What Agile ERP Consultants Think of Requirements Engineering for Inter-organizational ERP Systems: Insights from a Focus Group in BeNeLux

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***Abstract*—In 2006-2010, 12 practices for engineering the coordination requirements in inter-organizational Enterprise Resource Planning (ERP) projects were identified, classified to levels of inter-organizational coordination complexity, and subjected to a preliminary evaluation. Aim: This set of practices is now the object of a broader evaluation effort, including 8 focus groups with practitioners working in various project contexts (e.g. outsourced, cloud, agile), so that we get deeper understanding about those practices that happen in certain contexts and not in others. Method: In this paper, we present the focus group research pertaining to the agile ERP project context. We analyze the coordination requirements experiences of 9 practicing ERP consultants, specialized in agile ERP exclusively, for the purpose of understanding the fit of the 12 practices with these practitioners' project realities. Results/Conclusion: Our results suggest that all 12 practices have been observed by the practitioners. However, three out of the 12 practices were associated to levels of inter-organizational coordination complexity which were different than what we thought.**

Keywords-coordination requirements, inter-organizational enterprise systems, Enterprise Resource Planning, focus groups, qualitative study, requirements engineering practices.

I. INTRODUCTION

Enterprise resource planning (ERP) projects have built up their reputation as solutions to business coordination problems in organizations by implementing standard off-the-shelf packages of business applications (e.g. from SAP, Baan, Oracle). Requirements engineering (RE) for these projects had been recognized as a complex and risk-fraught activity [1] as it includes mutual adaptation of the package to the organizational coordination processes as well as of the client organization to the built-in coordination mechanisms in the package. While in the 20th century, the ERP projects were mostly happening within the walls of a single client organization integrating its internal processes and improving these processes' efficiencies, in the past decade these projects are launched in increasingly inter-organizational integration settings. For example, the business network of WalMart Stores Inc. uses a large ERP-based solution to collaborate – by means of a global ERP coordination support system, with a large number of non-U.S. companies and gives them direct access to the American market [2]. In the 21st century, the massive multi-enterprise collaboration and the extended use of mobile and cloud computing made RE for ERP projects even more difficult and riskier. This is due to the changing nature of the ERP-adopting businesses and the changing nature of the vendors' ERP packages. On the ERP-adopters' side, businesses launch increasingly more inter-organizational relationships [2] with other business entities to jointly deliver products or services (as in the WalMart example). On the ERP-vendors' side, this inter-organizational partnership-building trend triggers vendors' responses in the form of a new generation of enterprise software packages offering a broad range of pre-defined coordination mechanisms readily available to ERP adopters to configure and use [3,4]. However, the current ERP RE practices focus primarily on delivering business process, data, and interface requirements, and, by and large, provide little support to cope with complex ERP coordination requirements [4]. Earlier research of the first author [3,4] investigated the questions of (i) how to engineer the requirements for inter-organizational coordination shared ERP solutions and (ii) what represents good practices for doing so. This research found that the coordination among companies in an inter-organizational partnership takes place in four different levels of complexity. In regard to these levels, we also proposed 12 RE practices along with an early indication of the benefits one can expect of introducing each RE practice in a project. While in our earlier publications [3,4], we reported on our motivation to search for the RE practices and on our research process that helped us derive them [4], in this paper, we present practitioners' experiences regarding how these practices fit in real-life contexts. This empirical study provides an account on how we used a focus-group-based approach to do this. We make the note that this study represents one out of 8 focus groups that we are planning in the future for the purpose of empirically evaluating the RE practices in a broad variety of contexts, e.g. in agile, in cloud-based, and in outsourced project contexts (just to name a few). The overall goal of all these evaluation studies is to get a deeper understanding on whether the practices are observable by practitioners in certain contexts and not in others. The specific goal of the present study is to understand whether the practices are observable in *agile* inter-organizational ERP projects. Our motivation to focus on agile is traceable to recent analysis [6] of trends in RE for ERP suggesting that (i) agile is becoming one of the preferred approaches to ERP implementation and that (ii) agile ERP is an under-researched area. In what follows, Sect. II. presents the RE practices to be evaluated. Sect. III. reports on our research design, its application, the

results, the limitations of the study, and the implications for researchers and practitioners. Sect. IV. concludes.

II. BACKGROUND

The object of research in this study is a set of 12 RE practices for inter-organizational ERP coordination. In our earlier empirical study [4] we found evidence suggesting that these practices are not applicable to all ERP adopting organizations and we used the notion of 'coordination complexity level' to indicate which practice is suitable for what ERP coordination context in an organization. We call 'coordination complexity' the extent to which a company participates in an inter-organizational partnership. This term is based on Champy's analysis of the ways in which companies partner with others [2]. In [3], we defined four levels of coordination complexity, each reflecting how extensively a company lets other companies collaborate in and share its own business processes. Each level of coordination complexity is characterized by types of partner companies involved, unique inter-organizational coordination goals, areas of sharing, and coordination mechanisms used. The notion of coordination level, thus, reflects the understanding that the more diverse the business partners are in a value network, and the larger their number, the greater the coordination challenge [3,4]. Consequently, Level 1 represents the least challenging coordination scenarios and the least complex alignment requirements, while Levels 2, 3, and 4 successively progress to more and more challenging coordination processes and more complex alignment requirements. The levels are defined as follows:

- At Level 1, a company aligns its own processes. An ERP-adopter at Level 1 has the goal to improve internal coordination among departments.
- At Level 2 an organization aligns its processes along with the processes of one other type of organization. A Level 2 ERP-adopter's goal is to improve coordination with this type of organization (e.g. either a client, or a supplier [2]).
- At Level 3, a company aligns its processes along with the processes of two other types of organizations. A Level 3 ERP-adopter's goal is to improve coordination with two more company types, e.g. suppliers as well as clients.
- At Level 4, a company aligns its processes with the processes of organizations of three other types. A Level 4 ERP-adopter works to improve coordination with three other types of organizations. At this level, it is not uncommon for these networks to change the coordination mechanisms in an entire business sector. (An example of a Level 4 inter-organizational partnership is the collaboration of banks that come up with a common standardized process for inter-bank payment processing. The iDeal system in the Netherlands implements such a process).

To help companies make a choice on which out of the 12 RE practices to use in their ERP project, we associated each practice to one or more of the above-mentioned levels of coordination complexity. So, we assume that if an ERP-adopter is aware of its level of coordination complexity, it would be possible to pick up those RE practices suitable for a project which targets to achieve that particular level of coordination. The RE practices and their relevant levels of coordination complexity are presented in Table I. (The second column in Table I indicates the relevant complexity level for organizations to use the practice). We note that there is no one-to-one mapping between the practices and the levels. This means, that a practice can be associated to more than one levels of coordination complexity.

TABLE I. PRACTICES TO BE EVALUATED

RE Practice	Level
P_1. Define how work is divided between partner companies	2,3,4
P_2. For each network partner, document data, processes, and communication channels to be shared and with whom	2,3
P_3. Document values and goals to be shared and with whom	4
P_4. Collect enough knowledge on the ERP supported internal processes before starting for cooperating ERP scenarios	4
P_5. Document the data that separately kept applications of partners' companies share via interfaces to a common ERP	3
P_6. Align what is shared to what is kept separate	4
P_7. Understand how ERP-supported coordination mechanisms is to be used	3
P_8. Assess compatibility of partners' values and beliefs	2,3,4
P_9. Make a business coordination model	2,3,4
P_{10}. Map the business coordination model into a set of ERP-supported coordination mechanisms	2,3,4
P_{11}. Use the reference architecture for the package provided by the ERP vendor	2,3,4
P_{12}. Validate coordination models and their execution	2,3,4

III. THE RESEARCH PROCESS

We employed the research process of a focus group (FG) as per Krueger and Cassey [5]. Generally, a FG is a focused conversation where a moderator leads a group of participants through a set of questions on a particular topic. It is a way to better understand how people think about an issue, a practice, a product or a service. The group discussion is recorded by a researcher. In essence, the researcher provides the focus of the discussion, and the data comes from the group interaction. As the interaction is at the heart of the FG method, the researcher is primarily interested in how experts react to each other's statements and points of view, how they build bridges between their different perspectives, and how they build up shared understanding during the discussion. The key steps in a FG-based research process include: (1) defining the research questions, (2) planning the FG session, (3) selecting FG participants, (4) executing the session, (5) data analysis and (6) results reporting. Below, Sub-section III.A. presents how we implemented steps (1-3) in our specific settings and what research design choices we made along the way. It also describes our justification for these choices. Sub-section III.B presents step (4), Sub-section

III.C. – the results, i.e. steps (5-6) of the FG-process, and Sub-sections III.D, III.E and III.F is about our discussion.

A. *Planning the Focus Groups*

Using the GQM approach [11] to goal-formulation of empirical studies, we stated our FG research goal as follows: to collect feedback and evaluate, from the perspective of agile ERP consultants, the 12 practices and their association to specific complexity levels. This goal statement translates into two research questions that we want to answer:

(1) Do the *ERP consultants observe in their project realities?* and
(2) *If consultants do observe a practice, then which complexity level would they put it at?*

We decided to use the FG research method in answering these questions because of: (1) its suitability to an inquiry like ours, e.g. obtaining feedback on new concepts and helping clarify findings that resulted from using other methods, and (2) its cost-effectiveness [5], which was essential in this evaluation, as we were on tight budget and needed to collect observations in a short time span. Our FG plan included 9 professional consultants from six ERP professional services firms in Belgium, the Netherlands, and Luxembourg (known as the BeNeLux countries). These consultants were engaged in ERP projects executed by using the agile project development and management philosophy. The practitioners were specialized in implementing three ERP packages (Oracle, Microsoft Dynamics, and SAP) and worked for ERP projects in which the client organizations were large, middle-sized and small businesses. These 9 consultants were chosen by the first author because (i) they demonstrated an interest in exploring similar questions from their companies' perspectives; (ii) they had a characteristic in common, which pertains to the topic of the FG; and (iii) they had the potential to offer information-rich experiences. We make the note that FGs do not gather to vote or to reach consensus (see e.g. [5], p. 4). The intent is to promote self-disclosure and that is what we were after in this study. We wanted to collect data through group interaction of people with various backgrounds but with common professional values and common roles in which they execute their professional duties. As stated in [5,7], FGs are not used to provide statistically generalizable results applicable to all people similar to the practitioners in a specific study. Therefore, in this study we will adopt – based on the Patton's recommendations [7], the criterion of transferability as a useful measure of validity. Transferability asks for whether the results are presented in a way that allows other researchers to evaluate if the findings apply to their contexts [7]. As Patton indicates, "the validity, meaningfulness, and insights generated from a qualitative inquiry have more to do with information-richness than with a sample size" (p. 245).

All consultants in the FG had the following characteristics: (1) they all worked in inter-organizational projects in agile context for at least three years. (2) Each consultant was familiar with inter-organizational coordination issues and helped resolve them during the ERP implementation in an organizational partnership. The modules of consultants' specialization were: customer relationship management, financial accounting, sales management, and asset management. The industries in which the consultants implemented these modules are: life science, biotechnology, creative media and broadcasting. Among the FG-members (FGMs), two consultants were working in Coordination Complexity Level 2 organizations, five – in Level 3 organizations, and two – in Level 4 organizations. The consultants got to know the first author during an ERP-industry conference happening in the Netherlands. (The first author received a free admission for the event and used it to approach the practitioners. They agreed to participate in the FG which took place on the last day of the conference.) As in [5], the moderator (the researcher) "should be similar to the respondents", meaning he/she comes from the same population. (The first author of this paper was a former SAP professional consultant.) Using purposive sampling, she chose the FGMs based on her knowledge about their typicality. The number of FGMs was large enough to provide diversity in viewpoints, while enabling all participants to make contributions without having to compete for 'air time' (as in [5]).

B. *Executing the FG*

The execution built upon our earlier experience in conducting FGs as part of industrial events [8]. As in our earlier FG study [8], in this research we scheduled the FGMs' meeting in the lunch break for the event. The duration of the FG was 60 minutes and the lunch break was 90 minutes. The FGMs had a quick lunch and wanted to finish their FG meeting in time for the afternoon sessions of the event. For the FG, the moderator chose a closed meeting room in a location where the FGMs were free from interruptions and distractions. The meeting room provided a seating arrangement where everyone was round one table. On the day prior to the meeting, the first author provided informally each FGM with some background of this research study. Once the meeting was opened, the moderator presented the 12 practices as a checklist. The FGMs, then, worked in two stages, dealing with one research question at each stage. This was to ensure that the FGMs are not overwhelmed with a long list of inquiries at the start of the process. In the execution of the FG process, the first author served as a moderator. Her responsibility was (i) to review the feedback by the participants, (ii) to probe deeper when necessary, and (iii) to paraphrase participants' points to make sure misunderstandings were avoided. Also, she made sure everyone had a chance to express themselves, though without pressurizing any expert to write when they were not willing to do so. Once the FG was over, the moderator wrote up a summary of her notes. This was done to avoid memory lapses. Once the data was collected, preliminary analysis of the data took place immediately. The information content was sorted in a way that made sense in relation to the two questions. The next page describes the results in each stage.

C. *Results*

In **the first stage**, the FGMs were asked to review the checklist (from Table I.) and mark those practices which they either personally used or witnessed someone else on their RE

team using them in the early stage of their ERP projects. Their responses are summarized in Table II. For each practice, we report the number of FGMs who observed it at least once in real-life settings. Table II indicates that the 12 practices make sense for practitioners and were actually observed in real-life projects. However, not all practices were observed by all practitioners. For example, practice P_7 was observed by 4 practitioners only and their explanation for this was that the practice is hard to *"consolidate with the spirit of the agile philosophy"*. According to these 4 consultants, for an agile ERP team to be able to implement practice P_7, they have to rely on a broader stakeholders' participation and involvement from the partnering organizations, which translates in more costs however *"client companies who choose agile are usually extremely cost-conscious"* (as one consultant put it). This, in turn, *"limits the applicability of P_7 is agile context"*.

TABLE II. NUMBER OF OBSERVATIONS FOR EACH PRACTICE

Practice	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}
Observations	9	9	9	8	7	6	4	9	9	7	8	8

In **the second stage**, the moderator sorted randomly the list of 12 practices and asked the consultants to position them in the four coordination complexity levels. We, then, compared how the consultants associated the practices to the levels and how we (the researchers) did it (Table III, see at the end of the next page). For each practice, we assessed its mapping to a complexity level by using the percentage occurrences of those FGMs' rankings which coincide with ours. We adopted a cut-off of 75% as an acceptable matching level, as recommended in previous validation studies of software engineering practices [9]. The data in Table III suggests our mappings matched well with the FGMs'. Though, we observe four practices and associated levels, which do not meet the 75% cut-off level. These are: P_4, P_9, and P_{12}. The three practices were subjected to a second review by the FGMs. The FG deemed practice P_4 observable at all complexity levels. The FG was divided according to two standpoints on positioning practices P_9, and P_{12} both referring to the role of business coordination models. Seven FGMs thought of the business coordination model as something that is peculiar to Level 4 organizations, because it seemed an important source of business value in inter-organizational partnerships that include competitors within a business sector. Having an agreed-upon coordination model in agile setting meant to the FGMs that the partners can much easier maintain a balance between the business value generation process and the process of minimizing each partner's own costs. If such a model would not exist, then it might be hard to see how value is balanced against cost and risk, from individual partner's perspective. We also make the note that these FGMs deemed the explicitness on the business coordination a sensitive issue that must be documented and discussed in the open, so that all users are aware of the one shared source of business value that unites all partners. In contrast to this, in partnerships that have no competitors, each partner seems more flexible in choosing their own sources of business value, and these may but not necessarily overlap. The lack of competing business agendas among partner companies makes it possible for various partners' definitions of business value to co-exist and be treated equally in an agile project. *"What is important is not where you derive the business value from, but how you treat the dependencies among the features that add business value to every partnering company.* (as stated by one FGM).

In contrast to these 7 FGMs, two other FGMs thought that also Level 2 and Level 3 partnerships would benefit from the documentation of the business coordination model as this will ensure the understandability of the business requirements and the prioritization processes at inter-iteration time. *"Once you start partnering with others, regardless how many, 1 or 2 or 3, you find yourself you need this model to get clarity on the boundaries within which you can make safe requirements re-prioritization decisions."*

D. Comparison to Previously Published Studies

Since our 12 practices were proposed, we have done two early evaluations [8] and [10]. (We make the note that while [8] deploys a face-to-face FG approach, [10] uses an online FG.) In both, our participants were consultants who used the "classic paradigm" for ERP implementation entailing "big up-front requirements and architecture design", which is an expensive and labor-intensive process of engineering the requirements and ensuring they are technically implementable (after which point they are frozen till the end of the project). The participants in these previous studies had found it hard to agree on the role of modeling in ERP projects. They had put forward a variety of explanation mechanisms for why the role of modeling may not be that prominent as the ERP implementation literature [6] originally suggested. In contrast to [8] and [10], the present study indicates that in agile context modeling remains a well-accepted approach to handle coordination requirements. According to the agile consultants, the focus on business value and on dependencies among different partners' requirements make the modellling activity indispensable. While we have not observed any disagreement among the FGMs on the role of modeling as such, we did have disagreements regarding the role of one specific type of models – namely, the coordination models. Consultants assumed that the need in agile projects to balance business value, against risk and individual partner's profitability redefined how coordination models are perceived. Unlike in "classic ERP" settings where requirements are frozen and stakeholders' signatures are firm commitments till the end of the project, the agile paradigm injects "*fluidity"* and "*flexibility*" (as one participant called it) into the coordination model and partners clearly see that it's in their best interest to create and communicate such a model – that remains flexible and open to changes as the project progresses. This changed nature of the coordination model seemed an *"appealing feature of any coordination requirements specification"*.

E. Implications for Practice and Research

This FG study has a few implications. To practitioners, it provides a package of practices that have been evaluated.

Project managers in inter-organizational projects might consider practices of this package as candidates for inclusion in the project-specific agile project delivery cycles that design for their projects. The study also suggested that coordination requirement models seem a necessary artifact for (i) the proper management of dependencies among detailed feature-level requirements (that come up in the later iterations of the agile ERP cycle) and (ii) for informed re-prioritization decision-making. This finding was unexpected and we think it warrants further research. We consider it important, because requirements dependencies are a critical issue in scaling up agile principles to large projects [14]. Understanding how coordination models could resolve this issue forms a line for future research.

F. Limitations

Krueger and Casey [5] put forward three validity concerns pertinent to this kind of research: reactivity (the interference of the researcher's presence), moderator's bias, and FGMs' bias. They also provide a few strategies that reduce these threats to validity. We implemented these strategies as follows: (1) use of standardized procedures and audit trails: the FG was video-filmed. The transcribed data has been preserved and the analysis done by using a tool (Atlas.ti); (2) extended participation: the first author followed-up individually with each consultant to ask for clarifications on the transcribed data and make sure she understands completely what the consultant meant. Our later debriefing involved a team approach and we discussed alternative interpretations with each of the FGMs. The interpretation of the data was confirmed and the feedback was positive without exceptions; (3) Peer debriefing/support: the first author visited four of the companies and presented the preliminary results.

IV. SUMMARY

This study looked into agile ERP practitioners' experiences in engineering coordination requirements. We found that there are differences between this study and two other previously done studies [8,10]. Especially, the practices of creating and validating coordination models are contingent based on the context. We also indicated implications of the findings of our FG for future research and for practitioners. Last, we discussed the limitations of our research approach and what we did to counter them.

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TABLE III. INTER-ORGANIZATIONAL ERP RE PRACTICES ASSOCIATED TO COMPLEXITY LEVELS BY 9 FGMS.

Practice	Complexity level in Table I	FGMs' rankings for Level 2 match	FGMs' rankings for Level 3 match	FGMs' rankings for Level 4 match	FGMs' rankings for Level 2 and 3 match	FGMs' rankings for Level 3 and 4 match	FGMs' rankings for Level 2,3, and 4 match	Correct (%)
P_1	2,3,4	-	-	-	-	-	9	100.00
P_2	2,3	-		1	8	-	-	88.88
P_3	4	-	-	8	-	1	-	88.88
P_4	4	-	-	-	-	-	9	0.00
P_5	3	-	9	-	-	-		100.00
P_6	4	-	-	9	-	-	-	100.00
P_7	3	-	9	-	-	-	-	100.00
P_8	2,3,4	-	-	-	-	-	9	100.00
P_9	2,3,4	-	-	7	-	-	2	22.22
P_{10}	2,3,4	-	-	1	-	-	8	88.88
P_{11}	2,3,4	-	-	2	-	-	7	77.77
P_{12}	2,3,4	-	-	7	-	-	2	22.22