ERP and Customization: Case Study of Logistics Processes Integration in a Telecommunications Company

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Abstract

The avoidance of customization is considered as critical success factor for ERP implementation. In this context, this paper aims to try to answer the following question: "ERPs are expected to adapt to business rules of the company in standard but why the use of customization is almost inevitable?" To address this question, we propose a case study of a "telecommunications" logistics processes integration in ERP. This study revealed an issue that is not supported in standard by ERP or mentioned in supply chain standards; then this paper propose a theoretical framework to formalize this issue.

Keywords: *ERP, implementation, customization, critical success factor, logistics, supply chain, telecommunications, information system*

1. Introduction

1.1. Context

The major challenge for the modern company is to optimize the supply chain: maximizing the use of resources and the customer service compatible with the business strategy. This is the reason for the continual recourse to the implementation of ERP in most companies [6]. Indeed, the implementation of an ERP carefully chosen can significantly reduce the cost of storage, the cost of raw materials, the customer delivery time, the lead time and the cost of production [7].

The fundamental principle of an ERP is to build computer applications in a modular way by sharing a single and common database. This creates an important difference with the previous situation (the customized applications existing before ERPs) because data is now assumed standardized and shared, which eliminates multiple entries and avoids the ambiguity of multiple similar data.

Note that ERPs cannot fit all companies; each of them is unique and has special management. Two solutions are possible:

- review the specific business rules to fit the ERP. This involves a preliminary analysis of processes and a reflection to be undertaken by the project owner and a good change management during the implementation of ERP. Indeed, employees must be prepared to see the nature of their work evolve, adopt new business rules and abandon the old software they used.
- use the customization by achieving specific developments, but don't go too far in specifics because in this case we lose the benefit of ERP. Indeed, the customization can be required only when the competitor advantage which involves the use of a non-standard process can be clearly justified [8].

On 1000 companies interviewed over customizing the ERP: 41% proceed to reengineering their business processes to fit the application, 37% choose the applications that fit their business processes and conduct minimal customization and only 5% customize the application to fit their business processes [9].

1.2. Motivation

Among the most active areas of research, we find that on the critical success factors for ERP implementation. The avoidance of customization is considered as critical success factor for ERP implementation [3]. The customization is not necessarily the parameterization but the use of specific developments.

Customizations usually generate an increase in the cost of information systems and the duration of the implementation and prevent us to benefit from upgrade and maintenance offered by the editor [4]. And that is why all companies who opt for the implementation of ERP seek at any price to avoid the specific developments but unfortunately this desire is still not fully answered, which leads us to ask the following fundamental question:

« ***ERPs are expected to adapt to business rules of the company in standard but why the use of customization is almost inevitable?*** »

To answer this question, we will work on a case study of logistics processes implementation in a telecom operator: this case study is a good example where the use of specific developments is inevitable.

1.3. Methodology

A considerable investigation has been conducted in a telecom operator over two years since the launch phase of ERP implementation project to the post-implementation phase. At the same time other auxiliary investigations were carried out in five different types of companies implementing ERP for different sectors. All these companies were examined to understand how they have implemented their logistics processes in the ERP.

After these studies, results have been found to help provide a theoretical framework as a basis to develop the models.

The paper is organized in two chapters: the first chapter presents the ERP literature and focuses on customization while the second chapter develops the issue raised by the case study.

2. ERP

2.1. Introduction

The information system of a company which does not have an ERP is typically composed of non-standard systems which are not found on the market. To support the development of the company, these systems should communicate with each other using interfaces that make after a while the information system of the company unoptimized.

In contrast to specific developments, ERPs have several advantages:

- optimization of business processes;
- coherence and consistency of information;
- integrity and uniqueness of the information system;
- sharing the same information system facilitates internal and external communication;
- minimization of costs: no interface between modules, synchronization of treatments, simplified corrective maintenance as provided directly by the editor and not by the IT department of the company;
- globalization of training;
- control of costs and deadlines for implementation and deployment.

The ERPs allow a company to manage and optimize all of its resources from production to after-sales service, through human resources, finance, logistics and sales. These complex projects lead to rethink existing organizations, to clearly identify the needs and to carefully plan the implementation of the information system.

2.2. Definitions

[36] For Deixonne, ERP is a software solution that provides the ability to manage all the resources of the company (human, material and financial) by focusing on two aspects: communication between different business actors and consistency of information. Similarly [39] Rosemann defines ERP as standard software solutions with integrated management for all processes within an organization namely production planning, warehouse management, finance, human resources management …

ERP is a generic and adaptable solution, developed by a single editor and consists of several interconnected modules integrating key functions needed to manage flows and procedures of the company (accounting and finance, logistics, business management ...).

The integration of business processes is considered one of the main objectives of the ERP implementation [26,27,28]. ERPs are indeed designed to address the problem of fragmentation of information in organizations [22]. A typical ERP integrates all functions of a business by allowing modules to share and transfer information freely [23,24]. ERPs do offer great opportunities to provide information to organizations in a standardized and centralized way [25].

Furthermore, the ERP is recognized as being effective in reducing inventory costs, improving efficiency and increasing profitability [29,26]. ERP is also known to reduce production time [30,31]. The ERP allows the stock declines, reductions in operating costs, the wealth of information desired by the customer and the ability to manage the extended company of suppliers, alliances and customers as an integrated whole [32]. With these

advantages, the ERPs are widely implemented as backbone for many companies in the service and industry sectors [21].

2.3. Litterature

2.3.1. ERP Implementation and CSFs

[41] Botta-Genoulaz, Millet, Grabot (2000) classify the research literature on ERP systems in six categories: implementation of ERP, ERP optimization, management and ERP, ERP as a tool, ERP for supply chain management and case studies. They also noted that the post-implementation phase of projects, customization of ERP systems, the sociological aspects of the implementation, interoperability of the ERP with other systems and return on investment from the implementation are the most active areas of research.

The ERP system is a generic term for a large number of activities supported by multi-module software application that helps organizations to manage their resources [42]. However the ERP implementation is a complex exercise and many companies have encountered problems in the different phases [43,44]. In fact, many cases of failure in the ERP implementation due to cost and time overruns have been identified [45,46]. The high failure rate in implementing ERP calls a better understanding of the process [47]. In order to reduce the failure rate in implementing ERP, a number of studies have attempted to identify the critical success factors (CSFs) in ERP implementation.

[48] Bullen and Rockart defined CSF as "the limited number of areas in which satisfactory results will ensure competitive performance for the individual, department or organization. CSFs are the few key areas where things must function properly, so the business can thrive and the objectives of managers can be met". CSFs for ERP implementation bring a concept that helps an organization to identify critical issues that affect the process of implementation. Through a better understanding of the CSFs for ERP implementation, an organization can determine the corresponding solution to eliminate or avoid the causes of the most common failures in implementation [49].

For example, some CSFs identified in the case studies reviewed by Sumner [50] have included: the support of top management, the adaptation of business process to ERP standard, investment in training of the user, avoidance of customization and use of consultants with functional and technical expertise.

2.3.2. Customization

We propose in this section to examine customization of ERP systems which presents the area of research concerned by this paper. [52] According to Esteves and Pastor, the implementation phase concerns customization or parameterization and ERP package adaptation required to meet the needs of the organization. Often this task is performed with the help of consultants who provide implementation methodologies, know-how and training.

ERPs provide generic solutions to customers. They can more or less completely satisfy the needs of the company and especially when the business processes of the company are unique. And then customization is required. It is therefore important to choose the ERP that is easy to customize, so the time and cost consumed in the customization are minimized [58]. Customization is indeed a situation where a feature is added or modified not by the parameterization but by other means such as customizing the application code. In general, the modification of the ERP standard version in order to better support existing processes in an organization is referred to as customization.

Preserving the unique process is forcing companies to adopt ERP customization and take the risk of increasing the implementation time and the costs of maintenance and migration in the future [59]. However, companies must maintain a minimum customization since any change necessarily lead to higher costs [55] and more the software application is customized, more the cost and the possibility of error is high [56,57].

Generally customization increases the scope of the ERP project by adding time and cost to an implementation [54] and makes the software application unstable and difficult to maintain: a failure in the application can cause the cessation of the organization [53].

[60] Nah et al. (2001) list that minimizing customization is considered one of the CSFs for ERP implementation. And to minimize the need for customization, we must select at the acquisition phase the product that best meets the requirements of the organization [51].

New versions of the ERP may include new features that conflict with the changes already made or can remove structures that are required in the customized system of the organization [62]. This is why organizations implementing ERP should as far as possible try to adopt the features offered by the ERP rather than try to change the ERP to meet specific business practices [61]. CapGemini often advises that "it is cheaper to change the organization than to change SAP."

2.4. ERP implementation project

2.4.1. Context

The ERP implementation is a large project that undertakes for the enterprise very important installation and operating costs: licenses purchasing, acquisition of equipments, cost of implementation... Vision and objectives should be clearly stated in the business plan [66,67,83], including a justification of the investment, a clear statement of the project's mission and goals that should be associated with the business needs.

User habits can be conducted to change in this type of project in which a serious involvement of top management is strongly required to ensure achievement of objectives. For this, the top management must be willing to become involved and to allocate scarce resources to support the effort of implementation [66,67]. Indeed, ERP projects encroach on the boundaries between departments and affect many stakeholders, the top management was asked to mediate between different groups to solve political conflicts when necessary [68].

To be efficient and competitive, the company must consider the event of ERP implementation as a real opportunity to review its processes and to adopt good practices generally offered by ERPs.

2.4.2. Organization

The ERP implementation project cannot be ensured only by internal resources but necessarily requires the intervention of the integrator (supported by the editor) who provides the company functional and technical consultants bringing their expertise on ERP. The company must ensure the quality of consultants because it is considered as a critical success factor for the ERP implementation. As this project appeals to an external company, the organization of ERP implementation project is usually structured into two teams working in logic of customer/supplier relationship: project owner and project supervisor.

The project supervisor has the know-how and delivers ERP implementation; it then takes care of the training of key users, the animation of the needs analysis workshops and prototyping the adopted solution. While the project owner is responsible for monitoring the ERP implementation project and managing change which must be engaged early in the project. The quality assurance plan is a document often used to clearly identify the roles and responsibilities assigned to both project owner and project supervisor. It is recommended also that the project should be driven by the business department and not by the IT department [84,85,86].

2.4.3. Implementation

The ERP implementation is to configure and adapt the ERP to business processes identified and validated during the needs analysis with the various stakeholders and to put into production the finalized and accepted solution by key users. Parameterization and specific developments are obviously assured by the project supervisor and therefore a complete and clear documentation is essential: the documentation on parameterization must be performed throughout the project and in a very rigorous way, the used parameters, values and functional or technical meaning, interfaces with other systems, additions and modifications to the ERP must all be properly documented.

2.4.4. Change management

As long as the change management entails a real balance of power in favor of the change over the resisting forces [73], the company must be truly interested in changing policy to adopt at the beginning of the project. The company must indeed prove to users the choice of ERP and must carefully define why the ERP being implemented and what are the critical business needs addressed by the system [69,70,71,72].

Users generally adhere more to the ERP project than to the development project which generates naturally critics due to their technological and functional limitation compared to the ERP that offers more coverage and techniques from the latest technological advances.

A clear and effective communication at all levels of a company is required before and during the ERP implementation [82,67]. Communication includes the formal promotion of ERP project teams and the announcement of the progress of the project [66]. Amoako-Gyampah and Salam [81] note that effective communication is one of the success factors which act on the acceptance of the technology in an environment of ERP implementation.

The ERP requires the updating of skills that can only be achieved through training provided to employees of the company. If employees do not understand how a system works, they probably invent what they are capable of handling [74,75,76,77,78]. That is why the training is at the heart of change management and should be carefully managed. The company must consider both the initial training and recurrent training of users. Note also that user training will be effective only if it includes the business processes as a part of its content [79,80].

3. Case study

3.1. Introduction

During the investigation conducted in a telecom operator, we have examined the integration of logistics processes over all the phases of ERP implementation project.

In the phase of needs analysis, the logistics processes were carefully analyzed through several workshops with stakeholders: this phase helped to highlight the detail of data required for the logistics processes selected to be implemented eventually in the ERP. At this first phase, the integrator team warns that some features are not supported by the ERP standard, and then there were other workshops to prevent the use of specific developments but without success because the requested features are critical to the business and cannot be bypassed.

The use of specific developments was eventually chosen for the prototyping phase. The actual delay of this second phase was significantly higher than the expected delay because the specific developments were not anticipated previously.

After rolling the test phase, the project was put into production successfully. However requests for changes in the system have emerged during the post-production phase to ensure service continuity of the operator. We must recognize that the management of these changes has been difficult because of the rigidity of specific developments.

To understand why we had recourse to the specific developments, we first start by explaining the concept of “classical logistics” in the next paragraph, then we try in the paragraph that follows to describe the logistics processes of the operator while focusing on features not supported.

3.2. Description of « classical logistics »

Most companies, regardless of activity sector, proceed to purchase raw materials from suppliers to manufacture finished products for sale. Note that the raw materials, finished and semi-finished products are being stored in well-defined locations within warehouses. The implementation of this "classic logistics" is almost standardized by all ERPs.

The ERPs use the notion of item file to present the raw materials and finished products: an item must have a code that uniquely identifies it among other items codes handled by the company, be quantified according to a unit of measure and followed by a unique serial number.

After specifying the supplier for whom the purchase order of raw materials is intended, the purchase order transaction will include the item code to order, the ordered quantity and the unit of measure. When the delivery of supplier is performed, the receipt transaction must include the item code actually received, the quantity actually delivered by the supplier and the serial numbers associated with each unit if the item code needs to be followed by serial number.

The received items are sent to well-defined locations within warehouse: they can be moved or consumed on behalf of a work order for a finished product. Once the manufacturing process is complete, the finished product is stocked and ready to be delivered to customers. Likewise, the sale order transaction can materialize customer demand and includes information such item code, ordered quantity and requesting customer. For delivery to the customer, the shipping transaction must also specify the serial numbers actually shipped.

What we notice from the different transactions described above and that are implemented by all ERPs is that they all use the following information:

- Item Code
- Quantity
- Unit of measure
- Serial number (only invoked in the execution transactions namely receipt and shipping)

This set of information is a structural object supported by all supply chain modules of ERP.

3.3. Description of « telecom logistics »

The operations involved in logistics of a telecom operator are almost identical to those also found in classical logistics as it is described in the previous paragraph. Nevertheless logistics in a telecom operator has some features that deserve to be studied fine.

In fact, the items used in telecom logistics are mainly active items such as mobiles and smart cards for which phone numbers are associated. Logistically these items will have, identical to classical logistics, a code and a serial number and can be invoked in different transactions. These active items are characterized by technical attributes also called telecom attributes such as PIN, PUK, IMSI ... These attributes are useful for declaring active items on the network. This declaration is based on an information system which should draw its information from logistics operations. This suggests that the telecom logistics should convey telecom information (telecom attributes and phone

numbers) and the structural set (item code and serial number) which is implemented by ERP standard.

In this context, telecom logistics requires the use of specific developments to be implemented in the ERP: the ERPs can only manage a structural set in standard.

Below are the main features of telecom logistics:

- before delivering the active items, the supplier first expects to receive telecom information from the operator, this information will be incorporated into the physical items;
- when the supplier performs the delivery, the active items come with other telecom information in addition to those provided by the operator;
- the operation of combining a phone number to the active item can be made by the supplier or by the operator;
- this operation can be related to an active item or a compound item including one or more active items, a compound item is indeed the result of a physical assembly operation.

We can naturally assume that the issue raised by the telecom logistics could also be encountered in other sectors for which the notion of item is not only limited to the physical component. The concept of item as it is modeled by ERPs is limited only to the structural set (code, serial number) that represents the physical component: the other piece of information we now describe as logical component receives only a passive storage (in the form of specific developments) and therefore it is not supported in standard by all modules.
According to another investigation on other ERPs, it also turns out that this feature is not supported in standard. Supply chain standards also don't address this issue: hence the need to generalize this issue.

3.4. Issue formalization

The objective of the supply chain management is to deliver the right product at the right time, in the right place and at a lower cost. This shows that the fate of the product is at the center of concerns for the supply chain management.
Note that the raw material is at the origin of the product and both are considered as objects clearly identifiable in the company.

The ERPs use the generic term "item" to model the raw materials, semi-finished and finished products: an item is indeed identified by a code. In addition, the ERPs permit to manage the stock which can be defined simply as all the items held by the company.

The inventory management aims to know at any time the items available in the company. To do so, it must provide physical accounting that takes into account the inputs and outputs of many items in order to provide, at any time, a reporting of the inventory update:

- Items input: this operation allows taking into account the input of items in the store: these received items can be manufactured (finished or semi-finished) or purchased (raw materials). The stock manager is responsible for updating the quantities of the items by increasing the initial quantity with the received quantity.
- Items output: this operation consists of removing the stock of items (requested by customers or production) in accordance with an order or an issue transaction. As for input, the stock manager should update the quantity of items by removing the output quantity of the initial quantity.
- Inventory reporting: at any time, the stock manager should be able to provide reporting of stocks. This reporting must show at a given time the detailed situation, quantity and location of stock.

The stock is the result of a difference between an input flow and an output flow over a period of time; we propose to formalize this statement as follows:

$$S_a(t_n) = S_a(t_{n-1}) + I_a[q] - O_a[q]$$

$S_a(t_n)$: is the stock (or quantity) of the item (a) at time (t_n)

$S_a(t_{n-1})$: is the stock (or quantity) of the item (a) at time (t_{n-1})

$I_a[q]$: is the item input of the quantity (q) of the item (a)

$O_a[q]$: is the item ouput of the quantity (q) of the item (a)

Note that this formalization above is supported in standard by all ERPs. The ERPs offer screens as items files to enter all required information. Other screens allow the entry of input/output transactions that affect the available quantities of stock in accordance with the above formula.

We cannot speak of the input/output operations without mentioning the other major production operation that is limited here as the equivalent of an input operation of the product and output operations of components. Indeed, the ERPs use the notion of bill of material that describes the

composition of the product known as compound item. The composition of the product is the set of components items required to manufacture the product or compound item. As the previous statement, we propose to formalize this equivalence as follows:

$$Ma_p[q] \equiv \{Ia_e[q] , Oa_{c1}[q] , \dots , Oa_c[q] , \dots , Oa_{cm}[q]\}$$

$Ma_p[q]$: is production of the quantity (q) of the compound item (a_p)

$Ia_e[q]$: is the item input of the quantity (q) of the compound item (a_p)

$Oa_c[q]$: is the item output of the quantity (q) of the component item (a_c)

We consider that the bill of material of the compound item (ap) mentions that there is (m) components items (aci) and for better clarity of the formula above it is assumed that the link quantity between compound and components is always equal to 1.

Don't forget that the issue of telecom logistics which leads to specific developments was informally described in a previous paragraph. And that is why we propose in this section to take this issue and try to re-express it formally with the help of the formalism above:

$$Sa(t_n) = Sa(t_{n-1}) + Ia \begin{pmatrix} inf(1,1) \dots inf(1,k) \\ \dots \\ inf(q,1) \dots inf(q,k) \end{pmatrix} - Oa \begin{pmatrix} inf(1,1) \dots inf(1,k) \\ \dots \\ inf(1,1) \dots inf(1,k) \end{pmatrix}$$

inf(i,j) represents the information required (known as telecom attribute) for item (a) and can be invoked in the input/output operations: each item (a) occurrence from (q) items has (k) information.

Indeed, the ERPs don't know how to take into account in standard the storage of this information in the same way as serial numbers which have an active storage that allows them to be raised in all transactions without resorting to even specific developments. Today's ERPs propose just a passive storage of this information with the help of laborious specific developments.

4. Conclusions

It is clear that today's companies are looking tirelessly for standard solutions sparing them the use of specific developments which don't support the scalability of information system and directly impact the business continuity.

Thanks to technological advances, ERP is now an essential tool for companies to be more flexible and responsive. And this is why editors, integrators constantly advocate that ERP presents a flexible and global solution and is able to respond to all business rules of the company in standard. In part this is true but there are still many cases exempt from this rule like the case study discussed in this paper. The case study has indeed revealed truths that deserve to be well highlighted in this conclusion.

Experience shows that all firms having implemented ERP are inevitably confronted with the exercise of choice between the re-engineering of business processes and the use of customization when it is impossible to support in standard one of the business rules. This exercise is even more difficult when the unsupported business rule is critical to the business. It is not denied that the re-engineering of business process according to a good practice proposed by ERP is the best solution when a business rule is irrelevant. In such situations, it is necessary to use the event of ERP implementation to adopt best practices.

When the business rule is relevant and critical for the company, the use of customization is inevitable, as is the case in our case study where the business rules are very specific to telecom sector. However, the specific developments have two major drawbacks: the costs of development and maintenance are very high and the editors don't propose any support. The ERPs should be often customized by functional actors rather than being modified by the technical actors.

Before drawing lessons from the issue raised by the case study, it is first important to note that the theoretical framework of classical logistics is largely covered by ERP; this was found after exploring the ERPs features and studying supply chain standards related [87]. In addition companies exploit only a small part of the features offered by ERP. It was also found that the best-known ERPs are based on the same model when implementing supply chain: in a perspective of widening the functional coverage of ERP, a minimal model is proposed in [87] and could serve as a good starting point to extend the model.

We can naturally assume that the issue raised by the telecom logistics could also be encountered in other

sectors for which the notion of item is not only limited to the physical component. The concept of item as it is modeled by ERPs is limited only to the structural set (code, serial number) that represents the physical component: the other piece of information we now describe as logical component receives only a passive storage (in the form of specific developments) and therefore it is not supported in standard in all modules of ERP. It should also be noted that this issue is not addressed in the supply chain standards that are considered as a source of inspiration for ERP editors. The latter implement indeed the best practices as dictated by the standards in their software to fit to various sectors in standard and this therefore explains why all other ERPs don't take care of this issue.

To help theorists and practitioners, this issue has been formalized in a theoretical framework which is proposed in this paper and is supposed to be able to help generalize the issue and then evolve the standards.

In light of the foregoing, it can be deduced that the speed of standards and ERP updating is probably less than the speed of the market. This deduction could be considered as a possible answer to the fundamental question raised earlier in the introduction of this paper and reminded below:
"ERPs are expected to adapt to business rules of the company in standard but why the use of customization is almost inevitable?"

Similarly, the practices of some companies are not good and these companies refuse to admit this fact either by ignorance or for political considerations and they engage in specific developments; this could also be considered as other answer to the fundamental question.

The research community unanimously considers the minimization of customization as a critical success factor strongly affecting the ERP implementation, it is then highly recommended to enable the modern company to remain competitive by taking into account the specificities (resulting from the evolution of the market) which either are absent from standards or are not supported by ERP.

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