

# Agile ERP Implementation: The Case of a SME

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**Abstract:** The definition of system requirements is a critical management issue during an ERP project. The traditional and plan-driven approaches to define these system requirements during an ERP implementation create challenges for small organizations, notably difficulties in the expression of their requirements, often related to a lack of expertise on the subject. This research investigates the implementation of an agile project management approach to deal with this issue in the context of an ERP project. Due to the complexity of adopting agile methods in practice, few organizations are fully agile and are hence more comfortable adopting hybrid approaches by selecting a set of practices among the agile and traditional methods. Even though the adoption of these methods is rapidly growing in the case of real-life ERP projects, few research initiatives have looked into this subject. This paper analyses the case of a Canadian SME that recently implemented an ERP with an agile mindset. Based on the data collected through interviews, observations and documentation, a set of agile practices applied during the ERP project in the SME is highlighted and analyzed. Finally, the impact of this approach on requirements definition and possible improvements for the organization are also presented.

## 1 INTRODUCTION

In the current context of fierce competition, manufacturing companies' information systems (IS) are increasingly based on 'off-the-shelf' products such as Enterprise Resource Planning (ERP) systems. This type of systems allows organizations to improve their competitive advantage by increasing their ability to manage efficiently and effectively their resources (Aloini et al., 2007; Law et al., 2010). While large enterprises were the first to implement such software packages, the Small and Medium Enterprises (SME) are nowadays increasingly adopting them (Shaul and Tauber, 2013). The extent of the literature on the adoption of ERP systems by SME is still limited and the findings on ERP adoption by large enterprises cannot be applied due to characteristics specific to SME such as limited resources or limited technical expertise (Poba-Nzaou and Raymond, 2013).

This paper focuses on one of the most critical issue of an ERP project: the definition of the ERP system requirements (Millet, 2013), which mainly takes place during the business blueprint stage of an ERP project (once the ERP package has been selected). The company's requirements and the

standard business processes embedded in the ERP system are then matched (Millet, 2013; Soffer et al., 2005). Due to its standard nature, generally, the ERP system will not encompass all the specific needs of a company (Zach et al., 2012). In the case of a misalignment between what is offered and needed in terms of requirements, the company must decide either to adapt itself to the standard package, or to adapt the standard package to its specific needs by customizing it (Soffer et al., 2005). The business blueprint stage traditionally results in a detailed documentation defining the requirements for the future solution (Mamoghli et al., 2017). Following these defined requirements, the realization stage leads to the creation of a prototype, which is then tested to remove any defaults (bugs).

Such a traditional way of dealing with the definition of system requirements, which also implies clear initial user requirements (Fernandez and Fernandez, 2008), is not necessary suitable for SMEs. Indeed, as Zach et al., (2012) emphasized, the lack of experience with ERP systems by an SME implies a lack of knowledge on the different opportunities of such systems, which, in turn, can influence the definition of requirements. In this context, SMEs tend

to undermine the best practices embedded in the ERP system or to formulate unrealistic requirements (van Beijsterveld and van Groenendaal, 2016; Zach et al., 2012). Besides, de Carvalho et al., (2010) point out the difficulty for a company to express its requirements for complex software (such as ERP systems) in a “complete and precise way” before “effectively using some version of that software”.

To overcome such challenges, a solution could be to deviate from this traditional and plan-driven process and to manage the ERP system requirements issue in a more “flexible” way. In the past years, the Agile Project Management (APM) particularly emerged in order to tackle such challenges (Campanelli et al., 2018). The APM takes source in the Manifesto for Agile Software Development (Beck et al., 2001). This Manifesto regroups a set of principles and values that are the essence of the agile methods (Campanelli and Parreiras, 2015). Each of these methods is composed of a set of agile practices such as “Iterations” or “Onsite development” (Campanelli and Parreiras, 2015). Several authors (Campanelli et al., 2018; Tripp and Armstrong, 2018) argue that, in practice, few organizations are fully agile due to the complexity of the adoption of such an approach. The companies rather prefer to tailor their approach by selecting a set of practices among the agile and traditional approaches (Kupper et al., 2018), which concludes in hybrid management approaches.

In this paper, our objective is to investigate the agile practices that were applied during an ERP project in a Canadian SME in the textile industry, and to identify the challenges and impacts on the system requirements management when implementing such practices. Even if agile ERP implementations are more frequent, the literature mentions that it is an under-researched topic (Baig et al., 2017; Daneva and Ahituv, 2012; Misra et al., 2016).

This paper is organized as follows. Section 2 sets our theoretical framework and analyzes the literature related to agile ERP implementation. Section 3 then displays our research methodology, while the results are presented and discussed in the section 4. Finally, Section 5 concludes and gives some perspectives.

## 2 LITERATURE REVIEW

### 2.1 Theoretical Framework

Considering our research objective and the premise that the agile philosophy application is linked to the use of a set of agile practices (Conforto et al., 2014), we decided to base our theoretical framework on a list

of such practices. To constitute this list, we used, as a basis, the “requirement engineering agile practices” proposed by Inayat et al. (2014), that we adapted and completed with other practices found in (Tripp and Armstrong, 2018; Vallon et al., 2018; VersionOne, 2018).

The next step was to distinguish the software and management related practices (Campanelli and Parreiras, 2015; Paez et al., 2018; VersionOne, 2018), which are respectively listed in the Table 1 and 2. While the software practices concern aspects related to the architecture, the test or the programming of the system, the management ones rather concern aspects project planning or the requirements formulation.

Adopting one or another category of practices depends on the motivation of the project team. The software related practices’ adoption is rather motivated by obtaining a high quality of software and source code (Tripp and Armstrong, 2018). In the context of ERP systems, which correspond to standard packages, these practices make sense in the case of ERP system customization (i.e. modification of the code source). The motivation behind the adoption of management related practices rather relies on aspects like reducing costs or managing the alignment between the business and the IT (Tripp and Armstrong, 2018).

Even if the management related practices constitute the core of our interest, the software related practices are also included in this list in order to conduct an in-depth analysis of the literature on agile practices in an ERP project context.

Table 1: Software related practices.

Practices	References
Test-driven development	Inayat et al. 2014; Tripp and Armstrong 2018; Vallon et al. 2018
Unit testing	Tripp and Armstrong 2018; VersionOne 2018
Pair programming	Vallon et al. 2018
Coding standards	Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Automated builds and testing	Tripp and Armstrong 2018
Code refactoring	Inayat et al. 2014; Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Continuous integration	Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Simple and incremental design	Vallon et al. 2018
Collective code ownership	Vallon et al. 2018

Table 2: Management related practices.

Practices	References
Release planning	Tripp and Armstrong 2018
Iterations	Vallon et al. 2018; VersionOne 2018
Continuous iteration planning and estimation	Inayat et al. 2014; Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Continuous deployment	VersionOne 2018
Iterative requirements formulation	Inayat et al. 2014
Requirements prioritization	Inayat et al. 2014
Product backlog formulated through visual techniques with minimal textual descriptions	Inayat et al. 2014; Vallon et al. 2018
Feedback of the customer through prototyping	Inayat et al. 2014; Vallon et al. 2018; VersionOne 2018
Changes in the requirements accepted	Inayat et al. 2014
Requirements workshops	Vallon et al. 2018
Daily stand up	Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Burndown charts	Tripp and Armstrong 2018; Vallon et al. 2018
Retrospectives	Inayat et al. 2014; Tripp and Armstrong 2018; Vallon et al. 2018; VersionOne 2018
Face-to-face communication	Inayat et al. 2014
Pairing for requirements analysis	Inayat et al. 2014
Customer involvement and interaction	Inayat et al. 2014
Onsite development	Inayat et al. 2014; Vallon et al. 2018

## 2.2 Literature on Agile ERP Project Management

While some authors (Baig et al., 2017; Daneva and Ahituv, 2012; Meszaros and Aston, 2007; Stender, 2002) point out the real-life implementation of agile practices in the context of ERP projects, very few authors address this research subject:

Both Metrailler and Estier (2009) and (Stender, 2002) propose an approach corresponding to an iterative ERP project implementation process, through which a set of agile practices are applied. In both studies, the authors advise to define and

implement / customize, in each iteration, a set of functionalities, starting with the ones having the highest priority. Then, in each iteration, the implemented functionalities are tested and demonstrated through a prototype on which the company can provide feedback and propose changes. This prototype can be refined into one or several other prototypes until it is approved by the organization. Finally, the end of the iteration is marked by the deployment of the implemented functionalities.

Meszaros and Aston (2007) examined the case of an ERP project conducted in a Canadian class 1 railroad company for which agile practices were applied. They highlight the technical and cultural challenges encountered during the project.

Finally, de Carvalho et al. (2010) discuss the applicability of XP method agile practices in the context of ERP projects.

### 2.2.1 The Practices

Table 3 sums up the agile practices introduced in each studied paper. While the software related practices are well covered, along with the way to implement them, this is not the case of the management related ones. This particular focus on the software related practices can be explained by a common motivation among authors to preserve a high quality of source code in the context of ERP system customization.

Concerning the management related practices, almost all of the authors advise to implement the practices that constitute the essence of the agile philosophy (such as “iterations”, “Continuous iteration planning and estimation”, “Face-to-face communication”, “Customer involvement and interaction”). However, some practices are not covered at all (“Daily stand up”, “Burndown charts”, “Pairing for requirements analysis”, “Onsite development” and “Requirements workshops”).

Furthermore, it is important to mention that only one study illustrates the practices through a case study (Meszaros and Aston, 2007), but at a high level as the overall progress of the project is not detailed. The case rather focuses on the difficulties of implementing an agile ERP project management approach in terms of technical and cultural challenges. Such few illustration cases make it difficult to visualize how the management related agile practices are implemented in the context of ERP projects and their real feasibility.

Table 3: Agile practices introduced in each analyzed paper.

Category	Practices	Metrailler and Estier (2009)	Stender (2002)	de Carvalho et al. (2010)	Meszaros and Aston (2007)
Management related practices	Release planning	X			
	Iterations	X	X	X	X
	Continuous iteration planning and estimation	X	X		X
	Continuous deployment	X	X		
	Iterative requirements formulation	X	X		
	Requirements prioritization	X	X		
	Product backlog formulated through visual techniques with minimal textual descriptions	X	X		X
	Feedback of the customer through prototyping	X	X	X	X
	Changes in the requirements accepted	X			
	Requirements workshops				
	Daily stand up				
	Burndown charts				
	Retrospectives	X			X
	Face-to-face communication		X	X	X
	Pairing for requirements analysis				
	Customer involvement and interaction	X	X	X	
Onsite development					
Software related practices	Test-driven development		X	X	X
	Unit testing			X	X
	Pair programming		X		X
	Coding standards		X	X	X
	Automated builds and testing		X	X	X
	Code refactoring			X	
	Continuous integration			X	X
	Simple and incremental design		X	X	X
Collective code ownership				X	

### 2.2.2 The Challenges

Both cultural and integration challenges, when adopting agile practices in the ERP project context, are reported in the literature.

The integration challenge stems from the integrated nature of ERP systems (de Carvalho et al., 2010; Meszaros and Aston, 2007; Metrailler and Estier, 2009). This challenge must be managed when the ERP system source code is modified during an iteration, but without identifying the impact of such modifications on the rest of the source code (de Carvalho et al., 2010). Thus, such modifications may

induce late integration identification in subsequent iterations and increase the risk of rework. Some of these authors (de Carvalho et al., 2010; Metrailler and Estier, 2009) propose well-established solutions to overcome this challenge, depending on the type of the ERP package selected. First, Metrailler and Estier (2009) focus on open source systems and propose to take advantage of the system architecture's accessibility, which is characterized by no black boxes. Meszaros and Aston (2007) focus on their part on a proprietary system (SAP) and propose an "Agile Zone", which consists of one dedicated developer workspace for each pair of developers, to overcome

this challenge. Such configuration allowed them to “mitigate many of the impacts of the integrated system during the development phase of the project by giving the complete control over (their) development environment”.

The cultural challenge is particularly highlighted in Meszaros and Aston's (2007) study, where the project team involved in the case was composed of a set of agile experienced people – as the project manager – and of SAP specialists. The latter, which had no experience in agile ERP project implementation, had to deal with cultural barriers including a document-driven mindset, a refracting attitude towards analyzing and questioning the work process during the retrospectives, and also communication difficulties between workers from the same specialties or from different domains.

### 2.2.3 The Impacts

As there are very few case studies illustrating the implementation of agile practices, the impact of these practices on key ERP projects issues (such as system requirements management) is not particularly supported in the literature. In fact, the only reported impact, discussed in Meszaros and Aston's (2007) case, is related to the SAP developers' satisfaction in adopting the software related practices.

To conclude, approaches to implement the management related practices are not well covered in the literature, as well as the challenges of implementing such practices in the context of ERP projects and their impact on key ERP project issues. In light of these research gaps, we propose to explore these aspects through a case study.

## 3 METHODOLOGY

### 3.1 Case Study

Due to the exploratory nature of our research, we choose a single case study approach (Yin, 2011). This kind of qualitative approach are well suited to explore new research areas, that have been the subject of very few prior research (Yin, 2011). Our objective was particularly to gain in-depth understanding of the implementation of the agile management related practices in the particular context of ERP projects and the impact of such implementation on the system requirements management.

The organization involved in the case study, which we will name “ABC”, is a Canadian small and medium company of about 100 employees founded

fifty years ago. It is specialized in the manufacturing and wholesaling of work uniforms for employees from different sectors like forest fire protection, medical, research, mining or welding.

The company selected a new ERP package in March 2014. The integrator, who is also the vendor of the implemented ERP package, agreed to customize the system to the specific needs of ABC. Then, from October 2014 to August 2015, the ERP implementation focused on the following business processes: Wholesale ordering, Finished goods purchasing, Internal production launch, Finished goods reception, Customer shipment, Fabrics purchasing, Fabric reception, Haberdashery purchasing, Haberdashery reception, Billing and Accounting.

An important point to mention is that the vendor/integrator did not intentionally apply the agile philosophy. In fact, their implementation approach was built through the experiences it acquired over time with SMEs. Despite this experience, the vendor/integrator continues to adapt it depending on the context of each project. This way of defining an implementation approach is in line with recent studies that highlight the fact that practitioners define their specific approach to address each particular project situation (Kupper et al., 2018; Kuhrmann et al., 2018). Thus, the approaches are generally the result of individual experience acquired over time and are not based on a systematic construction procedure (Kupper et al., 2018).

The project team was composed of an external consultant, the integrator, two developers from the vendor/integrator's staff, the CEO of the SME and two business representatives - one from the accounting department and the other one from the production department. Other key users and end-users were often included in the implementation process. The two business representatives were the initiators of the ERP project.

### 3.2 Data Collection

The data collected through the case study was triangulated using multiple data collection methods: semi-structured interviews, observations, and documents analysis.

Six semi-structured interviews were conducted from April 2015 to January 2016, with key members of the project team (two business representatives, the vendor/integrator, the external consultant and an end-user). The interviews, which lasted 45 minutes on average, were composed of open-ended questions inserted in conversations, and were recorded and

transcribed. These six interviews were organized in two parts. The first part of questions concerned the progress of the project and was intended to identify which agile practices were implemented and how these practices were implemented. It covered aspects such as the project's series of stages, the business processes involved, the technical challenges encountered or the tools and techniques used. The second part concerned the respondent's perception on the ability of the company to express and take decisions about the system requirements.

In addition, we attended to four project meetings (one meeting in April 2015, two meetings July 2015 and one meeting in August 2015) that allowed us to make observations during the project. These meetings were also recorded and transcribed.

Concerning the third collection method, the company allowed us to access to different documents produced during the project such as the project planning, or even personal notes from the project team's members.

The information gathered was analyzed using two data analysis approaches. To analyze the agile practices implemented by the SME, we mapped our list of management related agile practices to the data collected at the same time during the interviews, from the documents analyzed and from our observations. It allowed us to extract a list of agile practices that ABC implemented as well as the way the company implemented them and overcame the related challenges. Then, a content analysis approach was employed to analyze the impact of the agile implementation practices on the system requirements definition. This last approach allowed us to structure and categorize a list of impacts that emerged from the interviews.

## 4 RESULTS

In the following, the results are three-fold: i) we list and discuss the agile practices implemented by ABC, ii) we analyze the challenges encountered by the firm while implementing these practices and iii) we highlight the impact perceived by the respondents in terms of system requirements definition.

### 4.1 Agile Practices

Our analysis of the data collected through the interviews, the observations, and the documents analysis led us to list the agile management practices that were implemented through the ERP project of the company ABC (see Table 4).

Table 4: Agile management related practices implemented in the ERP project of company ABC.

Management related practices	Company ABC
Release planning	X
Iterations	X
Continuous iteration planning and estimation	X
Continuous deployment	X (Partially)
Iterative requirements formulation	X
Requirements prioritization	X (Hybrid)
Product backlog formulated through visual techniques with minimal textual descriptions	X (Hybrid)
Feedback of the customer through prototyping	X
Changes in the requirements accepted	X
Requirements workshops	X (Partially)
Daily stand up	-
Burndown charts	-
Retrospectives	X (Partially)
Face-to-face communication	X
Pairing for requirements analysis	X
Customer involvement and interaction	X
Onsite development	X

Most of the practices were applied, except the "Daily stand up" and "Burndown flowcharts" practices. Some practices were implemented using a hybrid approach combining traditional and agile methods. For example, concerning the practice "Product backlog formulated through visual techniques with minimal textual descriptions", ABC did not use visual techniques to formulate its requirements nor did it use heavy documentation, as traditional approaches suggest, hence the hybrid application of this practice. Besides, other practices were partially implemented. For example, concerning the "Requirements workshops", meetings, including all the stakeholders, were regularly organized in order to make the point about the implementation process and the requirements of ABC. However, such workshops were not organized around structured requirements elicitation tools, but were rather ad hoc, hence the partial implementation of this practice.

### 4.2 Challenges

As seen in the literature, our observations as well as the interviews we conducted led us to notice that, the integration challenge of iteratively customizing the system was well handled by the vendor/integrator.

The latter reported that the architecture of the system was particularly designed to welcome such iterative customization: *“We know that we are going to customize the system, the system’s architecture is designed according to that”*.

Contrary to the experience reported in Meszaros and Aston (2007), we did not observe any cultural barriers during the implementation of agile practices, neither from the vendor/integrator, nor from the SME. Indeed, contrary to the results of (Meszaros and Aston 2007)’s case, the implementation approach followed to manage the ERP project of ABC was pushed by the vendor/integrator. This latter particularly adapted its implementation approach to fit the particular context of SME.

However, we highlighted another challenge in this case study that was not found in the literature. At the beginning on the project, there was a misunderstanding, between the company ABC and the vendor/integrator, on the implementation approach to be followed during the project. While the former understood that the project would be planned in a traditional way, the latter had rather an agile approach in mind. This misunderstanding induced surprises during the ERP project and the most important one occurred in October 2014. At that time, when the vendor/integrator provided a first prototype of the ERP system, the company thought that this prototype was going to be closer to their specific requirements. However, some required features were not included in the ERP yet, and the vendor/integrator was about to begin the iterations and prototyping.

### 4.3 Impact Perceived on the System Requirements Definition

Our analysis of the interviews allowed us to highlight four kinds of impacts perceived by the respondents, in terms of system requirements definition.

**Requirement Elicitation Improvement.** The practices “Iterations”, “Continuous deployment”, “Iterative requirements formulation”, “Feedback of the customer through prototyping” and “Customer involvement and interaction” helped the company in its requirements elicitation. In fact, the more the key-users (or even the end-users involved in the project) were experienced with the system, by making a feedback on the prototype (from October 2014 to February 2015) or by using it (From February 2015), the more they were able to formulate specific and detailed requirements. With such gained experience, detailed requirements were reported to be iteratively emerging. As the vendor/integrator pointed out: *“If we ask the company (to express in detail its needs)*

*before experimenting the system, there is no experience, and without experience, their intervention is less relevant, but if they experiment it since several months, the customer is more able to express exactly what he wants, it’s more stimulating for the employees”*. In the same way, one of the business representatives stated: *“Implementing step by step make it easier to define what we want, you know... now we know how it works, so we are able to say ‘I need this specific functionality or information at a this specific place’, because I know where this information is missing [...] it’s easier to identify our needs”*.

**Communication of the Requirements Improvement.** The practices “Pairing for requirements analysis”, “Onsite development” and “Face-to-face communication” helped both the company to communicate more adequately its requirements and the vendor/integrator to understand these requirements. As the vendor/integrator pointed out, the practice “Pairing for requirements analysis” helped the company in its requirements communication: *“Sometimes the customer isn’t able to easily communicate its needs, and to put it on a paper, there is too many cases. Thus, it helps to sit down together. The customer is, then, able to communicate what he wants”*. One key-user also pointed out the requirements understanding from the vendor/integrator that resulted from the onsite development sessions: *“While programming, when the developer wasn’t sure about one specific requirement, he could ask directly to the corresponding employee”*. Such live exchanges between the vendor/integrator and the company also promoted the requirements communication.

**ERP System Capabilities Discovering.** While experiencing the system through the successive iterations and deployments, the company gained also an understanding about the capabilities of the ERP system. As such, the vendor/integrator stated that through the interactions, *“The customer discovers the possibilities, and it brings to a new level where they ask for new features”*. Thus, in regards to these discovered capabilities, as a business representative pointed out, the company can formulate new requirements: *“Some things were pushed a little further [...], things that we did not thought about at first, but he could configure it”*.

**ERP’s Limits Taking into Account.** Through the progress of the project, and thanks to the agile practices, the company not only gained experience on the capabilities of the ERP system but also on its limits. Such emerging awareness helps one to formulate requirements that are more realistic. At the

beginning of the project, as the vendor/integrator stated, people are not aware of these limits, and this unrealistic vision evolves over time: “People have a magic idea of what an ERP system can do, they think that it can do everything, but this is not the case, and during the process, they realize what is the reality of an ERP”.

## 5 CONCLUSION

The definition of system requirements is a critical management issue during an ERP project. The traditional approach to deal with this issue presents some limits for the small and medium enterprises (SME). Integrating agile practices in the context of ERP projects has been identified, in this study, as a potential solution to overcome such limits. We analyzed the case of a Canadian SME from the textile industry, which experienced an agile ERP implementation. The case study results show that the company experienced an important set of the agile management related practices found in the literature. This implementation was sometimes partial or hybrid between the agile and the traditional approaches. This implementation approach using agile practices was not surprising since the vendor, also initiator of the approach, did not explicitly apply an agile philosophy. It must be noted that no cultural or technical challenges were reported by the different respondents during our study. However, there was a common misunderstanding, between ABC and the vendor/integrator, of the hybrid implementation approach to be followed, which proved essential the adequate involvement of ABC in the project. Finally, the implementation of the agile practices allowed the company to gain experience about the system all along the project. This enabled the company to better elicit and communicate its requirements, in the right vocabulary, by also taking into account both the capabilities of the ERP system as well as its limits.

This study represents a first step in the understanding of the use of agile practices in the context of an ERP project. The results provide evidence about the feasibility of following an agile philosophy in such a context and on how a SME can benefit from this philosophy to enhance its system requirements definition. Apart from research implication, this study could also be useful for ERP integrators to i) better frame their ERP implementation approach, and ii) be aware of its benefits and impacts and communicate it rightly to their clients.

This research has also limitations, opening up new research questions. First, this study investigates only one case and would benefit from exploration in other organizations, which would allow the results to be generalized. Along the same line, the research and practice community could benefit from a quantitative approach investigating what agile practices are, nowadays, commonly adopted in real-life ERP projects, as well as the motivations behind their adoption and their impact. Since this study focuses only on the impact agile practices have on software requirements definition, it could also include an analysis of the impact of the approach on user satisfaction. Another limitation is that this study does not look at the critical context that could favor the implementation of agile practices, including factors like the company’s culture, its available resources or even its experience and knowledge on ERP systems. Finally, the practitioners’ community could benefit from a research implementation model that combines both the agile and traditional philosophies, allowing them to better manage and frame their approach and benefit from it.

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