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Abstract. Software-as-a-Service (SaaS) is becoming a very powerful strategy for develop more flexible software solutions and to shorten their time-to-market. Typical SaaS providers are SMEs, which have several limitations to keep competitive. The essential motivation of this work is to provide better means to allow groups of SaaS providers (a Virtual Organization - VO) to work collaboratively towards more valuable SaaS solutions that are composed of individual and shared SaaS providers' services. However, working collaboratively requires handling plenty of issues in many dimensions. This work provides a comprehensive and consolidated list of reference processes that SaaS providers should deal with along the (VO) life cycle of a collaboration. This helps them to better plan and manages their activities and involved assets in a collaboration.

Keywords: Collaboration, Business Process, Software-as-a-Service.

1 Introduction

The adoption of strategic alliances focused on highly intense collaboration has been seen as a sustainable alternative to increase enterprise competitiveness through innovation and productivity [1]. Collaborative Networks (CN) has emerged as a prominent paradigm allowing companies to keep focused on their skills and to aggregate competencies with other companies in order to offer products with higher value to meet businesses [2]. CN can provide the basis for capacity elasticity and workload allocation flexibility in dynamic and adaptive value chain networks.

ICT represents one of the most important sectors in the nowadays knowledge and increasingly service-oriented economy, and has become vital to leverage enterprises competitiveness [3]. However, it is important to consider the typical profile of ICT companies. In Europe, for instance, there are more than fifty thousand SMEs within the ICT sector [4]. It is well known that SMEs have many limitations, such as in terms of human and financial resources, marketing, scalability, time-to-market, best practices and innovation. Therefore, it is crucial to develop sustainable models for ICT companies that are aligned to that reality.

Within this context, cloud computing and Service Oriented Architecture (SOA) paradigms have introduced a new outlook on systems design, development, integration and servitization [5]. Following this trend, a number of architectural and supporting business models start to be widely adopted, such as SaaS (Software-as-a-Service) [6]. SaaS is an architectural and availability model of software that is accessed on demand via Internet and that is paid per use. In this model companies no longer buy traditional software packages' licenses but remotely invoke ('rent')

specific software services from providers instead. Although not mandatorily, in order to take more advantages of the software features provided by SOA, several SaaS solutions are developed under this paradigm, where a SaaS solution is then composed of a set of (decoupled) software services [7].

Regarding the ICT companies that have been investing in SOA and SaaS-based solutions, on one hand the adoption of these models can open new business opportunities. On the other hand this does not solve those limitations by itself as companies usually remain working alone, developing services by their own and for their use only, keeping them deployed at their local silos [8]. The underlying motivation of this paper is to explore the premise that ICT SMEs sustainability can be highly enhanced if they collaborate more with other companies - even being competitors - in the form of sharing services and business strategies with the aim of composing and offering more value-added services-based solutions to the market.

CN appears as an adequate scientific foundation to pave a collaborative work among ICT SMEs in that perspective. In this paper, the envisaged business scenario refers to making such companies sharing their individual (interoperable) services in order to compose more flexible SaaS solutions to better cope with market needs. This scenario has been called as "Collaborative SaaS" [9]. In the light of CN paradigm, this means creating a Virtual Organization (VO) to attend to a concrete demand for or to prospectively develop a new SaaS solution, where the VO members are the ICT companies which own the involved services of that solution.

A number of works in the literature use to generally state about the importance of ICT companies to more intensely work in a collaborative way. However, no one say how to do that in a precise and comprehensively way. Even larger companies that do that use to make it in an *ad-hoc* manner and very much focused on their reality regarding their long-term and know partners. The fact is that working collaboratively - and even more in such Collaborative SaaS scenario - is not a mere wish. There are many organizational, legal, financial, technological among other issues to cope with to approach this problem. This is especially difficult considering that companies are naturally heterogeneous and that their independence and autonomy must be kept along the collaboration.

In this sense, this work provides a comprehensive list of the business processes that SaaS providers should deal with along a collaboration towards having a SaaS solution. In a previous work [9] authors provided a preliminary list of collaborative processes for Collaborative SaaS. This article now presents the consolidated and formalized version of this list, the processes' related practices and the positioning of each process within each phase of the VO life cycle. A list like that is an important instrument offering a more solid basis to SaaS providers about the impact of these processes on their current practice. As such, they can be better prepared for supporting the processes, for better managing resources and efforts in each VO / collaboration phase as well as for implementing processes' related practices.

This article is organized as follows: section 2 depicts the essentials of research methodology applied in this work as well as of the literature review. Section 3 presents the list of collaborative processes and example of practices. Section 4 discusses about the main findings of this research.

2 Basic Research Methodology and Literature Review

This research corresponds to a qualitative and applied work, strongly grounded on revision of literature. The literature review was mostly conducted applying the SLR methodology [15] over *IEEExplore, ACM Digital Library, Compendex/Engineering Village* and *ScienceDirect* scientific databases collecting papers published in journals and conference proceedings between Sept 2000 and Sept 2012. This was complemented with *ad-hoc* searches, also looking at works developed in the software industry. From an initial and rigorously filtered list of 278 works that were found out, 11 works were taken as the core theoretical referential source of collaborative processes [11-13] [14-19], regarding their scope and depth in the processes description.

An inductive method was applied as the research strategy aiming at creating a generalized but preliminary list of collaborative processes from particular instances (related works) and from empirical evidences.

It could be observed that Collaborative SaaS is a new area and no very directed related works were found out. Therefore, that list had to be compiled and adapted to that as well as fit in along the VO life cycle. It is important to clarify that reference models as CMMI or ISO/IEC 15504 [10] are devoted to software improvement processes and for the acquisition model, and not to collaborative processes and service-oriented model. On the other hand, being very consolidated models, they were used as the basis for the elaboration of the processes' base practices.

A selected international working group composed of 24 experts on the areas of collaborative processes/systems and services was formed to refine and evaluate the compiled processes list. This was carried out along three rounds of interactions via a web site created for that. Intermediate and final refinements were conducted by the authors, also based on their experience in the involved areas. This has also involved a final consolidation of the resulting list in order to check redundancies (i.e. different processes' purposes dealing with equivalent concepts), synonyms (i.e. different words but with the same meaning) and semantics misleading (i.e. definitions of processes that were in fact more related to other process' definition). A number of supporting books were also taken into account for that 'normalization', [20] in more particular.

3 Collaborative Processes

With the processes compiled with 'normalized' names and purposes, they were analyzed and categorized within and according to the phases of the VO life cycle reference model [20]: *creation, operation, evolution* and *dissolution*. Due to the more amplitude, the processes within Operation and Evolution phases were organized into subcategories, regarding their more intrinsic nature. They were also prioritized in terms of which ones have to be primary supported. The prioritization (P) level was divided into 5 categories: *essential (5)*, *very important (4)*, *important (3)*, *low important (3)* and *likely unnecessary (1)* to be supported only if they are indeed necessary for the particular case. Table 1 resumes the consolidated list of 42

processes required to support Collaborative SaaS. The prioritization was built based on experts' opinions. This prioritization should be seen as a reference and, as any qualitative classification, has some degree of subjectivity. Depending on local conditions and culture, strategic planning, working methods, among other aspects, this can change and so can be deployed differently. It might be said that this corresponds to the 'why', 'what' and 'when' to do the collaboration.

Table 1. Consolidated list of Processes for Collaborative SaaS.

Phase		P	Processes	Purpose
Creation		4	Business Opportunity characterization	Involves the identification and characterization of a new collaboration opportunity of a new SaaS collaboration.
		3	Selection of performance indicators	Performance indicators to be used in the monitoring must to be defined by the SaaS collaboration group.
		4	Partner Search	Identification of potential partners, and their assessment and selection to be a SaaS provider.
		4	Partner Selection	Setting up SaaS partner's section criteria and selection supporting method.
		4	Negotiation & Risk Analysis	Activities and supporting tools to assist partners during the negotiation processes and risk analysis assessment towards the SaaS collaboration.
		5	E-Contracting	Final formulation of contracts and agreements as well as the contract signing process itself, before the SaaS collaboration can effectively be launched.
		4	Collaboration Planning	Determination of a rough structure of the potential SaaS collaboration, identifying the required competencies and capacities, structure of the task to be performed as well.
Operation & Evolution	QoS Management Processes	4	Trust Management	Promotion the establishment of trust relationships and levels among SaaS participants.
		5	Governance Management	Management activities and supporting tools for the SaaS collaboration policy management, operational rules and bylaws, regulation, and control of the network structure.
		3	Measurement and analysis	Developing and sustaining a measurement and analysis capability of the SaaS collaboration that is used to support management information needs.
		3	Decision Support Management	Management activities and supporting tools for decision support, using KPIs in the SaaS collaboration.
		2	Process and Product Assurance	Provides appropriate conformance guidance and objectively reviews the activities and SaaS work products of work efforts within the collaboration to ensure.
	Strategic collaborative processes	5	Strategic Management	Formulating, and evaluating functional decisions that will enable a collaboration to achieve its objectives.
		3	Customer Relationship Management	Managing the interaction with SaaS customers with the collaboration, using enterprises data and information.
		2	Organizational Innovation	Selection and deployment of innovative and measurably improvements of the SaaS collaboration's processes
		5	Collaborative Strategy	Investment in strategies to improve the SaaS collaboration, to develop provider competence and to improve the general network.
		5	Reconciling Individual and Collective Interests	Achieving trade-off between individual partners' missions and collective interest.
		3	Simulation	Generation of scenarios about implementation decisions evolving SaaS and collaboration.

Operation & Evolution	Project Processes	3	Collaborative Project Management	Establishment and managing Collaborative SaaS projects and the involvement of the relevant stakeholders.
		3	Requirements Management	Managing the requirements of the SaaS project's products and to identify inconsistencies between those requirements and the project's plans and work products.
		2	Requirements Development	Producing and analyzing customer, product and product component requirements.
		4	Risk Management	Identify potential problems so that risk-handling can be planned and invoked as needed along the collaboration.
		3	Quantitative Project Management	Managing project's processes to achieve the project's established quality and process-performance objectives.
		4	Partnership formation project	Negotiation of roles and responsibilities, deliverables and payments related with SaaS collaborative project
		2	Resources Management	Plans and manages the acquisition, allocation, and reassignment of all resources needed to prepare, deploy, operate, and support the collaboration.
	Technical Processes	5	Technical Solutions	Design, develop and implement solutions to the committed requirements between SaaS and collaboration.
		4	System design and task partitioning	Modularity, interface definition and task interdependencies in a SaaS development.
		4	Support Institutions Management	Management activities for identifying and integrating Support Institutions into the SaaS collaboration.
		5	Performance Management	Activities and tools of planning, monitoring, rating and rewarding collaboration actors based on the KPIs.
		3	ICT Management	Management activities and supporting tools for managing easy-to-access and operational infrastructure that will allow collaboration actors with different applications.
	Administrative, Legal & Financial	3	Collaboration Launching	Refine the SaaS collaboration plan and its governance principles, to formulate and model contracts and agreements and to put the collaboration into operation.
		3	Collaboration Agreement	Setting up the terms in which the collaboration will take place.
		2	Marketing Management	Management activities and supporting tools that will support the strategic formulation process, including the marketing and branding activities
		3	Financial Management	Planning income and expenditure, and making decisions that will enable the enterprises survive financially.
		2	Accounting Management	Activities to guarantee the enterprise financial health and ensure the effective and efficient and use of the resources.
		3	IPR Management	Agreement about the terms of the Intellectual Property Rights within the collaboration.
Dissolution		3	Collaboration inheritance	Management of inheritance information after collaboration dissolution.
		3	Partners assessment	Sharing the analysis results is dependent on the network and the collaboration rules and practices.
		3	Checking contract	Finalization the collaboration contract terms.
		2	Security access cancellation	Ending the services access between the enterprises.
		2	Legal issues	Finishing the legal issues on the use of virtual companies since they imply cooperation agreements.

Once identified each process should be more formally specified in order to be more properly understood and used. This would correspond to the 'how' to do the collaboration. This work has applied the ISO/IEC 15504 standard for that. A PRM (*Process Reference Model*) describes the implementation mechanisms of every single process, providing: *process' domain and scope*, *process purpose*,

process outcomes (PO) and *base practices (BP)*. BPs contains the list of indicators that should be used to achieve process' purpose, including some optional notes. POs can be seen as the checklist to evaluate if BPs were properly implemented.

A PRM and related BPs should be seen as a referential basis and so they should be expressed at a relatively abstract level allowing a further particularization for collaborative companies. ISO/IEC 15504 was also used as a basis for the BPs and then adapted to the Collaborative SaaS scenario. Table 2 shows a PRM of one of the 42 elicited collaborative processes. It refers to the process 'collaborative strategy', which is performed in the operation ('OPE') phase of the VO/collaboration life cycle, it is the first ('.1') process in this phase, and that has seven BPs. The complete list of PRM for all processes can be found at: http://www.das.ufsc.br/~maiara/Collab_SaaS_MM.pdf.

Table 2. Process, Purpose, Outcomes and Base Practices.

Process ID	OPE.1
Name	Collaborative Strategy
Process Purpose	The purpose of Collaborative Strategy is to select and deploy improvements to the SaaS Solution.
Process Outcomes	As a result of successful implementation of this process: 1) Improvements to SaaS Solutions known; 2) Improvements analyzed; 3) Goals, strategies and plan defined; 4) Goals, strategies and plan implemented.
Base Practices	**OPE.1.BP1**: Research and identify possible improvements to deploy in the SaaS Solution. [Outcome 1] **OPE.1.BP2**: Analyze if the improvements are aligned with the business strategy. [Outcome 2] **OPE.1.BP3**: Analyze how the proposed change generates value for the customer. [Outcome 2] **OPE.1.BP4**: Analyze what investment is required and if the needed investment will generate an acceptable return. [Outcome 2] **OPE.1.BP5**: Analyze what would be the impact of the improvement on the current business. [Outcome 2] **OPE.1.BP6**: Implement activities for improvement.[Outcome 4] NOTE 1: When the improvement involves innovation, it is strongly recommended to use a Model of Innovation Management.
Sources	[21] [22] [16]

4 Discussion and Conclusions

This article has presented a comprehensive list of the collaborative processes that are generally required when groups of SaaS providers decide to work collaboratively aiming at providing a given SaaS solution as a Virtual Organization. Processes are detailed and formalized in way to help companies in their implementation and management along the VO / collaboration life cycle.

This list should be taken as complementary to the traditional transaction-based business processes that companies use to execute in their daily business life.

One of the most important usages of that list is to give awareness to SaaS providers about what, how and when to do in a collaboration. As such, they can

help companies in making less difficult the 'shifting process' of transforming collaboration as a process routine and value adding instead of an exception and sporadic action, as usually happens in the companies, SMEs in particular.

Although comprehensive and it had been validated by a group of international experts, the processes list cannot be seen as definitive. A number of works in the literature has brought up valuable outcomes on collaboration among companies but essentially focused on more consolidated sectors, as manufacturing, and sometimes targeting to specific problems. Collaborative SaaS, on the contrary, is a new scenario, having a number of open points and challenges. As such, it is natural that the list evolves as long as such form of collaboration gets more mature and companies start using them more intensely as a basis for continuous process improvement. Therefore, this list should be seen as an initial contribution, as a starting point. Even though, it should be adapted to the current or envisaged SaaS digital business ecosystem, considering aspects as business strategy and local conditions, capacity and maturity models, organizational change management, trust building, companies' performance evaluation and reputation management, financial impact, selection and use of proper implementation ICTs, interoperability, security, SLA management and services deployment, among many other. All this costs and takes time to be implemented and to evolve.

It is important to highlight that the processes list and related PRM does not cover other macro phases of a SaaS life cycle. It assumes that a sort of services are registered and made available in a proper and standard-based way so diverse composite SaaS solutions can be assembled on top of this. The provided list copes with the processes involved in this 'assembly' and basic provision. Other phases, as services conception, design, implementation, fully provision and maintenance, are not supported as they were out of the scope of this specific research.

Next main steps of this research refer to its expansion in general. Firstly but gradually, to enlarge that list in order to also comprise those mentioned SaaS macro phases. Secondly, to evaluate at which extent companies can enhance their organization for more efficient creation and provision of SaaS solutions if they become members of long-term alliance, as VBE – Virtual organization Breeding Environment [20]) and Federation [23].

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