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Implementation of an ERP system: A case study of a full-scope SAP project

Introduction

Although the research literature on Enterprise Resource Planning (ERP) systems is prolific, and covers all stages of the system lifecycle [Eden et al., 2014], detailed analysis of the implementation process is limited. Furthermore, misconceptions regarding this topic appear in the literature. The purpose of this study is to analyse the implementation of an ERP system in order to determine what activities were performed in each of the project phases, what effort was involved for each activity and how long they lasted. The paper is structured as follows. A literature review is presented, which was performed to determine current understanding of the ERP implementation process. The results of a case study of a SAP implementation project are then presented. Analysis of the documentation was used as the primary research method. Based on an analysis of the activity reports produced by the consultants during the project, the activities and resulting outcomes were identified for each of the project phases. The duration and effort of the consultants that was needed to accomplish each of the project phases were then identified.

1. ERP implementation – literature review

The implementation (project) phase of an ERP system lifecycle begins after the system and the implementing partner have been chosen, and ends after the system "go-live" [Lech, 2013]. It involves all of the activities necessary to make the selected system operational in a given organisation. Although the implementation phase is the most researched topic in the ERP system lifecycle, papers detailing the implementation and the activities performed during the implementation are scarce [Eden et al., 2014]. The studies that have presented the implementation phases in a comprehensive way are presented in table 1.

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Table 1. ERP system implementation phases

(1) Ahituv et al. [2002]	(2) Bajwa et al. [2004]	(3) Esteves et al. [2003]
Design: Definition of scope Establishing implementation teams and timetables Training of the implementation teams Initial implementation of the system	Preparation: Definition of scope Establishment of implementation teams and timetables Training of implementation teams Initial prototyping Determination of implementation approach	Project Preparation: Definition of project objectives and scope Preparation of project plan Definition of project team
Implementation: Gap analysis Business process reengineering Identification of complementary solutions Construction of prototype Data conversion Definition of work procedures Full implementation of the system Training of users Acceptance tests	Implementation: Detailed gap analysis Business process reengineering Identification of complementary solutions Construction of prototype Data conversion Clarity of work procedures Full implementation User training Acceptance tests	Business Blueprint: Detailed documentation of the organisational structure and business processes Scope adjustment Realization: System configuration Final preparation: Testing User training Cut over activities
Operation: Establishing of support centres Performance of changes and enhancements Upgrading the system System audit System termination	Operation: System use Maintenance Business integration	Go-live and support: Move from pre-production to production environment Support organization set up for end-users System performance improvement

Source: [Ahituv et al., 2002; Bajwa et al., 2004; Esteves et al., 2003].

Disregarding the differences in the naming of the phases, which is of minor importance, the activities presented in table 1 are quite similar, although there are some major differences.

1. Papers 1 and 2 mention the training of the teams and the prototyping/initial system implementation in the preparation phase of the project, while Paper 3 does not.
2. Papers 1 and 2 suggest the realisation phase starts from gap analysis and business process reengineering, which is then followed by the identification of complementary solutions and construction of the prototype. In this phase, Paper 3 presents detailed documentation of the organisational structure and business processes, followed by the system configuration.

It is noteworthy that in Paper 3, configuration is the only activity mentioned in the realisation phase. Papers 1 and 2 do not mention how the system is tailored to the needs of the adopting organisation.

Further analysis of ERP-related papers indicates that there is no clear view on what is carried out during the realisation phase of the project. Some of the authors reduce the realisation process to the installation of the software [Al-Mashari, Al-Mudimigh, 2003; Amoako-Gyampah, 2004; Beheshti, Beheshti, 2010; Vilpola, 2008]. Another group of authors make a distinction between the installation of the so-called "vanilla" system and system customisation, during which the system is altered to fit the organisational processes of the organisation [Grossman, Walsh; 2004; Ko, 2010; Helo et al., 2008; Somers, Nelson, 2004]. Chan and Rosemann [2001] as well as Wang et al. [2007], state that the implementation process mainly consists of the system configuration, blended with the organisational change. Hislop [2002] differentiates between configuration and customisation as the two ways of adjusting the system to the specificity of the adopting organisation, where configuration is the setting up the system parameters, and customisation is the changing of the existing code.

In this study, the approach presented by Hislop [2002] was applied, as it fits the reality experienced by the author in more than twenty implementation projects. To adjust the system to the specificity of an adopting organisation, one can choose between (or combine):

– configuration – i.e., setting the system parameters to determine the way the system operates by choosing from the existing options;

– customisation – i.e., changing the existing code of the system to alter its operation or developing a new code to extend or change the functionality of the system.

The implementation of an ERP system using only configuration meets the definition of a "vanilla" implementation. However, a "vanilla" implementation should not be considered as a simple system installation, because the biggest ERP systems include thousands of configuration tables [Brehm et al., 2001; Campagnolo, 2013; Light, Wagner, 2006] offering a "myriad of business processes to choose from" [Light, Wagner, 2006]. Therefore, planning and executing the configuration of a large system requires significant time and effort.

The aim of this study is to analyse the implementation of a big ERP system, namely SAP ERP, to determine what activities were performed during the project and with what effort. The remainder of this paper presents the results of the case study.

2. Research approach

The following research questions were posed in this study:

1. What activities are performed during the ERP implementation project?
2. How long does a project phase last?
3. How much effort do these activities involve?

Case study was selected as the research method, with the analysis of documentation being the main data collection approach. The unit of analysis was a full-scope SAP ERP project in a medium-sized production company, employing 200 employees. The reasons for the implementation of a new ERP system was the inefficiency of the legacy system. As the company grew, the complexity of the business processes increased, and so did the need for complex planning and information. The legacy system could not cope with these increasing requirements, which resulted in the decision to implement a new system.

The project duration was sixteen months and the implementation covered all major areas of the adopting enterprise's operations: purchasing, stock management, production planning and execution, sales and distribution, and accounting. The project was executed in a client – consultant mode: the adopting organisation hired a professional consulting firm to execute the implementation project. While the client's staff participated actively in all phases of the project, formulating the requirements, super-

vising the implementation work and testing the system, most of the implementation was done by the employees of the consulting enterprise. These individuals, both consultants and programmers, reported their work on a weekly basis in a form of *Activity Reports* (AR-s) which contained short descriptions of what had been done, together with the effort expended (in man-days, where half a day was the minimum unit of evidence). These ARs of the consultants and programmers were the source of data for this study. In total, 250 entries were identified, relating to 724 man-days of consulting work (as many activities lasted longer than one day).

3. ERP implementation – case study results

The results are broken down by the project phase, according to the ASAP methodology project split.

3.1. Project preparation

In the project preparation phase, the work was done mostly by the project manager of the consulting enterprise, with some input from the project manager of the adopting organisation. The aim of this phase was to prepare the project's environment from formal and organisational perspectives so that the work in the subsequent phases would be performed in a structured way. The main product of this phase was the Project Charter document:

1. Project plan:
   - the project scope and the budget (repeated from the contract),
   - the project phases and their descriptions,
   - a definition of products for each project phase,
   - a definition of project milestones,
   - a detailed project schedule (based on the general schedule from the contract).
2. Definition of the project organisational structure:
   - a definition of project roles and responsibilities,
   - the assignment of project participants to their respective roles.
3. Project procedures:
   - communication, i.e., communication means, frequency, and communication paths,
   - documentation, i.e., project repository and document templates,
   - risk management, i.e., identification, reporting, mitigation, and escalation of risks,

- change management, i.e., identification, reporting, approval, and escalation of change,
- management of open items, i.e., identification, reporting, management, and escalation of open items,
- status reporting, i.e., frequency, logistics (physical meeting or teleconference), and reporting document templates of status reports.

Compared to the lists of activities derived from the literature and presented in table 1, the following differences are noteworthy:

1. Project scope, budget, and schedule were not defined in the project preparation phase. This was done during the phase of selection of the implementation partner, which was the part of the pre-project activities.
2. There was no initial implementation of the system in the project preparation phase.

These differences are not only true only for the project in this study, but also for all of the 20+ projects in which the author took part.

The project preparation phase lasted for one month and involved twelve days of consulting by the project manager, which constituted 1,66% of the total workload.

According to ASAP methodology, in the project preparation phase the system is also installed. However, in the project being analysed in this study, the system environment was already in place, so no installation was needed. An SAP system landscape usually consists of three systems:

- a development system, which is used for system configuration and customisation during the project;
- a quality assurance/test system – used for testing;
- a production system – used for daily operations.

Finally, a development system should be available at the end of the project preparation phase.

A sandbox is often installed to be used for prototyping during the project. The sandbox is usually a part of the development system (separate "client", i.e. logical subsystem in the development system). The Project Preparation phase ended with a project kick-off meeting, during which the teams met together and were briefed regarding the project's goals, deliverables, scope, and schedule.

3.2. Business Blueprint

In the Business Blueprint phase, the consultants gathered detailed knowledge regarding the business processes and information requirements of the adopting organisation. The main sources of information were

workshops with the process owners and key-users from the adopting organisation. An additional source of information was an analysis of the existing documentation (documentation of the systems, reports, and printouts currently used). As a result of this phase, Business Blueprint documents were produced for each of the functional areas. These documents contained the "translation" of the adopting company's requirements into SAP language. They described the way in which the company structure would be reflected in SAP, the structure of the master data. They also included a brief description of the business processes, followed by a detailed description of how these processes would be executed in SAP, using the standard functionality i.e., how the system would be configured. This was the basis for the actual system configuration in the subsequent project phases. The Business Blueprint documents also contained a high-level description of the system customisations: enhancements, interfaces with other systems, non-standard reports, and printouts (forms) – RICEF in SAP nomenclature (Reports, Interfaces, Conversions, Enhancements, and Forms).

The Business Blueprint phase lasted for four months and involved a total of 145,5 days of consultants' work, which constituted 20,10% of the total workload. Of these 145,5 days, workshops with the process owners and key-users involved 92,5 days (12,77% of the total workload), preparation of the Business Blueprint documents involved 43,5 days of work (6,01% of the total effort) and 9,5 days (1,31% of effort) were used for project management activities.

3.3. Realisation

During the Realisation phase, the system was actually configured according to the design included in the Business Blueprint. The technical design for the customisation work was also prepared, and the customisation was executed. The realisation phase lasted for three months (although some customisation work was developed at a later stage – some work continued for the next three months) and involved 204 days of work from consultants and programmers, which constituted 28,18% of the total workload.

The split of the workload was the following:

- configuration – 50,5 days (6,98% of total workload),
- customisation – 130 days (17,96% of total workload),
- requirements analysis and preparation of the technical blueprints – 56,5 days,

- coding – 75,5 days,
- data migration – 18,5 days (2,56% of total workload),
- project management – 5 days (0,69% of total workload) days.

Configuration is the primary method of adjusting the SAP system to the requirements of an adopting organisation. All SAP configuration transactions (a transaction is an executable program in SAP) are collected in a separate menu – the IMG (implementation guide). The IMG is intended to guide the users through the implementation process on a top-down basis: from general settings, affecting all companies and all functional areas, to the detailed ones, specific for a given functional area of the company (or part of the company). However, SAP offers so many configuration options, which interdepend or contradict each other, that even with the use of the IMG, the configuration of the system requires a lot of specific knowledge and experience, and therefore, this is usually carried out by professional consultants. The configuration starts with the setting up the company structure. Each of the functional areas in SAP has its own elements of company structure, which have to be defined and connected to each other. The master data types are then defined, together with their steering parameters and their field statuses. This is followed by the configuration of the transactions, which reflect the business processes in the system. The field statuses for each screen can also be adjusted.

The customisation items were also defined and programmed during the realisation phase. As in the Business Blueprint these items were only identified. The first step was to detail the requirements and prepare the technical design documents (technical blueprint) for each element that required programming. Then the actual programming was executed. The majority of the customisation work involved creation of interfaces between the ERP system and the Manufacture Execution System, the Sales Force Automation System and the Business Intelligence platform, as well as development of reports and forms (printouts). Minor extensions of the standard functionality were also developed in the logistics area. No modifications of the standard code were made.

Data migration templates and programmes were also prepared in this phase. The data migration templates mapped the master data from legacy systems to the SAP system. They were prepared as Excel files, which were later filled with real data from the legacy systems. Data migration programmes allowed for the automatic input of the data from the Excel files to SAP.

3.4. Testing

Testing is not a standalone phase in ASAP methodology. However, in this project, testing was started at the end of the realisation phase and, for some developments, continued during the final preparation phase. Therefore, for clarity of the analysis, activities related to system testing were shown separately. The tests were carried out in three phases:

- unit testing was done by consultants alone, in each of the functional areas (modules) separately;
- modular tests were done by the key-users with the assistance of the consultants for each of the functional areas (modules) separately;
- integration tests were done by the key-users with the assistance of the consultants and the whole business process was tested, involving multiple functional areas (modules). Integration tests were also considered to be user acceptance tests (UAT), no separate UAT sessions were performed.

Modular and integration tests were carried out with the use of test scenarios, prepared by the key-users. They included standard and non-standard situations, as well as negative scenarios (erroneous transactions and their corrections). Unit tests, done solely by the consultants, were not carried out using the formal test scenarios.

Testing involved 142,5 man-days of work from the consultants and programmers, which constituted 19,68% of the total workload. The general testing activities lasted for three months but as some of the customisation work related to the development of interfaces and printouts was late, and the tests of these items continued for the next two months, in parallel with the final preparation activities, and were finished right before the productive start of the system.

3.5. Final preparation

During the final preparation phase, all of the configuration and customisation was moved to the production system, which was then fine-tuned to be ready for the "go-live". Data migration was performed for the master data, opening balances and open items and end-users were trained to use the system. User authorisation profiles were also created and users were assigned to them so that each user had access only to the system functions he/she was authorised to execute.

All these activities were performed according to the Productive Start Plan, which was developed at the beginning of the phase. This document stated a sequence of actions, both in the legacy systems and in the new sy-

stem, which ensured a smooth transition to the new IT environment. In particular, the Productive Start Plan specified the exact dates of freezing the legacy systems so that closing balances and open items from these systems were transferred to the new system via the data migration templates and programs. It also specified how the delta of the data is treated: as the migration takes time (data from legacy system have to be moved to the data migration templates, checked for consistency, then migration has to be done to the new system). There is usually a time lag between the freezing of the legacy system and the start of the new system. During that time, new data cannot be stored in an old system or in a new one. The solution is to either collect source documents during that period and input the data into the new system manually, or to create temporary tools to evidence that data and then input in to the new system using the migration mechanisms. This phase lasted for two months and involved 64 days of consulting work, which constituted 8,84% of the total workload.

3.6. "Go-live" and support

After the system "go-live", it began to be used for daily operations. However, as the system is complicated to operate, the users required help from the consultants during the first three months. During this time, some minor errors were also identified and corrected. The support phase involved 156 man-days of work from the consultants and programmers, which constituted 21,54% of the total workload. After three months, the project was completed and the system was subject to the routine support agreement.

4. ERP implementation process – research summary

The summary of the results, presenting the phases, the activities and the products, constituting a complete ERP implementation process, is presented in table 2.

Table 2. ERP implementation process

Phase	Activities	Products	Duration	Effort
Project preparation	Definition of: – Project plan, – Project organisation – Project procedures System installation Kick-off	Project Charter System environment ready to start the project	1 month	12 days 1,66%
Business Blueprint	Analytical workshops, definition of: – enterprise structure, – master data, – business processes, Identification of RICEF Preparation of Business Blueprint documents (system design)	Business Blueprint, including: – enterprise structure, – master data structure, – configuration design for business processes, – list of RICEF with high-level description	4 months	145,5 days 20,10%
Realisation	Configuration of the system according to the design from the Business Blueprint Detailed requirements analysis and preparation of technical blueprints for customisation items (reports, printouts, interfaces, enhancements) Preparation of data migration templates and programs	System configured according to the design from Business Blueprint Customisation items programmed Data migration templates and programs	3 months	204 days 28,18%

Phase	Activities	Products	Duration	Effort
Testing	Unit tests Modular tests Integration/user acceptance tests	System accepted by the adopting organisation	3 months	142,5 days 19,68%
Final preparation	Preparation of the Productive Start Plan Transport of the configuration and customisation to the productive environment Fine-tuning of the productive system Data migration End-user training Preparation of user authorisation profiles	System ready for "go-live"	2 months	64 days 8,84%
Go-live and support	System launch Support of the users Correction of errors	System in normal operation Users familiar with the system Errors corrected	3 months	156 days 21,54%

Source: Own elaboration.

The activities performed during the project are in line with the implementation methodology presented in Esteves et al. [2003]. The major differences are the following:

1. Project objectives and scope were not defined during the Project Preparation phase. Instead, they were defined before the project start, and included in the contract between the adopting organisation and consulting partner.
2. Business Blueprint was not only the documentation of the organisational structure and business processes. A design of how these would be reflected in the system with the use of configuration and customisation was also produced.
3. In the Realisation phase, the system was not only configured, but also customised.

These differences can be seen, not only in this project, but also in the many other projects in which the author took part. The current study also presented the activities in more detail. The testing is actually not the separate project phase, and in this study, it was only shown separately because it involved significant effort.

The similarity of the project methodology applied in the study of this project with the one presented in Esteves et al. [2003] does not necessarily mean that the other approaches presented in the literature review are not correct. They may reflect different approaches to implementation. However, the results presented above correspond to the experiences from other 20+ projects in which the author took part.

The results from one project cannot obviously be generalized with regards to time and effort needed to accomplish a project. However the phases, the activities and the products presented in this research, as well as the division of implementation work between configuration and customisation are common also to other projects.

Conclusion

The study presented in this paper analysed the activities, products, and effort needed to perform a full-scope ERP project. As a result, a list of the activities performed in each project phase and the resulting products was developed. This list is more comprehensive than those developed in previous research studies. Although the current study analysed one implementation project, the list of activities corresponds to the experience gained in other projects in which the author took part. Therefore, the re-

sulting implementation process can be treated as universal to some extent (although not the only possibility, of course). A clear distinction was also made between the system configuration and customisation. Configuration was defined as setting the parameters of the system, and customisation referred to changing or adding a new code to the system. Both methods of adjusting the system to the needs of an adopting organisation were used in this project. The analysis of effort showed that the effort needed for configuration should not be underestimated. Even if the project were a "vanilla implementation", i.e., not involving any customisation, this would still require significant time and effort. The project duration and effort are specific to the project that was analysed and may differ significantly in other projects. This data should, by no means, be generalised or extrapolated to other projects.

The main limitation of the study is that it was based on one case study. Therefore the duration and workload for each of the activities may differ in other cases. The list of activities performed in each of the project phases, as well as products of these activities may also differ from case to case (e.g. if agile methodology is implemented), however the results presented in this paper offer a working, detailed and full-scope methodology, which was tested in practice. It may be used as a reference for practitioners aiming at implementing an ERP system. It may also be used for researchers as a reference while examining ERP implementation projects in detail. The results also shed light on the notion of the "vanilla" system, present in the IT literature. For big ERP systems, like SAP ERP, no such thing as vanilla system exists – i.e. after installation the system is not ready to use. An implementation project is always needed before the system can be used, even if it only involves configuration of the system, without any programming work (i.e. customisation). Therefore, when performing studies on ERP implementations, one should indicate if the study involves small, ready-to-use systems, offered on a take-it-or-leave-it basis, or big ERP suites.

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Implementation of an ERP system: a case study of a full-scope SAP project (Summary)

The paper presents the process of implementation of an ERP system basing on a single case study, with analysis of documentation being the main data collection approach. Activities and resulting products were presented for each of the project phases. Duration and effort needed to accomplish each phase were also identified. The result of the study is presentation of a real-life ERP system implementation methodology, verified during the full-scope implementation project. The paper may be of interest to researchers, who want to study any aspect of the ERP implementation as well as practitioners not familiar with ERP methodology, for example individuals aiming at entering the consulting industry or implementing ERP in their organisations.

Keywords
ERP, methodology, configuration, customisation