	4
Project Management	4.06	4.04
System Analysis, and Technical Implementation	3.92	3.75
Business Plan and Vision	3.87	3.63

Each factor has been ranked with a five-likert scale on the results of a survey to experts (being five the most critical value). Factors' influence varies on the type of project (implementation or upgrade).

3 RESEARCH

3.1 Research Question

The implementation of an ERP system is often very expensive, and a large part of the cost of implementing and maintaining an ERP system is due to the cost of the consultancy. In our research, we aim at investigating the success of an ERP implementation with particular focus on the activities performed by the consultants and their business value during an implementation or upgrade of an ERP system. In particular, we focus on the following research question:

Q1 what activities of consultancy are critical for the success of an ERP implementation or upgrade project according to objective measurement principles?

3.1.1 Success Factors and Measures

In our research, we were able to collect data and measures, in terms of effort and size, on three CSFs: "Team composition", "Project management", and "System analysis, selection and technical implementation". This three factors are included in our success model in figure 1.

Team Composition concerns professional roles and competences of the project team. Project team should be balanced, cross-functional and representative of the different areas of interest of the project (Razmi et al., 2009).

Project Management defines responsibility and scope of the project. The activities in project management relate to control and monitor the implementation of the project and its schedule and budget.

System Analysis and Selection and Technical Implementation consist in all those activities related to integration with existing legacy systems, to definition of architecture and design of the ERP system and to the selection of the more suitable software package.

Then we aim at evaluating the business value of the consultancy characterizing:

- the **Team Composition** in terms of size of professional roles involved and in terms of effort of their activities in ERP projects;
- the **System analysis and technical implementation** in terms of the effort spent in the ERP projects;
- the **project management** as percentage of time spent in this activity as well as the allocated resources. Many of these CSFs refer to activities made by external consultants. These measures are reported as indicator as predictor of success in the model presented in figure 1.

3.2 Research Methods

This preliminary research work, using a case study, aim at analyze the various projects, the professional roles played by the internal and external team, and at categorize the activities done from each category of professionals, during the implementation and the upgrade project performed in Energy.

Referring to Markus and Tanis model, we focus on the "Project stage". During this stage, we have also collected the information related to the activities carried out, through the time sheets daily compiled by external consultants and by the employees of the internal IT department.

3.2.1 Case Study: Energy

Using the model in presentation, we intend to develop our research work analyzing the data gathered in a real company. This is a local firm, of medium size, located in Italy, with around 450 employees, which produces, distributes and sells electricity and gas in one region of Italy. For convenience, we will call this company Energy.

3.2.2 The SAP Projects in Energy

The business information system of Energy is a SAP ERP system, deployed in 2002, implementing the modules of SAP R3. During 2003 was implemented the project SAP ISU Electricity (Electricity) that has involved the core business processes related with the distribution and sales of electricity. During 2005,

Energy implemented the project SAP ISU Gas (Gas), derived from SAP ISU Electricity. Then, during 2006, Energy has implemented the sales processes on the deregulated national market, through the SAP ISU Trading (Trading). In 2010, Energy decided to upgrade their SAP system released 4.6C toward the new version of the software named ECC6.0 (Upgrade).The upgrade project implied a technical upgrade of the whole software system, then rewriting of all the most important customizations made in the old version and finally a strong testing activity of all programs, functions and processes.

3.2.3 Projects' Description

The four SAP projects performed in Energy are described in Table 2, where we summarized data on size and complexity. In particular, we have classified them in Implementation, Rollout and Upgrade.

Table 2: The four project under study by type, number of modules, number of users, number of change requests, budget and duration.

Project	Type	Mod	Users	CR	Budg	Durat
		Nr.	Nr.	Nr.	K€	Months
Electricity	Impl	5	100	117	450	10
Gas	Enhan.	5	70	14	330	9
Trading	Roll.	4	20	19	90	5
Upgrade	Upg.	11	220	730	190	5

Table 2 illustrates, the name , the type of the project, the number of the ERP modules implemented (complexity of the project), and the number of the New Change Requests (CR) (business complexity). In the case of the Upgrade project, the number of CRs indicates the number of programs that have been changed during the technical upgrade. The first project, Electricity, is an Implementation Project. The business processes were tailored starting from a pre-customized model for Utilities companies. Although the original commitment was to reduce as minimum as possible the customizations (as suggested by (Wu and Wang, 2006)), the number of the CRs implemented is high (117). This was the first project implemented at the company and demonstrates poor project success in scheduling and budget as reported in Table 3.

The second project, ISU Gas, was implemented starting from the ISU Electricity, because many parts of the processes were in common. For this reason the number of new change requests is much lower (14). This indicates a strong strategy of reuse to reduce cost and effort. The project was on time and on budget and, as such, demonstrated a high degree of success. The third project implemented is Energy Trading: this was a rollout project directly derived from ISU Electricity. In our context, this project was a replication of the first one and as such has a good degree of reuse (low CRs) but a smaller complexity of modules implemented. This is because this project doesn't include more complex processes of electricity distribution. Table 3 illustrates the projects and their success according to the perception of the IT manager of Energy.

Table 3: Success in the four ERP projects.

Project name	On time?	On budget?	Success
Electricity	No	No	No
GAS	Yes	Yes	Yes
Energy Trading	Yes	Yes	Yes
Upgrade	Yes	Yes	Yes

3.2.4 Professional Roles

Analyzing data, we have identified seven different professional roles in project teams: the System Specialist (SS) provides technical knowledge about the software, competence on hardware configurations and on systems tuning. The Junior Developer (PrJR) is a programmer with experience in development, usually less than three years. Senior Developer (Pr) is a programmer with extensive experience in development with the programming languages of the ERP system being implemented and his skills cover several functional modules of the system. Junior Consultant (CJR) has work experience less than 3 years, superficial knowledge of a limited number of software modules. Senior Consultant (C) is a practitioner with several years (minimum 7) of experience and a strong knowledge about the specific topics of the customer's firm; Moreover, they know very well, how the different modules of the software are working, and they develop the functional and technical analysis, set the configuration's parameters and address the customizing activities. The Project Manager (PM) has, for side of the consulting firm, the control of the external resources involved and he is responsible, together with the internal project manager, for the outcome of the entire project.. User (U) is selected from various operating departments and must be familiar with business processes and have domain knowledge of their areas .They are involved at the analysis and the testing stages.

Table 4 displays the number of the persons involved and the effort per project by role. The data regarding the Upgrade project are split among internal and external team. The percentage is referred to total amount of effort spent in the project.

Table 4: Effort by team role.

6		PM	C	CJR	Pr	PrJR	SS	U	Total
Electricity	Nr	1	6	4	4	2	1		18
	Days	34	476	150	369	28	25		1082
	%	3,1%	44,0%	13,9%	34,1%	2,6%	2,3%		100,0%
Gas	Nr	1	6	1	4				12
	Days	33	252	39	171				495
	%	6,7%	50,9%	7,9%	34,5%				100,0%
Trading	Nr	1	4		2				7
	Days	2	116		44				162
	%	1,2%	71,6%		27,2%				100,0%
Upgrade external Team	Nr	1	5	1	2	1	2		12
	Days	46	129	84	80	10	50		399
	%	8,3%	23,3%	15,2%	14,4%	1,8%	9,0%		72,0%
Upgrade Internal team	Nr	1	4			1	1	2	7
	Days	N/A	49			46	47	13	155
	%	N/A	8,8%			8,3%	8,5%	2,3%	28,0%
Upgrade Sum		8,3%	32,1%	15,2%	14,4%	10,1%	17,5%	2,3%	100,0%

Table 5: Effort (in days) per project by activity.

Project	PM	Cust	Dev	Test	Train	Sys Act	Supp post	Err Hand	Tot
Electricity	36	308	392	149	46	25	88	37	1082
	3,3%	28,5%	36,2%	13,8%	4,3%	2,3%	8,2%	3,4%	100,0%
Gas	46	184	153	64	10	5	32		494
	9,3%	37,2%	31,0%	13,0%	2,0%	1,0%	6,5%		100,0%
Trading	12	88	37	10	1	3	11		162
	7,4%	54,3%	22,8%	6,2%	0,6%	1,9%	6,8%		100,0%
Upgrade	49	0	106	242	1	105	17	32	552
	8,9%	0,0%	19,2%	43,8%	0,2%	19,0%	3,1%	5,8%	100,0%

3.2.5 Project Activities

We analysed the four projects by the activities reported in the time sheets (records), differentiating between internal and external effort. After a deep analysis of the records, we came up with the following categorization of activities:

Project management: activities related to organization, management and control of the project.

Customization: activities to tailor the system on the customer requirements. This includes analysis of requirements, parameter setting and tuning.

Development: activities of software development needed to satisfy customer requirements that cannot be satisfied directly from parametric customizing. It includes analysis, code writing, and first testing on the development system.

Test: system testing to verify the functionalities of each module and integration testing to verify modules integration.

Training: activities performed by external consultants and addressed to users. They aim at transferring knowledge about system's functionalities from external to internal staff.

System Activity: activities needed to install, prepare, tune and synchronize the different systems included in the system environment.

Post go live support: activities performed by internal or external consultants, after the go-live of the system to stabilize the system in its first operational phase. The duration of these activities can give an indication of the success of the project.

Error handling: activities specific for solving errors detected after the go - live of the project.

Table 6: Electricity: Effort in days by activity and role.

Role	PM	Cust	Dev	Test	Train	Sys Act	Supp post	Err Hand	Tot
C	11	**252**	48	69	25		44	27	476
CJR		56	11	42	22		10	10	150
Pr	4		325	30			10		369
PrJR			5				22		28
Sys						25			25
PM	21		3	8			2		34
Tot	36	308	392	149	46	25	88	37	1082

Table 7: Gas: Effort in days by activity and role.

Role	PM	Cust	Dev	Test	Train	Sys Act	Supp post	Err Hand	Tot
C	11	**171**	1	30	9	5	24		252
CJR	2	13		15	1		8		39
Pr			152	19					171
PM	33								33
Tot	46	184	153	64	10	5	32		495

Table 8: Trading: Effort in days by activity and role.

Role	PM	Cust	Dev	Test	Train	Sys Act	Supp post	Err Hand	Tot
C	10	**88**		10	1	3	4		116
Pr			37				7		44
PM	1								1
Total	12	88	37	10	1	3	11		161

3.3 Model Construction

To build up our success model, we first identified the success factors to put in input of the model, among these ranked in the work of Nah and Delgado (2006) (Table 1): but only the factors we could measure in the projects analyzed in this work. Then we identified, for each factor proposed, the measures that we used to characterize them (Size, Roles; Effort per Activity). For each project we are able to identify them in time and budget as indicator of success, as perceived from IT manager (Table 3). Speculating on the measure values collected against the values of the success model,we have determined which measures actually might predict the success of the project. Otherwise we have knowledge that other factor could be indicate success in other context, and this is a limitation of our model.

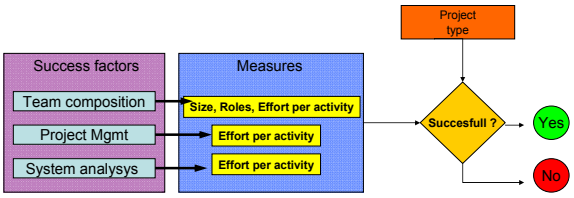

Figure 1: The model of success proposed in the study.

4 FINDINGS

Using the model proposed, we analyze the data regarding the factors identified as critical for the success. As first "**Team composition**", evaluated through the following measures:

Size of the team in terms of total number of persons involved in each project (table 4): we note that, considering only the external team composition , the size results high (18) in Electricity, and lower in Gas (12) and Trading (7) and Upgrade External (12): it seems that a lower size of the team might be indicator of success. But we have to be aware of the business complexity of the projects, it was higher in Electricity than in the other implementation projects.

Roles: measured in terms of effort spent for each role in the project. We note that in all projects, the most part of activities is made by Senior Consultants (C). As such, their activity is necessary to achieve success but, focusing on implementation projects, it seems that more activities are needed from this role. Analyzing the role of Junior Consultant, it seems that this role is not relevant for the success.

Effort per Activity: measured in terms of days spent per activity done. Analyzing table 5, we see that the activities are distributed among the different roles, but the most performed activities are customizing and development. In the Upgrade project, no customization has been reported as no functional upgrade was performed. Electricity project has the highest effort in development and the lowest in customization among the projects. We pose the attention on the activities made by each role, but in particular by Senior consultants. Analyzing table 6,7,8 we see that the major activity done from them (C), excluding Upgrade Project ,is the customizing (Cust.) activity: 53% of his activities in Electricity, 67% in Gas and 76% in Trading. Moreover, in the projects Gas and Trading , both successful , Customizing is the most activity done. Conversely in the project Electricity the most performed activity results the development, probably because of the high number of CR. Analyzing this data, it seems that the customizing activity is critical, and the major actor is the Senior Consultant, who, to achieve success, has to do the customizing activity, in a more focused way, without spending time in other activities.

Then we analyze the activities related with "Project management" (PM) that is characterized by the measure of effort in project management activity: table 4 shows that the role of project manager is normally played by only one external employee. Table 5 shows the effort per project by activity: the PM activity has a similar value among the four projects, but we note that the minor value (3,3,%) regards the project Electricity. this is a not successful project, That's why to achieve success we need an higher effort in this activity.

Finally we evaluate the activities related with "System analysis, selection and technical implementation" that in our case is characterized by the measure of the effort spent in "System's activity", performed by System specialists (SS) or by Consultants (C). Analyzing the implementation or rollout projects the values of the system's activity appear quite similar. This means that this activity is not relevant to achieve success. The effort spent in system activity for Upgrade project, conversely, is very high, and this measure, together with the test activity, characterizes very well this kind of projects.

5 CONCLUSIONS

This preliminary work aim at characterizing the business value of the professional roles, measuring the activities performed in implementation and upgrade of ERP projects to understand which roles are critical for the project to succeed. We propose a simple model drafted from these initial observations, based on the success factors of Nah and Delgado, (2006) and a set of measures that, evaluated on these factors characterizes the factors in terms of the overall project success. By analyzing the distribution of effort over the activities performed in four different SAP projects, we found that in our context the key factors of success are Team composition, Project management and System analysis and technical implementation. Using our model we found that to achieve success, the project team should not be too large, and we have identified as critical for the implementation projects the role of Senior Consultant, that is mainly involved in several activities. Moreover, we observed that his activities are critical, that's why his effort should be well enough provided and focused on the customization activity. By upgrade projects, where there is no customizing activity, the critical activities are Testing, performed by internal and external Consultants, and System's activity, performed mainly by system's specialists.

The success has been also determined by the increasing knowledge reuse and retain acquired by the internal staff with the implementation of the projects. This knowledge allowed the manager to reduce the cost for external staff and establish an internal Help Desk that automatically manages the change requests.

6 LIMITATIONS

The findings of this study are specific to one single ERP System, the SAP System, and one company. The size of the company, medium for Europe, the number of the users involved, the characterization of the specific business (energy) could limit the generalization of the findings. Moreover, not all the professional roles considered - as Junior developer or junior Consultant – can be found in literature. In addition, the classification of the activities is made interpreting the activity's description written from team members on time sheets. As such, data are subjective and subject to bias. For the Upgrade project, an automated system for Help Desk has been implemented and more objective analysis on the activities and the requests of change can be derived. This will be matter of future work. In our projects, we were able to collect data for three CSFs: Project Management, Technical Activities and ERP and Team composition. Other factors were not considered relevant at time of data collection. For this reason, the model and the related discussion is limited.

7 FUTURE WORKS

The success defined in this work concerns the contractual commitment of the suppliers. The project has been successful if it has been on time and on budget at go live. According to Markus and Tanis (2000), the activities performed after go live are critical and key indicators of long-term success. As such, Energy has established a Help Desk service that automatically collects bug reports and new CRs and provides solutions.. With this data we can trace the flow of request and the time of occurrences and fixing of issues Future work will mine this wealth of information to get a more objective characterization of the projects during maintenance.

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