An E-government Field Study of Process Virtualization Modeling

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Abstract. Process virtualization is increasingly important as organizations frequently use virtual teams for project management and decision making. Virtual teams are more prevalent and essential to accomplish business goals. The multiplicity and continually evolving set of collaboration technologies makes it imperative that teams know how to select and employ appropriate tool(s) for each collaborative task across the whole project lifecycle and for each work process. This paper reports on application of the MAIN+ process virtualization approach through an e-government public e-procurement field study. E-procurement is expected to simplify work procedures, automate processes and enhance collaboration between call for tender stakeholders. The results should be of interest to academic researchers and information systems practitioners interested in collaborative business process virtualization. The research contributes to process virtualization literature, theory and practice through a detailed case study that develops artifacts that provide evidence of proof of value and proof of use in the field.

Keywords: Process Virtualization; Collaboration; Virtual Teams; Collaboration Technology; e-procurement; e-government.

1 Introduction

In today's information society, many aspects of everyday life and business are increasingly becoming virtualized as large numbers of processes that traditionally required participant collocation are now executed in a distributed manner across time and space. This tendency toward process virtualization is becoming increasingly important and researchers have begun study it effectively from several different perspectives. One critical aspect for organizations is the virtualization of collaboration processes (Biuk-Aghai 2003; Overby 2008) as virtual teams become more prevalent and collaboration technologies become more advanced and complex.

MAIN+ (i.e. Method to Analyze of collaborative Interactions Plus) was proposed, in Boughzala (2007) and more deeply described in Boughzala & Romano (2010), to help in Process Virtualization Modeling (PVM). This method facilitates virtual team selection of the most appropriate portfolio of information systems (IS) capabilities to provide effective support for key tasks both in collocated and distributed situations whatever the form of collaboration is. Since 2003, MAIN+ has been iteratively developed, evaluated and refined based on results from a series of laboratory and field studies. Since 2005, this approach was applied in an e-government call for tenders (e-procurement) processes. This field study is part of the R&D project called ProAdmin (Assar & Boughzala 2006) which was initiated to study the important evolution of processes in the French public sector.

The goal of the application of the MAIN+ PVM method in this study was to deeply assess its relevance in defining appropriate collaboration tools for each step of the processes of a call for tenders process to illustrate proof of value and proof of use of the method. More specifically, the research question was: "to what extent the application of the MAIN+ PVM method can lead to an increased level of process virtualization?" This study was conducted as a combination of empirical observation, formal survey (for end-users) and informal discussions (with French government managers). We have applied the collaborative situation analysis proposed in MAIN+ to the call for tender process and used the result of this analysis to make two evaluations. The first is a comparison with collaborative features that are supported by actual public e-procurement platforms (Assar & Boughzala 2008). The second is an interaction of MAIN+ analysis with a group of end-users and domain experts during a practitioner's seminar (Assar & Boughzala 2006). This paper extends the previous work by presenting artifacts developed during the MAIN+ process for a specific case and thus gives a thick description and explanation about how the method can be deployed in the field to illustrate proof of value and proof of use.

The purpose of this paper is to report on this e-government field study and to present its main findings and both theoretical and practical implications. It provides an overview of the application of the MAIN+ method in a real-world setting, demonstrates its value and discusses its limitations. This could serve as guidelines for further applications in this area. The remainder of this paper is structured as follows. The next section discusses the context of the MAIN+ application in the new French legal framework for public procurement. Section 3 introduces the methodological background related to MAIN+. The application of MAIN+ in the e-government field

study is reported in Section 4. The results of this application are evaluated and discussed in Section 5. The paper concludes with a summary of the limitations and the key directions for future research.

2 Application Context

Since January 1st, 2005, French public purchase processes are required to be supported by electronic means. Thousands of public institutions (governmental agencies, local authorities, public universities and hospitals, etc.) are concerned. E-procurement is expected to simplify work procedures and automate processes, and successful adoption should lead to potential benefits like reduced transaction cost and increased operational efficiencies. The underlying processes are generally complex, long with many special cases depending on the nature of purchased product or service and the amount of the purchase. They involve multiple actors with different profiles and different organizational cultures. Different forms of collaboration might occur and working situations are multiple and variable. The virtualization of the underlying business processes is not straightforward. Most purchases in public sector institutions require that a bureaucratic procedure be followed.

This field of public e-procurement is very well suited for illustrating and further exploring the use of MAIN+. Implementing e-procurement implies moving the purchase process from a standard form (paper based communication, physical meetings) to an electronically supported virtual process. As the notion of public contract covers vast panoply of public purchase types, we have considered in this paper one among many others we have studied - the open call for tenders. This research was completed as part of the ProAdmin project – an R&D project funded by the Institut Telecom as a prospective research for the French Ministry of Industry (Assar & Boughzala 2006).

3 Methodological Background

MAIN+ is a methodological approach based on Business PVM (Boughzala & Romano 2010) in which collaborative situations are analyzed according to the nature both of the work and of the collaboration (collaboration forms: communication, coordination and co-production, Boughzala 2001-2007). The results of the analysis facilitate the selection of the best collaboration technologies according to 16 collaborative situations described in the empirically derived correspondence table (see below Table 2).

MAIN+ seeks to demonstrate the potential for process virtualization (existing or to be deployed processes) and suggests several tools to be chosen according of constraints and requirements of each context: existing collaboration tools, level of desired tools' simplicity/complexity, size and structure of teams, time/frequency of use, project duration, computer literacy, budgets, team management modes, desired degree of virtuality, task types and complexity, experience working together of individuals, etc.

MAIN+ has been defined to describe the steps for how to perform PVM. Figure 1 summarizes the four main MAIN+ method steps. Prior to application of MAIN+ PVM, business processes must be assessed for virtualizeability (See the initial steps dashed rounded rectangle in figure 2). Overby (2008) developed Process Virtualization Theory and provides guidance on the factors/requirements (sensory, relationship, synchronism and, identification and control requirements) that determine whether a process can be successfully virtualized or not. This step is critical and provides the primary input for MAIN+ PVM, that is 'virtualizeable" business processes. In what follows, we will not detail this point and assume that modeled processes are suitable for virtualization.

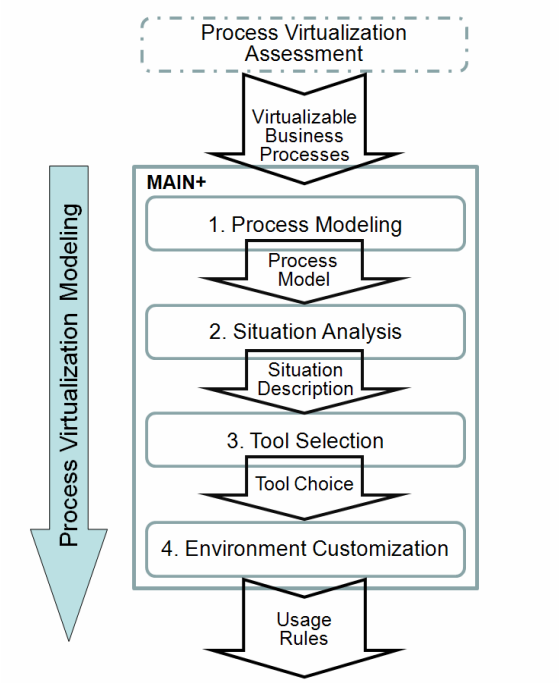

Fig. 1. MAIN+ Process Virtualization Modeling.

1. Process Modeling describes activities/tasks, inputs/outputs, documentation and actors: A Microsoft Visio application (MAIN+ template tool) was customized to facilitate the BPMN modeling and analysis of each task for further tool choices.

2. Collaborative Situation Analysis identifies the interactions of actors within each task. Two matrices guide identification of the nature of the work and the form of the collaboration.

3. Collaboration Tool Selection ensures that each task is appropriately supported by guiding collaboration tools choice according to task analysis, needs and constraints.

4. Collaborative Environment Customization facilitates the best choice of separately used tools or the customization of a virtual workspace specified according

to the previously modeled process and based on existing collaborative platforms such as Eroom, Quickplace, SharePoint, etc. The product of this step is a set of defined policies and rules of usage for the tools.

The fourth step will not be detailed in the next MAIN+ application.

MAIN+ was elaborated on the ground at the *Institut Telecom* and has been employed by students in Master's projects since 2003 (about 60 projects; 10 projects per year with project teams of 5-8 persons over a 3 month period in the framework of the course: "MIS 4502: Virtual project management", to learn how to collaborate remotely using the appropriate tools). MAIN+ has also been applied in numerous field studies such as Consulting, E-government, Industrial Design, Automotive, etc (Boughzala & Romano 2010).

4 Application in an E-government Field Study

In this section, we report in detail specifically on the application of MAIN+ in the e-procurement field to assess the potential for virtualization of the studied process. This field study was conducted longitudinally with a holistic approach as a combination of juridical text examination, MAIN+ application, end-users formal survey and domain experts brainstorming session.

4.1 Methods and Procedures

This field study was carried out as a longitudinal case study for the application of MAIN+. Data and evidence were collected in four different ways before, during and after the MAIN+ application (Assar & Boughzala 2007):

- As public purchases in France are strictly defined and controlled by legal texts, we have studied first the juridical background to get a picture of the procurement processes (as a first source of information). This examination was essential before and during the first step of MAIN+ application as an input for the process modeling.
- As a second source of information, we studied available electronic platforms and developed an empirical evaluation to assess their support for public e-procurement processes (Assar & Boughzala 2008). This study was important for exploring the features of the As-Is platforms and for noticing their scarcity in terms of interaction and collaboration tools.
- A third source of information is a quantitative-oriented survey conducted on a middle size sample of users in public administrations (Beauvallet & Boughzala 2007). The purpose of the survey was to establish how end-users globally perceive e-procurement implementation. Some questions were directly related to collaboration and virtualization and how they are or should be supported by e- procurement platforms. This survey was relevant to confirm needs and preferences of end-users. It was very informative for the

third step of MAIN+ application for the collaboration tool selection in order to better user interactions.

- The fourth source of information is a practitioner's workshop in which the empirical platform evaluation, the results of the end-users survey and the MAIN+ PVM were presented to obtain practitioners (end-users, e-procurement platform editors, government's managers and domain experts) feedback and to reconcile our points of view with those of some domain experts through a brainstorming session (Assar & Boughzala 2006). This brainstorming session was very interesting for enhancing the MAIN+ PVM and therefore the final deliverable for the French Ministry of Industry.

Following we will focus on only the execution of the first three MAIN+ PVM steps.

4.2 Process Modeling

The primary concerns in this step are:

- Process description in terms of activities and tasks, inputs and outputs, resources and actors.
- Activity (at the macro level) and task (at the micro level) identification, the role of each actor (leader or participant) and the interactions of actors: with whom each actor interacts during the task?
- Identification of documentation resources used during each activity and task as input or output.
- Duration estimates for each activity/task (in term of hours/days). While not mandatory, this is an important factor for successful coordination in the case of virtual project management (Zigurs et al. 2001).

Based on knowledge extracted from the juridical texts, we have represented the call for tenders process using Business Process Modeling Notation (BPMN). At the macro level, this procedure is composed of four main phases (cf. figure 2):

1. Requirements gathering: this phase is informal and unstructured and will trigger the formal part of the procurement process.
2. Public contract notice (AAPC, *"Avis d'Appel Public à la Concurrence"*) publication: Candidate companies can download the companies' tendering documents (DCE, "*Dossier de Consultation des Entreprises*").
3. Tender proposal submission: in this phase, proposals are sent or uploaded within time constraints. Once the submission deadline is reached, the tender is closed and all received folders are opened according to a specific procedure which is slightly different according to the public institution category. The offers are analyzed and compared, and certain complementary information can be requested from bidding enterprises. The selection process takes place later and a list of selected offers is published. The contract is

validated when the selected candidates supply all the necessary contracting documents.

4. The contract can then be executed and a billing phase is triggered later. The macro level representation of the 3rd phase of the process is shown in detail in Figure 3.

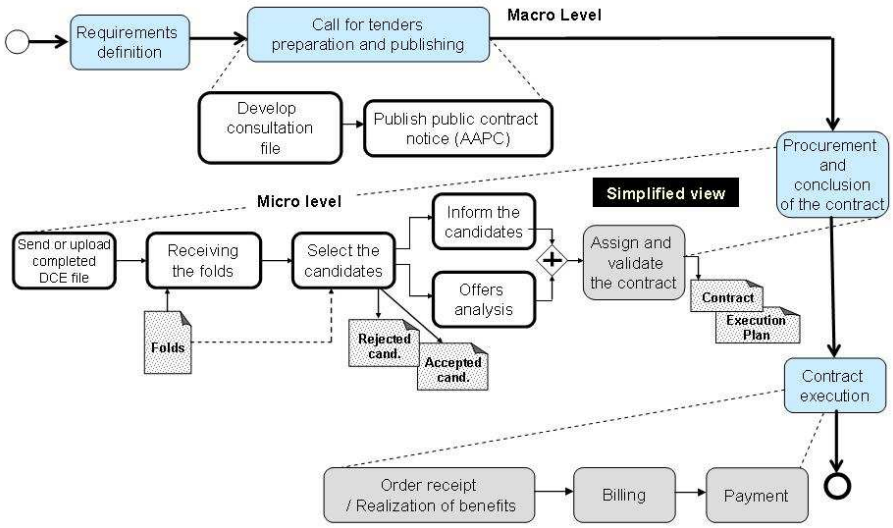

Fig. 2. Global view (macro level) of the call for tender process.

Figure 3 depicts the fully detailed version of the studied process. Certain selected tasks are numbered. The working situations in these selected tasks are analyzed later in the next step.

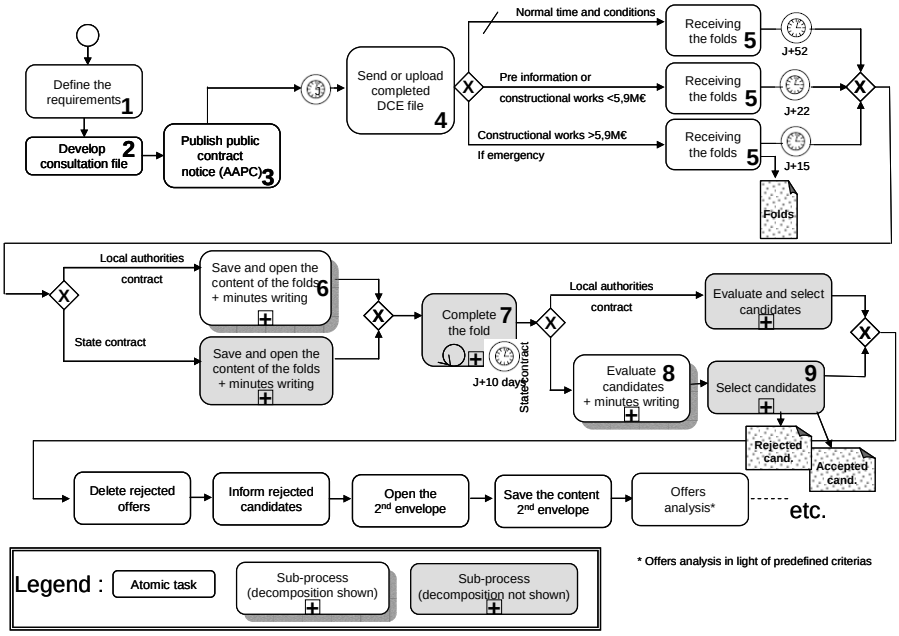

Fig. 3. Detailed view (micro level) of procurement & contract conclusion process.

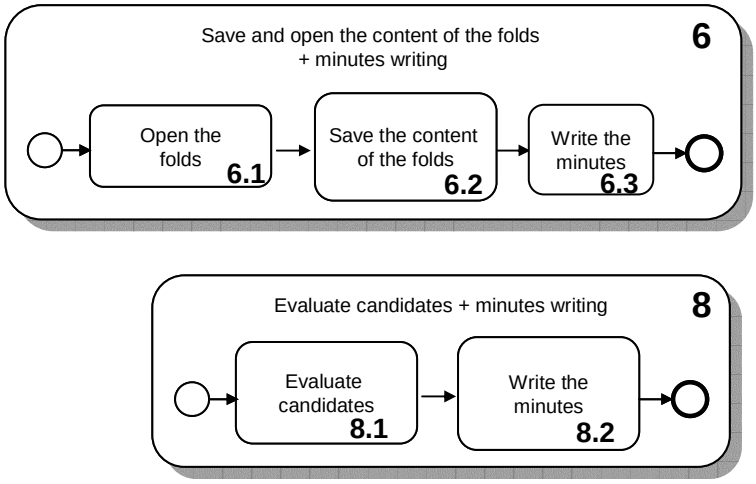

Figure 4. Detailed view of the tasks 6 and 8.

4.3 Collaborative Situation Analysis

The goal of this step is analyze each task as a working situation from a collaboration perspective. Two matrices are used to perform this important aspect of MAIN+: the work matrix and the collaboration matrix (figure 5.).

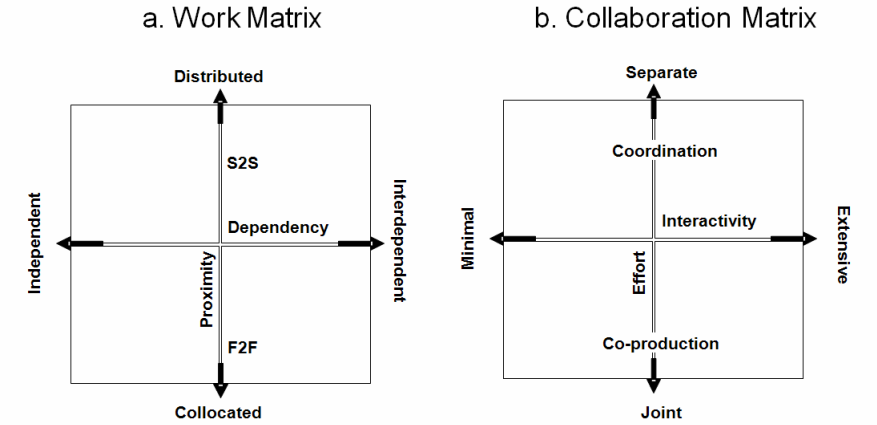

Fig. 5. Work Matrix (a) and Collaboration Matrix (b).
S2S = Screen-to-screen; F2F = Face-to-face.
Work matrix partially adapted from (Levan 2004.)

The work matrix (figure 5a) is inspired from the space-time matrix initially proposed by Johanson et al. (Johanson, Sibbet et al. 1991) and adapted partially from (Levan 2004). The horizontal axis represents the axis of dependency (work dependency) which ranges from independent work (individual work) to interdependent work (collective work). The vertical axis represents the axis of proximity (member proximity) (Dennis 1988) which ranges from collocated (Face to Face in the same place) work to distributed/remote (Screen-to-Screen at different places) work. Time is not considered in this matrix but in the Collaboration Tool Selection Framework to distinguish between (Asynchronous vs. Synchronous communication (see below table 1)).

The collaboration matrix (figure 5b) is an analysis according to two axes based on the collaboration forms: communication, coordination and co-production (Boughzala 2001). The horizontal axis represents the axis of communication interactivity that ranges from minimal to extensive (Rafaeli 1988; Lowry, Romano et al. 2009). The vertical axis represents effort from separate effort to joint effort. Separate effort is coordination where each participant carries out her/his part of task in consistency with those of the group according to the overall process. It can be asynchronous or synchronous with respect to others' efforts. Joint effort involves co-production where each participant brings their own knowledge, experience and expertise to solve a common problem simultaneously or to collectively carry out a group task in a

synchronous mode (Nunamaker, Romano et al. 2001-2002). Collaboration here means interdependence in terms of both goals and deliverables.

These two matrices enable each process modeling task to be placed in context within one of the four quadrants of each matrix to depict their relative collaborative nature within the 16 unique working situation arch-types (see table 2.) They also define the intersection of the four possible work matrix scenarios (Independent vs. Interdependent work, Collocated vs. Distributed work) with the four possible collaboration matrix scenarios (Minimal vs. Extensive communication, Separate vs. Joint effort). Boughzala & Romano (2010) provides examples for each scenario.

The next step analyzes working situations underlying each task of the call for tender process (Figure 3). A first set of collaborative tools is proposed to support the virtualization based on the correspondence table. The result of this analysis is depicted in table 3.

4.4 Collaboration Tool Selection

The goal of this step is identification of the best collaboration tools (single tool or a combination of tools) that will allow actors to effectively carry out the process according to the collaborative nature of the tasks and the contextual requirements. This increases actors and teams' awareness of the potential virtualization of the process. This selection is based on the Collaboration Tool Selection Framework (table 1) and the correspondence table (table 2).

The Collaboration Tool Selection Framework classifies existing collaboration tools into three main categories according to three forms of the collaboration (Boughzala 2001; Nunamaker, Romano et al. 2001-2002). This framework has been compiled on the basis of empirical evidence, laboratory and field experiments each year since 2003 and has been evaluated and improved iteratively based on each year's projects (Boughzala & Romano 2010).

The correspondence table (table 2) is then built based on the Collaboration Tool Selection Framework. It suggests the most appropriate tool set for each of the 16 different working situations from the work/collaboration matrices in Figure 2. This fit between the working situations and the corresponding set of tools has been established on empirical and experience based evidence and not on a theoretical basis such as for example the Task-Technology Fit theory (Zigurs and Buckland 1998); however our experience over time has shown that it does provide a useful guideline for actors that results in appropriate tool selection.

Table 1. Collaboration Tools Selection Framework.

Collaboration Forms	**Collaboration tools** NB: The same tool could be used at various forms of collaboration in different ways (e.g. blog, Note/Post-it, White board, RSS, FAQ, Application sharing…)		
	Type	**Less Formal**	**More Formal**
Communication	**Synchronous**	Instant Messaging, VoIP, Phone*, Audio/Visio/Web Conference, White board *Traditional hard phone or mobile	CMC (Conferencing Meeting Center), 3D Social Virtual World (e.g. Second Life)
	Asynchronous	SMS, Email, Link, MMS, Weblog (Blog), Alert/Notification	Mailing list, Discussion forum, RSS (Really Simple Syndication), Electronic repository, EDI (Electronic Data Interchange)
Coordination	**Less structured**	Note/Post-It, Files Sharing, Wiki, FAQ, Folder/Library/Document base	Awareness (Indicator of presence), Document review system
	More structured	Shared diary, Dashboard, Knowledge dictionary	Task and project management plan, EFM (Experience Feedback Management), Workflow engine, Knowledge base, CMS (Content Management System)
Co-production	**Knowledge Access**	E-repository, Knowledge dictionary	Ontology, Intelligent search engine
	Knowledge Sharing	Note/Post-It, RSS, FAQ (Frequently Asked Questions), Blog, Wiki, White board, (Information, competence/ knowledge, process) Mapping	Task and project management plan, EFM, Application sharing, Shared edition, Knowledge base, CMS
	Knowledge Creation	E-voting system	Survey system, Application sharing, 3D simulation, GDSS (Group Decision Support System), Text/Data-mining, CBR (Case Based Reasoning)

The call for tender process (see figure 3) is initiated in step 1 where some initial requirements are expressed by users in the public institution. This task can vary from a simple demand for purchasing a daily product (like portable computers or office furniture) to a more complex product and/or service request (a car location yearly based supply and maintenance contract). For this task, in which the working situation is interdependent and distributed and the collaboration situation shows extensive communication with separate efforts, the users need to discuss their needs collectively and the appropriate tools according to the collaboration matrix are chat, internet based phone, web-based conferences and awareness tools. In step 2 of the process, the users

begin elaborating the call for tender. They develop the consultation file in which they express the main requirements and publish the public contract notice (task A2). Email and document bases are appropriate tools in this context.
From the company side, bidding proposals (using the DCE forms) can be uploaded in the platform (task 3 and 4). Email, file sharing and document bases can be used to elaborate the proposals. Alert, awareness, email and file sharing are used on the user side to prevent of new proposal uploads and to receive the folders (task 5). The time constraints vary depending on the specific conditions, context and nature of the call for tender (a call for a construction work contract, necessity of pre-information, emergency situation, etc.) When the bidding deadline is past and the moment comes to open and review the proposals, depending on the status of the public institution that issued the call (state agency or local authority), the actors in this step are slightly different. The composition of the review and selection committee differs according to the juridical texts. In task 6, the folders are open, verified and saved, and a short report is written about the action taken. This step is usually done in a formal meeting where physical presence is required. Depending on the characteristics of the contract, it can be done in a virtual way. Real time communication using web conference or chat tools together with file sharing and document bases can be used. Shared edition tools and chat support are needed to document the minutes of the meeting. Task 7 involves bidding companies that have submitted incomplete folders; and they are requested to complete their folders. This situation is similar to situation in tasks 4/5, and email, document bases and awareness tools can be used.

Task 8 is further decomposed into two subtasks (see figure 4). Subtask 8.1 is dedicated to proposal evaluation. In this subtask, members of the review and selection committee have to give opinions and provide comments. Electronic voting systems and Group Decision Support Systems (GDSS) can help in virtualizing this task. Task 8.2 is dedicated to writing minutes of the previous subtask, shared edition tools and chat support can be used. The last step that is analyzed in our example is candidate selection (task 9). This is a decision making task and the committee members must develop a short list of selected proposals. Competence cartography tools are helpful to compare bidding companies and evaluate proposals. Cartography tools, electronic voting systems and GDSS can be used to generate a sorted list of selected candidates.
Working situations underlying each task of the call for tender process (Figure 3) are analyzed based on the correspondence table (Table 2). The result of this analysis is summarized in table 3.

5 Results: Evaluation and Discussion

The process studied here is not a typical working process that can be automated in workflow fashion. It contains interesting and unique collaborative features. Many of the steps are complex and highly collaborative (embedded collaboration activities) where tasks like brainstorming and decision making may occur. This process is well suited to illustrate the MAIN+ method.

The obtained results concerning the suggested tools are of general concern to all call for tender stakeholders and to others that employ complex collaborative

processes. This is because the process description as it is defined by juridical texts and translated into the model are very generic. Different executions of this process can lead to different collaboration contexts at each step of the process depending on various characteristics like the sophistication of the purchased product, the number of bidding enterprises, the constraints on the budget, the level of consensus between. members of deciding committee, etc. The set of possible support tools that is obtained by applying MAIN+ method has to be considered as a generic and suggestive answer to collaboration requirements at the level of each activity. Further refinement should be done according to the specificity of the execution of each process so that virtualization can take place effectively and result in an efficient process.

The first generation of public e-procurement platforms did not fully support collaboration at task level and basic collaboration tools like forums and shared agendas were seldom present (Assar & Boughzala 2008). Using the results of this field study, we have elaborated a set of proposals for enhancing existing e-procurement platforms. This proposal was presented and discussed with domain experts and e-procurement platform editors in a practitioner's workshop (Assar & Boughzala 2006). Exchanges were organized by workgroups according to a directed brainstorming with specific questions according to a particular scenario/process. The latest editions of these platforms include collaboration tools like shared agenda, blog and forum for discussion. However, these tools are not integrated well into the e-procurement processes and their usage is decided by the end-user or project leader without any guidance concerning the adequacy of the tool for the working situation. This evolution of e-procurement tools in the market is consistent with the results of this field study (Assar & Boughzala 2008).

The public e-procurement end-users themselves provided another validation of the appropriateness of the MAIN+ method. In the brainstorming session, we presented the execution of a purchasing process in two different ways: first is the traditional process supported by physical meetings and paper document exchange; second is a fully virtualized process. For each step we selected and proposed a collaboration tool to support the working situation. These two alternatives for running a purchase process were simulated and discussed with end-users. The virtualized process clearly showed a reduction in execution time and easier implementation from an organizational point of view. However, users pointed to the specificity of each execution. The proposal of a set of collaboration tools in which the project leader can select appropriate ones in a dynamic way (according to working situations) was considered as a relevant approach to implementing process virtualization. This conclusion was coherent with the survey results which revealed that a large percentage of end-users expected a virtualized process to provide better support for communication, asynchronous and distance work, electronic document exchange and annotation than a traditional process (Assar & Boughzala 2007.)

Table 2. Correspondence Table.

	Work Matrix				**Collaboration Matrix**				Possible / Selected set of adequate tools: communication to co-production informal to formal tools		
	Independent	***Interdependent***	***Distributed***	***Collocated***	***Minimal***	***Extensive***	***Separate***	***Joint***			
									Communication	***Coordination***	***Co-production***
1	X		X		X		X		SMS MMS Email Blog Link Alert/Notification	Note/Post-It FAQ Files Folder/ Library/ Sharing document base Wiki Document review system	
2								X			E- repository Blog Knowledge Intelligent search Dictionary engine Ontology Mind-Mapping
3						X	X		Blog Discussion Forum	Wiki Awareness	
4								X		Wiki Document review system	CBR
5	X			X	X		X		Link RSS	Note/Post-It Folder/Library/Document base Files Sharing Document review system FAQ Knowledge dictionary Shared Diary Dashboard	
6								X			Knowledge dictionary Mapping Ontology E-voting system
7						X	X			Dashboard Task and project management plan	
8								X			Task & project management plan

9					X		X		Email Blog RSS Discussion forum Link Alert/Notification	Note/Post-It Folder/Library/ Document base Files Document review system Sharing Dashboard Wiki FAQ EFM Shared CSS Diary Workflow Engine Knowledge base Task and project management plan	
10		X	X					X			E-repository E-voting system EFM Knowledge dictionary Ontology Knowledge base CMS Text/Data mining CBR Intelligent search engine Note/Post-It Mind-Mapping
11						X	X		Phone Chat/Instant messaging CMC 3D Social Virtual World VoIP Audio/Visio/Web conference	Wiki Awareness Workflow engine	
12								X	Phone Chat/Instant messaging VoIP White board CMC 3D Social Virtual World Audio/Visio/Web conference	Awarenes s	GDSS Application CBR Sharing Shared edition 3D Simulation
13					X		X			EFM Knowledge dictionary Dashboar d Folder/Library/ Document base Note/Post -It Task and project management plan Shared Diary Knowledge base	
14		X		X				X			EFM Knowledge dictionary GDSS Mind-Mapping Ontology E-voting system Text/Data mining
15						X	X			Dashboard Task and project management plan	
16								X		GDSS CBR Note/Post-It White board Task and project management plan	

Table 3. Situation analysis and tools proposal. (refer to table 1 for acronyms)

Situation		***Work Matrix***	***Collaboration Matrix***	***Proposed tools: from less to more formal tools***
A1: Requirements definition		Interdependent X Distributed	Extensive X Separate	Chat, VoIP, Web Conference, Awareness
A2: Develop consultation file		Independent X Distributed	Minimal X Separate	Email, Folder/Library/Document base
A3 : Publish public contract notice				Email, Mailing list, Files sharing, Library/Document base
A4: Send or upload completed DCE file				Email, Files sharing, Alert, Folder/Library/Document base, Awareness
A5 : Receiving the folders				Email, Files sharing, Alert, Library/Document base
A6 (Local authorities contract)	A6.1 : Open the folders	Interdependent X Distributed	Extensive X Separate	Chat, VoIP, Web Conference,
	A6.2 : Save the content of the folders	Independent X Distributed	Minimal X Separate	Files sharing, Folder/Library/Document base
	A6.3 : Write the minutes	Interdependent X Distributed	Extensive X Joint	Chat, Shared edition
A7 : Complete the folder		Independent X Distributed	Minimal X Separate	Email, Alert/Notification, Folder/Library/Document base
A8	A8.1 : Evaluate candidates	Interdependent X Collocated	Minimal X Joint	Electronic voting system, GDSS
	A8.2 : Write the minutes	Interdependent X Distributed	Extensive X Joint	Chat, Shared edition
A9 : Select candidates		Interdependent X Collocated	Minimal X Joint	Mapping, Electronic voting system, GDSS

Finally, most of the participants (end-users, e-procurement platform editors, government's managers and domain experts), in this field study have reported that MAIN+ was relevant and satisfactory. They also stated that they thought MAIN+ focuses on real problems and provides consistent and useful artifacts and solutions. French Government managers that have participated in the study reported that they thought they could reuse MAIN+ by themselves for future process virtualization projects. One manager said "*whatever the complexity of the process, MAIN+ is well suited to illustrate the nature of the collaboration situations and to help in the selection of tools*".

6 Conclusion and Perspectives

In this paper, we have presented a detailed case study of an application of MAIN+ PVM method in the e-government field to facilitate process virtualization to provide effective public e-procurement. The results of the study also provide guidance for the improvement of existing e-procurement platforms. One contribution is enhanced comprehension of the various e-procurement processes for the e-government client that provides a solution to the specific problem at hand. Additional contributions of the study include both the artifacts created and their use as evidence of proof of value and proof of use of the method in a real-world setting. The results should be of interest to academic researchers and information systems practitioners interested in virtualization of collaborative business processes. The research contributes to the literature, theory and practice in process virtualization through a detailed case study that develops artifacts that provide evidence of proof of value and proof of use in the field.

Nevertheless, we are aware of some limitations of this work. One limitation concerns the correspondence table which we believe needs to be further refined. We plan to gather additional evidence to refine the tool selection process. We also think that additional criteria should be added to provide more explicit and precise guidance for team leaders and users.

Several future research directions are suggested to enhance the current version of MAIN+. One interesting idea is to take into account nonfunctional requirements so that tool selection is more straightforward. If simplicity of use and interoperability are major concerns, the correspondence table can be simplified to contain a smaller set of easier-to-use, interoperable tools. Another possible useful direction would be to study how teams engaged in business process virtualization move from a F2F situation to an S2S situation. This could reveal useful insights into the limitations of F2F and the requirements for S2S collaboration. We also believe that further field studies should be conducted to enhance the quality of the MAIN+ artifacts in terms of practical value and validation through experience.

Another avenue for future research that is currently under study is the design of a MAIN+ graphical modeling notation which when combined with BPMN could provide visualizations of the virtualized process steps. This notation is a first step towards developing a virtualization formalism that will combine an information

structure meta-model and a set of assembly operators that can be used to combine virtualized process steps and define appropriate collaboration tool sets that can be used along the virtualized process collaboration chain.

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