A Focus Group Study on Inter-organizational ERP Requirements Engineering Practices

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ABSTRACT
This focus group study evaluates 12 practices for engineering the coordination requirements in inter-organizational Enterprise Resource Planning projects. The practices were proposed and initially evaluated in previously published articles. Here, we present independent feedback of practitioners on the fit of the practices with these practitioners' project realities. We found that all 12 practices have been observed by the practitioners. Four out of the 12 practices have been observed in contexts that we have not expected, which formed ideas for future research.

Categories and Subject Descriptors
D.2.9 [**Management**]: Software Process Models.

General Terms
Management

Keywords
Requirements engineering, enterprise resource planning, empirical software engineering, focus groups

1. INTRODUCTION
Enterprise resource planning (ERP) projects solve business coordination problems in organizations by implementing standard off-the-shelf packages of business applications. Such a project 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. Requirements engineering (RE) for these projects has been recognized as a complex endeavor [2]. In the last decade, RE for ERP got even more difficult and riskier due to the changing nature of the ERP-adopting businesses and the changing nature of the ERP packages offered by ERP vendors. Businesses are engaging increasingly more in inter-organizational relationships [2] with other business entities to jointly deliver a product or a service. For example, the business network of WalMart Stores Inc. uses an ERP-enabled value web 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 [5]. To meet the collaboration and coordination needs of the companies forming inter-organizational partnerships, ERP producers launched a new generation of software packages offering a broad range of pre-defined coordination mechanisms readily available to ERP adopters to configure and use [3].

Traditional 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 [1,2]. In our earlier research, we investigated the questions of (i) how to engineer the requirements for inter-organizational coordination in ERP projects [2] and (ii) what represents good practices of engineering the coordination requirements for shared ERP solutions [3]. We 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 an organization. While in our earlier publications [2,3], we reported on our motivation to search for the RE practices and on our research process that helped us derive them [3], in this paper, we present the practices while explicitly focusing on the need to evaluate them. Specifically, our goal is to carry out an evaluation of the practices based on detailed feedback by ERP practitioners. This paper provides a detailed account on how we used a focus-group-based approach to do this. Our evaluation study represents the one out of the many steps we planned to empirically evaluate the RE practices. In what follows, Sect. 2 presents the RE practices to be evaluated, Sect. 3 reports on our research design, its application, and the limitations of the study. Sect. 4 concludes the paper.

2. BACKGROUND
The object of research in this study is a set of 12 practices for engineering the coordination requirements in an ERP project. In our earlier empirical study [2,3] 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 participate in partnerships [5]. 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

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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 [2,3]. 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 [3]).
- 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.

Table 1. 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

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 1. (The second column in Table 1 indicates the relevant complexity level for organizations to use the practice). We make the 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.

3. THE RESEARCH DESIGN

Our research design rests methodologically on the focus group (FG) research approach in [8]. Generally, a FG is a group discussion on a given topic, which is monitored, facilitated and 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 focus-group-based research process include the following: (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, we present how we implemented these steps in our specific settings. We make the note that while the FG method is broadly used in academic business research, in the RE field, its use as an empirical research tool has been only recently discussed [5,6]. These authors are among the very few who deployed the FG research method in studies on RE topics.

3.1 Objectives and Research Questions

The objective of our study is to collect feedback and evaluate, from the perspective of ERP functional consultants, the 12 practices and their association to specific complexity levels. Our study sets out to answer two research questions (RQs):

RQ 1: *Is what we think to be a good inter-organizational ERP RE practice something that ERP functional consultants observe in their project realities?* and

RQ2: *If consultants do observe a practice, then which complexity level would they put it at?*

We chose the FG research method to answer these RQs 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 [6], which was essential in this evaluation, as we were on tight budget and needed to collect observations in a short time span.

3.2 Planning the Focus Group

As per [8], we used our two RQs to identify the sampling frame for our study, i.e., to choose who to involve as a FG member (FGM). Our sample included 10 practicing professional consultants from seven ERP professional services firms in the United States. The firms were large, middle-sized and small consulting businesses specialized in implementing four ERP packages (SAP, Oracle, Peoplesoft and JD Edwards). The consultants were chosen because they demonstrated an interest in exploring similar questions from their companies' perspectives.

The consultants were all specialized in the SAP's package. As part of our planning, we acknowledged that the choice of include SAP consultants only might pose a validity threat to the FG results. We however planned some counter measures to reduce this threat (see Section 3.4 for more details on validity concerns). The FGMs were selected because (i) they had a characteristic in common, which pertains to the topic of the FG and (ii) 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. [8], p. 4). The intent is to promote self-disclosure and that is what we were after in this study. We collected 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 in [8], FGs are not used to provide a 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 recommendations in [8], 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.

All 10 consultants had the following characteristics: (1) They all worked in inter-organizational projects that had stakeholders and users at locations in at least two states or countries. (2) Each participant was a consultant that had at least 12 years of experience in inter-organizational ERP RE and was familiar with inter-organizational coordination issues. The modules in which the consultants were specialized were: material management, project system, financial accounting, service management, sales management. The industries in which their backgrounds were are: banking, insurance, telecommunication, and pharmaceuticals. Two consultants were working in Coordination Complexity Level 2 organizations, seven consultants - in Level 3 organizations, and one was embedded in a Level 4 ERP adopter. The consultants got to know the first author during the American SAP User Group's Educational Summit in September 2009 in Toronto, Canada. During this event, the author approached the ten consultants and they agreed to participate in the FG which took place during the event. As in [8], the moderator (in this case, the researcher) "should be similar to the respondents", meaning he/she comes from the same population. (The researcher 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 a diversity in viewpoints, while enabling all participants to make contributions without having to compete for 'air time' who have "the greatest amount of insights on the topic" (as in [8]).

3.3 Execution and Results

The FGMs scheduled their meeting as part of 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 meeting in time for the afternoon sessions of the event. The moderator chose a closed meeting room in a location for the FG where participants were free from interruptions and distractions. The meeting room provided seating arrangements where everyone was round one table. The day prior to the meeting, the first author provided informally each FGM with some background of this research study. When 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 to review the feedback by the participants, to probe deeper when necessary, and to paraphrase participants' points to make sure misunderstandings were avoided. This researcher 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. She spent 2 hours writing and this quick turnaround time on the transcription helped avoid memory lapses. This also proved to be easiest for her to remember what was meant by a particular acronym or shorthand immediately following the session. 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 research questions.

Stage 1: In this stage, the FGMs were asked to review the checklist 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 2. For each practice, we report the number of FGMs who observed it at least once in real-life settings. Table 2 indicates that the 12 practices make sense for practitioners and were actually observed in real-life projects.

Table 2. Number of observations of FGMs for each practice

RE Practice	Observations	RE Practice	Observations
P_1	10	P_7	9
P_2	9	P_8	3
P_3	10	P_9	6
P_4	10	P_{10}	5
P_5	10	P_{11}	10
P_6	10	P_{12}	5

Stage 2: In this 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 3, 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 [7]. The data in Table 3 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: P6, P10, P11 and P12, which all refer to the role of modelling in ERP RE. They were subjected to a second review by the FGMs. The FG accepted practice P6 for all complexity levels. The FG was divided according to two standpoints on positioning practices P10, P11, and P12. Seven FGMs thought that documenting inter-organizational coordination processes should be done by Level 4 ERP adopters because this is a very expensive effort and its pay-offs are much less tangible for Level 2 or 3 organizations. Three FGMs gave evidence that there exited Level 2 and Level 3 organizations that "acted smart" (i)

when selecting their solution, (ii) when selecting their way of working and (iii) when organizing their business and IT resources. The different arrangements these organizations chose for their ERP projects helped them complete coordination requirements modeling and use the models for their advantage. We, however, considered this an open point of discussion which warrants further research. Our immediate step will be to run a case study in two organizations to develop an understanding of the context in which practices P10, P11, and P12 can get associated with complexity levels 2, 3, and 4. We think, it is interesting to discover the underlying mechanisms at play in an inter-organizational partnership that make or break the process of inter-organizational coordination requirements modeling.

3.4 Limitations

Robson [9] lists three validity concerns pertinent to this kind of research: reactivity (the interference of the researcher's presence), moderator's bias, and FGMs' bias. Robson also provides a few strategies that reduce these threats to validity. We implemented these strategies as follows: (1) Audit trail: the FG was video-filmed. The trascripbed data has been preserved and the analysis results are available via a tool (Atlas.ti); (2) Prolonged involvement: the researcher followed-up individually with each consultant to ask for clarifications on the transcribed data and make sure she understands completely what the consultant meant. The interpretation of the data was confirmed and the feedback was positive without exceptions; (3) Peer debriefing/support: the first author visited three of the companies and presented the preliminary results.

4. CONCLUSIONS

This FG study evaluated 12 RE practices for inter-organizational ERP projects. We found that 8 practices were observed by 9 or 10 (out of 10) FGM, and 4 practices – by at least 3 FGMs. We also found that the FGMs associated the practices to the levels of coordination complexity, in a way that converged with ours. We also indicated implications of the findings of our group study for future research. Last, we discussed the limitations of our research approach and identified ideas for immediate future research.

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Table 3. Inter-organizational ERP RE practices associated to complexity levels by 10 FGMs.

RE Practice	Complexity level in Table 1	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	-	-	-	-	-	10	100.00
P_2	2,3	-	1	1	8	-	-	80.00
P_3	4	-	-	9	-	1	-	90.00
P_4	4	-	-	8	-	2	-	80.00
P_5	3	1	9		-	-		90.00
P_6	4	-	-	1	9	-	-	10.00
P_7	3	-	9	-	1	-	-	90.00
P_8	2,3,4	-	-	-	-	-	10	100.00
P_9	2,3,4	-	-	1	1	-	8	80.00
P_{10}	2,3,4	-	-	7	-	-	3	30.00
P_{11}	2,3,4	-	-	6	-	-	4	40.00
P_{12}	2,3,4	-	-	8	-	-	2	20.00