

Solutions to Problems Occurring over the Enterprise System Adoption Lifecycle: A Preliminary Study

Completed Research Paper

Grażyna Paliwoda-Pękosz

Cracow University of Economics, Poland
paliwodg@uek.krakow.pl

Piotr Soja

Cracow University of Economics, Poland
eisoja@cyf-kr.edu.pl

Abstract

The paper investigates solutions incorporated by companies to overcome problems occurring during enterprise system (ES) adoption. It draws from the experience of Polish practitioners who participated in ES implementations. Following grounded theory approach and incorporating open and axial coding the solutions given by respondents were classified into 14 main categories and their distribution across the system lifecycle was analyzed. The research revealed uneven distribution of solutions from different categories across the system lifecycle and an in-depth analysis of this distribution resulted in practical guidance for companies that consider ES implementation.

Keywords

Enterprise system, ES adoption, solutions, problems, ES lifecycle, Poland.

Introduction

Enterprise systems (ES) support the management of the whole enterprise and integrate all areas of its functioning (Davenport 1998, p.121). ES have their roots in MRP, MRP II, and ERP systems, and are now very complex systems that support the management and integration of the whole company and offer inter-organizational integration with company's clients and suppliers (Volkoff et al. 2005). ES adoptions embrace the whole organization and involve multiple stakeholders who represent both the adopting company and external organizations. ES projects tend to extend over time and, in consequence, are very costly (Brown and Vessey 2003, Jones 2008).

Prior research emphasizes that during the usually long process of ES adoption the company may experience many problems and impediments to project success (e.g. Kim et al. 2005, Markus et al. 2000, Themistocleous and Irani 2001, Wright and Wright 2002). Further, the multi-staged character of ES adoption requires the incorporation of the system lifecycle into the investigation of ES adoption issues (Themistocleous et al. 2011). Nevertheless, to the best of our knowledge, prior research lacks the empirical investigation into the means employed by companies to overcome problems occurring during ES implementation. Therefore, this paper aims to investigate solutions to problems encountered during ES adoption. Specifically, the research questions employed by this study are:

- What solutions were undertaken to solve problems encountered during ES adoption?
- How do these solutions spread across the system lifecycle?

This paper is organized as follows: in the next section the background of our research is provided, which is followed by the description of research methodology. Further, the results and data analysis are presented. Next, implications for research and practice are formulated. Finally, the limitations of current study and directions for future research are outlined.

Research background

Prior studies dealing with difficulties in ES implementation and based on empirical research have been conducted among various ES practitioners. The enquired respondents include adopters (e.g. Kim et al. 2005, Kremers and van Dissel 2000, Themistocleous et al. 2001), experts representing ES system providers or consulting companies (e.g. Soja 2008, Wright and Wright 2002), and representatives of both system suppliers and adopters (Markus et al. 2000).

The issues most often reported by previous studies as significant problems during ES adoption include time over-run, lack of business process redesign, system drawbacks, and lack of users' involvement (Kim et al. 2005, Kremers and van Dissel 2000, Themistocleous et al. 2001, Wright and Wright 2002). Nevertheless, prior research works report difficulties which have various meanings and use varied categorizations, which makes comparing their findings difficult. Additionally, as pointed out by Authors (2009), previous studies do not analyze interrelations between discovered difficulties and do not attempt to find the source problems.

As mentioned earlier, there is a need for incorporating the enterprise system lifecycle into the analysis of ES adoption considerations in general, and impediments to ES success in particular (Themistocleous et al. 2011). Such a requirement has been met by the study by Markus et al. (2000), who interestingly divided the discovered difficulties into groups on the basis of ES adoption project phase. However, other studies dealing with ES adoption difficulties do not follow this approach and do not analyze changing considerations of ES adoption across the project phases.

The ES lifecycle has various definitions in prior research works (Themistocleous et al. 2011). In particular, Parr and Shanks (2000) divide implementation process into 3 general phases: Planning, Project, and Enhancement. Within the Project phase, they distinguish 5 sub-phases: Set up, Reengineering, Design, Configuration and testing, and Installation. Markus and Tanis (2000) discern 4 main ES adoption phases named: Project chartering, The project, Shakedown, and Onward and upward. Ross and Vitale (2000) suggest 5 adoption stages: design, implementation, stabilization, continuous improvement, and transformation.

This research is an extension of the authors' previous research that concerned impediments to ES adoption and their occurrence over the ES lifecycle (Authors 2009, 2013). In the current research we focused on investigating solutions employed by ES practitioners to overcome problems that occurred over the ES lifecycle. Our research is based on problem categories elaborated in the course of previous research (Authors 2009). Further, while incorporating ES lifecycle, we employed Somers and Nelson's (2004) categorization of ES implementation phases in which the following phases are distinguished:

- Initiation – ES system adoption justification, choosing the system, definition of business objectives,
- Adoption – project definition, creation of project design, selection of project participants,
- Adaptation – actual implementation of project design,
- Acceptance – delivering and running the system,
- Routinization – the system usage on a daily basis,
- Infusion – experience of the full potential of the system.

This model, developed on the basis of the six-stage model of IT diffusion (Cooper and Zmud 1990), captures comprehensively the whole process of ES adoption, including the post-adoption phase that is represented by the last two stages. For this reason we employed it in an analysis of activities that aimed at solving problems occurring during ES adoption.

Research methodology and sample

In order to investigate problems and solutions in ES adoption we turned to practitioners who participated in ES implementations. A semi-structured questionnaire with open ended questions was used to gather their opinions. The respondents were asked to enumerate problems that they encountered during ES implementation and describe how these problems were handled. They were also asked to indicate ES lifecycle phases related to the problem occurrence. We adopted a qualitative research approach that draws

from grounded theory proposed by Glaser and Strauss (1967) and employed open and axial coding (Corbin and Strauss 1990). In consequence, we classified solutions to the problems identified by the respondents into categories and subcategories. Then, we mapped solution categories unto the previously developed problem categories. Finally, we analyzed the distribution of solutions across the system lifecycle.

As a result of conducted research, 180 respondents expressed their opinions about implementation projects that were carried out in companies that operated in Poland. Table 1 presents the distribution of respondents by their role in the implementation, Table 2 shows respondents' structure according to their organizational position, and Table 3 depicts the distribution of respondents by company size.

Role in the implementation	n
member of the Project Team	66
project manager	33
supervisor/member of the Steering Committee	22
provider's representative/consultant	21
none/lack of participation	20
user	18

Table 1 Respondents by Role in the Implementation

Organizational position	n
specialist	78
manager	67
top management	16
director	15
n/a	4

Table 2 Respondents by Organizational Position

Number of employees	n
<= 250	81
251 – 500	17
501 – 1000	18
1000+	27
n/a	23

Table 3 Respondents by Company Size

Data Analysis and Discussion

Problems and Problem Categories

As a result of data analysis, the discovered difficulties have been categorized into 9 problem categories. The revealed problem categories are presented in the following, with percentages of answers for each category indicated in parentheses.

- Employees (23%) – problems mainly connected with employees' skills and negative attitudes such as fear, reluctance, and lack of system acceptance,
- System (15%) – difficulties mainly related with the enterprise system solution, its errors, efficiency, configuration, and level of complexity,

- Enterprise (15%) – problems mainly connected with the condition of the adopting company, its financial problems, organizational structure, undergoing changes, preparation for the project, and management personnel,
- Implementation Process (12%) – difficulties mainly related with the project definition, duration time, planning, and involved participants,
- System Misfit (9%) – problems mainly connected with lack of fit between the company's needs and the enterprise system, its functional deficiency and customization,
- IT Infrastructure (9%) – difficulties mainly related with network and hardware infrastructure needed by the enterprise system,
- System Replacement (6%) – problems mainly connected with data import, existing legacy systems, and smooth transitioning to the new ES,
- Training (5%) – difficulties mainly related with trainings, their schedule, scope and quality,
- System Vendor (3%) – problems mainly connected with implementation consultants and the vendor's lack of competence and sufficient resources.

Solution Categories

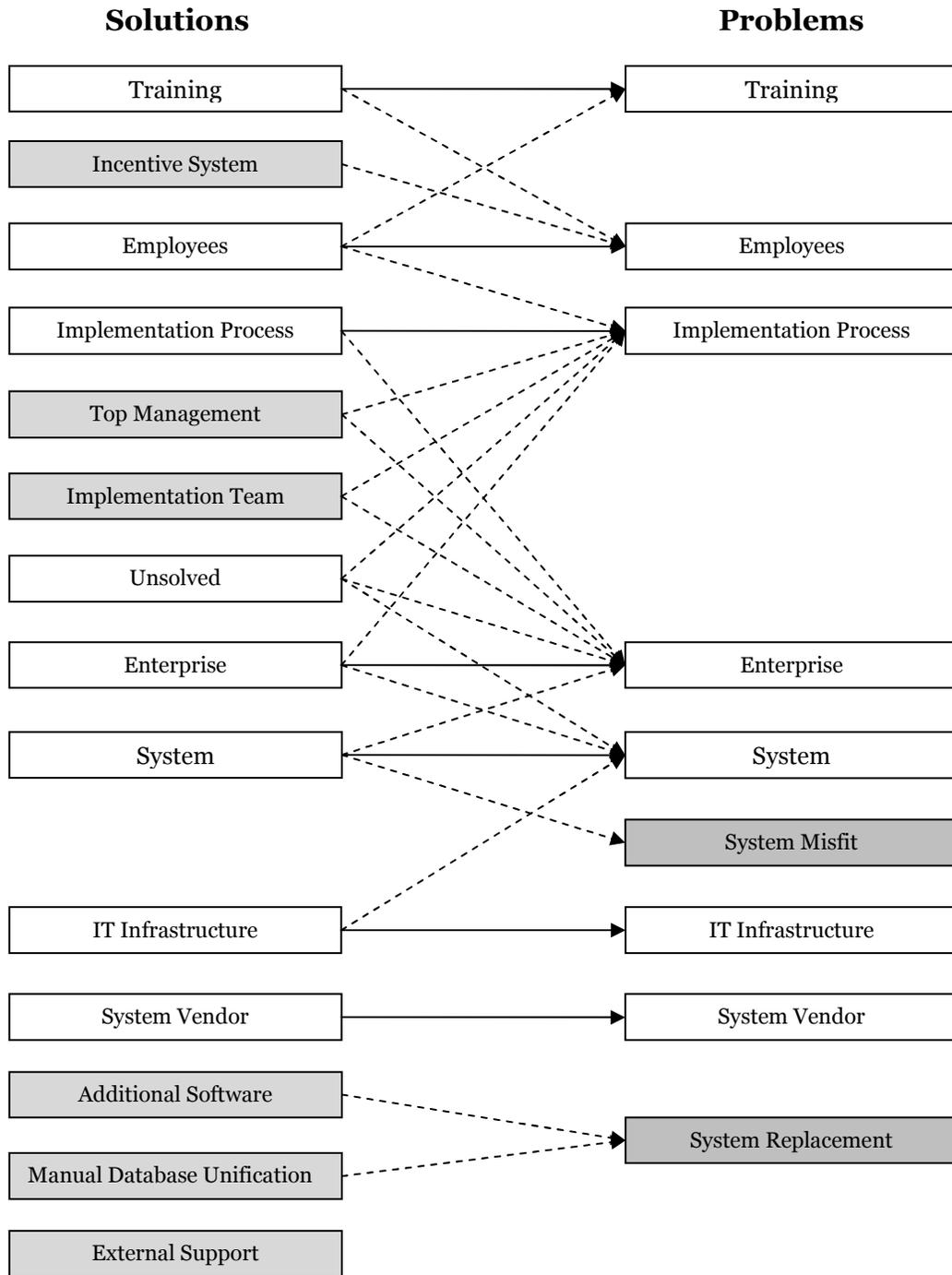
In general, respondents reported 902 solutions to 921 problems. During the analysis we distinguished 14 solution categories. They are presented in Table 4 which contains short definitions of categories and percentages of respondent answers for each category. The solution categories have been ordered in decreasing order of percentages of answers. The most numerous category encompasses solutions connected with various approaches to training. It is followed by a category that includes solutions related to the modification of ES system and its adjustment to the company needs. Then, with the similar frequency of appearance, Implementation Process and IT Infrastructure categories occur. They are followed by Employees, Enterprise and System Vendor categories. The solutions related to Manual Data Unification, Incentive System, Top Management, and Implementation Team were reported in almost the same number of cases. Respondents mentioned the least frequently solutions that belong to Additional Software and External Support categories. It should be noted that not all problems were addressed by the investigated companies. In consequence, the answers capturing lack of solutions to the declared problems were assigned to Unsolved category.

Solution category	Description	Percentage
Training	employing various kinds of training	21%
System	system customization, modification, and optimization	19%
Implementation Process	solutions connected with the management of implementation process	10%
IT Infrastructure	hardware and software improvement, enhancement of Internet connection	9%
Employees	solutions that require employees' initiative and involvement	7%
Unsolved	problems that remained unsolved	6%
Enterprise	improvement in company's organization and business processes	6%
System Vendor	solutions connected with vendor support and consultants	5%
Manual Database Unification	unification of databases by manual data entering or verification	3%
Incentive System	incentives introduced to encourage employees to accept the new system	3%
Top Management	solutions connected with top management involvement	3%
Implementation Team	adjusting implementation team composition and performance	3%
Additional Software	employing third party software to overcome shortcomings of ES system	2%
External Support	using the external services or funds	2%

Table 4 Solution Categories

Interrelation between Solutions and Problems

Figure 1 presents the mapping of solution categories onto problem categories. In general, it seems that some solution categories are more detailed than problem categories. This particularly refers to difficulties from Implementation Process problem category, which were addressed by solutions that belonged to Implementation Process, Top Management, and Implementation Team solutions categories. Similarly, problems from System Replacement problem category had their solutions from Additional Software and Manual Data Modification solution categories. Further, external support in the form of EU funds or other companies' services addressed problems from various problem categories; nonetheless, using this kind of support by ES adopters was limited.



Note: The mapping is marked when at least a medium level of solutions has been reported for the certain problem category.

Solid line denotes direct correspondence between solution and problem categories. Grey boxes denote solution/problem categories that do not appear in the corresponding list of problem/solution categories.

Figure 1 Solutions Categories Mapped onto Problem Categories

Solutions across the System Lifecycle

Table 5 illustrates the distribution of solutions across the problem categories and ES lifecycle. Solution categories are ordered in decreasing order of frequencies of solutions assigned to a certain category. The rightmost (shaded) part of the table displays the distribution of solutions across the ES lifecycle phases.

Employee training was organized in all stages of ES lifecycle; nevertheless, it is somewhat surprising that training on basic computer skills appeared only in Adaptation phase. This also refers to training connected with the explanation of benefits from ES adoption and use. It seems that these kinds of actions should be undertaken earlier in order to prepare employees and eliminate possible causes of future difficulties. Further, the high occurrence of additional trainings during the last three stages of ES lifecycle may suggest that practitioners organize trainings as an answer to occurring problems.

Solutions from System category concern mostly system customization, modifications, and bug fixing. It appears that the need of these actions was discovered in the course of actual system usage. Therefore, these solutions were mainly carried out starting from Adaptation phase. Nevertheless, the system-related solutions span also over the initial stages of the lifecycle, they are connected with system configuration and new modules installation.

It is not surprising that solutions concerning Implementation Process appear in all phases of the lifecycle with the least intensity falling on Infusion stage, which is the last post-implementation period of the lifecycle. However, it is surprising that solutions connected with implementation process goal definition were the most frequently reported by respondents and were present in all stages of ES implementation.

IT Infrastructure enhancements were carried out during the whole lifecycle; nevertheless, the highest concentration of this actions fall on Acceptance phase. In general, it might seem that IT infrastructure-related solutions are being applied too late. However, on the other hand, often only during the system normal operation the problems with hardware and networks can be revealed. Naturally, solutions from the IT Infrastructure category refer to problems connected with the system and IT infrastructure. However, they are also related to problems resulting from mistakes made during the implementation process, such as errors during analysis and design, inadequate testing and erroneous assumptions about infrastructure.

Solutions connected directly with employees (category Employees) were adopted during the whole ES lifecycle. This finding illustrates the importance of constant care of employees and the need to maintain their involvement over the whole lifecycle. Similar to solutions connected with employees, Incentive System-related solutions and those connected with Top Management (however, to a smaller extent), span over all stages of the lifecycle. This generally suggests that actions connected with people require constant attention and activity across all phases of the system lifecycle.

The need for enterprise reorganization is visible in all stages of ES implementation; however, as might be expected, the highest intensity of these kinds of solutions appeared in Adaptation and Adoption phases. Surprisingly, companies conducted some reorganization in the last two stages of ES implementation (Routinization and Infusion) that suggest that company's business processes were not correctly analyzed in the preceding phases.

The necessity of Manual Database Unification or Additional Software installation appeared in Adaptation phase as a response to problems with system replacement. These findings are not surprising as in this stage an ES is actually being installed and data from legacy systems need to be imported into the new system. This operation should be conducted with an extreme caution and it often requires manual data verification. It should be noted that sometimes additional software or add-ons to the new system are needed in order to transfer data from legacy systems.

As might be expected, issues connected with Implementation Team composition are crucial in the initial stages of ES implementation project. Nonetheless, it appears that close cooperation with system vendor and its adequate support enabled ES adopters to solve the whole range of problems that span across all stages of implementation process.

External support in the form of using other companies' services or benefiting from UE funds was of minor importance; however, it occurred in all phases except Infusion. It should also be noted that not all

problems found their solutions, which might suggest a failure or a sub-optimal performance of ES adoption.

Solution \ Problem	Employees	System	Enterprise	Implementation Process	System Misfit	IT Infrastructure	System Replacement	Training	System Vendor	Initiation	Adoption	Adaptation	Acceptance	Routinization	Infusion
	Training														
training/self-study	●●	○	○	○	○		○	○							
additional	●	○	○	○			○	●							
explaining benefits	●		○	○					○						
continuous	○	○	○	○											
leaders' training	○							○							
for all personnel	○			○											
schedule	○							○							
hands-on	○														
individual	○							○							
computer courses	○														
System															
customization	○	○	○	○	●										
modifications/enhancements	○	●	○	○	○		○	○	○						
bug fixing		●	○	○	○										
configuration		●	○	○	○	○									
new modules installation		○	○	○	○	○		○							
additional software		○	○		○										
updating		○			○										
interface modification	○	○	○												
database optimization		○	○		○	○	○								
testing	○	○	○	○			○								
license purchase		○	○			○									
Implementation Process															
re-analysis	○		○	○	○										
time extension	○	○	○	○	○		○	○	○						
goal definition		○	○	●	○										
pre-implementation analysis	○	○	○	○	○	○									
schedule	○		○	○				○							
implementation methodology	○		○						○						
employee time	○			○				○							
parallel work of systems	○						○								
monitoring				○				○							
IT Infrastructure															
network modernization		○		○	○	●									
purchase of equipment		○		○		●									
equipment replacement		○				○									
equipment modernization		○				○									
Internet connection		○		○		○									
hardware configuration		○		○		○									
Employees															
informing	●			○	○										
mutual assistance	○	○	○	○			○	○							
self-training	○	○	○					○	○						
involvement	○	○	○	○											
considering employee feedback	○		○					○							
time to adjust	○	○							○						

Solution \ Problem															
	Employees	System	Enterprise	Implementation Process	System Misfit	IT Infrastructure	System Replacement	Training	System Vendor	Initiation	Adoption	Adaptation	Acceptance	Routinization	Infusion
Unsolved															
unresolved	○	●	○	○	○		○	○	○						
problem acceptance	○	○			○	○		○							
unknown		○		○	○										
enduring			○		○		○								
Enterprise															
reorganization	○	○	●	●	○	○	○		○						
alternative solutions		○			○		○								
financial decisions			○	○											
employee control	○														
new employees recruitment	○														
System Vendor															
support	○	○	○		○	○		○	○						
additional consultants		○		○				○	○						
agreement			○						○						
cooperation	○	○		○					○						
consultant replacement									○						
local consultants	○				○										
Manual Database Unification															
data verification		○	○		○	○	●								
data entry		○			○		●								
Incentive System															
awards	○			○	○			○							
paid overtime	○		○	○											
employment guarantee	○														
introduction of an incentive system	○		○	○				○							
support of management	○														
Top Management															
involvement	○		○	○					○						
problem reporting to top management	○		○					○							
Implementation Team															
appointment of responsible employees	○		○	○											
more employees	○			○			○	○							
involvement			○					○							
Additional Software															
data conversion					○		●		○						
add-ons/overlays			○		○										
purchase		○			○										
External Support															
external company	○	○	○	○		○	○								
EU funding			○			○									

Note: Bullets represent the level of solution occurrence reported by the respondents:
 ●● – extremely high, ● – high, ● – medium, ○ - low.

Table 5 Solutions to Problems across ES Lifecycle

Implications for Practice and Research

On the basis of current research the following implications for practitioners might be formulated:

- taking care of employees is vital during the whole ES lifecycle. The system of financial and intangible incentives should be elaborated in order to gain employees' involvement,
- an appropriate training might solve most problems connected with employees, however, it needs to be prepared carefully in terms of schedule and scope. The training should foresee some possible future problems instead of being an answer to problems that have already appeared. Special attention should be paid to providing employees with information concerning a new system and explanation of benefits resulting from the system use. These activities might help in strengthening the employees' motivation and involvement,
- companies should not neglect the training on basic computer skills; such a training should be conducted for appropriate employees at the beginning of an implementation process,
- an in-depth analysis of requirements for target IT infrastructure in the pre-implementation stage should be conducted in order to eliminate future problems connected with inadequate IT infrastructure,
- companies should clearly define goals at the beginning of implementation process in order to focus all actions around these goals and to avoid disorder and lack of focus in later stages of implementation process,
- it is beneficial to analyze company's business processes at the outset of the implementation process in order to minimize the necessity of reorganization in the later stages of ES implementation,
- a company should be prepared for the need for organizational changes during all stages of ES lifecycle, which is often the consequence of an inadequate business process analysis during the project definition phase,
- it appears that in many cases system vendor-related problems boil down to problems with consultants and consultant replacement might solve the difficulties connected with system vendor.

The current study's findings illustrate the need to incorporate ES lifecycle into ES adoption-related research, which should result in a deeper understanding of this complex process. Further, the solution taxonomy elaborated in the course of current research might be useful for other researchers who investigate ES implementation considerations.

Limitation and Further Research

The main limitation of this research is related to the scope of research. The research was based on the data that came from companies that operated only in one country, Poland. Its applications to other countries might be limited; however, it might be first and foremost useful for companies that operate in a similar economic environment, i.e. countries from the Central and Eastern Europe.

In the further research we would like to conduct a comprehensive analysis of ES implementation that would include interrelations among impediments, solutions, and benefits reported in the ES lifecycle. In consequence we aim to work out how to overcome impediments to benefit realization during ES adoption. Another promising avenue of future research is connected with the impact of system customization on the implementation process and impediments resulting from the customization activities.

Conclusion

The research investigates means of overcoming difficulties that occur along the ES implementation lifecycle. On the basis of empirical data gathered from ES practitioners and incorporating grounded theory approach, the authors developed a solution taxonomy. The taxonomy distinguished 14 main solution categories with various subcategories. The solutions most frequently listed by respondents were connected with Training, System, Implementation Process, IT Infrastructure, and Employees. They were followed by solutions associated to Enterprise, System Vendor, Incentive System, Top Management, Implementation Team, Additional Software, and External Support. It should also be noted that some problems did not find any solution and they were assigned to Unsolved category. The analysis of solutions' occurrences across the system lifecycle resulted in a number of insights for practitioners and researchers. In general, solutions connected with people need to be applied in the all stages of implementation process and they could include activities connected with employees (appropriate, informative training, introduction of incentive system), top management (support and engagement), and system vendor consultants (support, replacement). Special attention needs to be paid to goal setting and IT infrastructure requirements definition in order to avoid their hasty adjustment in the final stages of implementation process.

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