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DESIGNING A COLLABORATIVE INFORMATION SYSTEM FOR A BUSINESS OPPORTUNITY

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ABSTRACT

Designing an "on demand collaborative information system" of partners having heterogeneous and distributed information systems is a challenging issue. It consists of combining partners' web services to respond to a new requirement in a fast and efficient manner. In this paper, we propose an approach for generating a collaborative process of a business opportunity in which requirements consist on a business need expressed by a partner that we call project initiator. Our approach is based on five steps, it starts with collecting the business need's activities and partners' web services in respect of specific meta models before injecting them into our ontology, then SWRL rules are used to automate the extraction of the nominated services for collaboration, Those services are filtered and ordered manually by the project initiator in the purpose to generate the collaborative business process, in respect of BPM paradigm, through our algorithm. Finally, a case study is presented in order to highlight the advantages of our approach.

KEYWORDS: *Partners, Collaborative Information System, Collaborative Process, Distributed Architecture, Ontology.*

I. INTRODUCTION

The current macro-economic climate, conquered by a tough global crisis, exhorts small, medium and large companies, to abandon the traditional economic model, based on permanent, constant and costly partnerships, and to focus on new forms of collaboration, marked by the constraints to cooperate promptly, efficiently and proficiently. To respond to market opportunities in a timely and efficient manner, organizations from all over the world must acquire consistent capabilities as responsiveness and flexibility; these skills are prerequisites for a successful on demand collaboration.

On demand cooperation or collaboration is a temporary grouping of partners distributed in space and time. This grouping is formed of opportunistic alliances initiated by a company called *initiating company*, the project of cooperation dissolves once the opportunity completed. This scenario involves the collaboration of different stakeholders in a cooperative process composed of several processes executed by different partners in order to achieve a common goal or respond to an opportunity in the market [2]. Ensuring a dynamic and reactive response to a business opportunity in collaboration with several heterogeneous partners is a really subtle mission, because:

- The partners involved in the collaboration, come with their own processes, services, semantics and a given data format. Each of them wishes to preserve its functional autonomy and technical architecture, and exhibit the only skills (process, services, and data) that they would like to share with the outside.
- Organizations must be able to integrate or leave the collaboration in a simple way and with less effort.

- The partnership should tolerate evolutions and changes in activities and /or priorities.

The architectural solution that could support on demand business collaboration should meet the following requirements:

- Ensuring Interoperability (interoperability is effective if the interaction between two systems can at least take place on three levels: data, applications and business processes with well-defined semantics [3]).
- Guaranteeing interoperability at lesser effort, which means that independent systems are able to work together with minimal effort [5].
- Agile and allowing changes in terms of partners and activities.
- Warranting the confidentiality of internal business processes of the partners.

The outline of this paper is as follows. In the next three sections we present respectively the Meta models of the opportunity, the system of study and the processing system. In Sect.4, we describe the collaborative process Meta model. We present in Sect. 5 the generation procedure of the collaborative process which meets the computation independent model (CIM) in the model driven engineering paradigm (MDE). In Section 6, we illustrate our approach via a use case. Finally, we conclude the paper with plans for further work.

II. THE STUDIED SYSTEM

2.1 The Opportunity

The *opportunity* represents the business need which pushes the organization initiating the collaborative project to create a business opportunity. This one gives birth to several projects and missions, these ones are realized through the accomplishment of one or more activities. We symbolize its Meta model as follow (Figure 1)

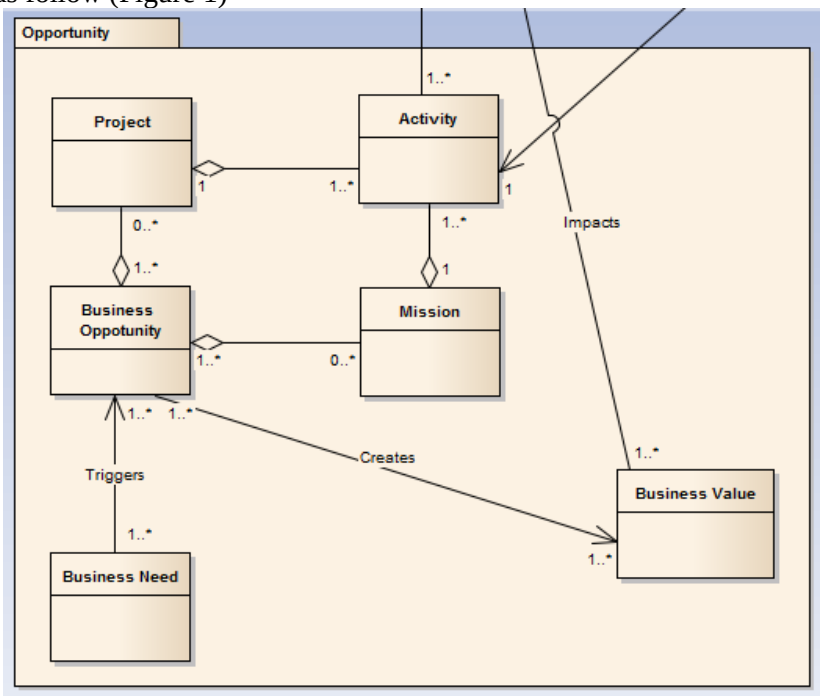

Figure 1. Studied System Opportunity meta model (SSO)

2.2 The Information System

the *Information System* characterizes the environment affected by the occurrence of a business opportunity, this environment or any portion of it may be altered via the outputs of one or more activities (e.g. data modification, configuration change, etc...) or through the business value generated via the business opportunity (e.g. new services, new processes, etc...). In our paper, the system of

study if restricted to the *information system* of the partner initiating the collaborative project. We represent its meta model as follow (Figure 2).

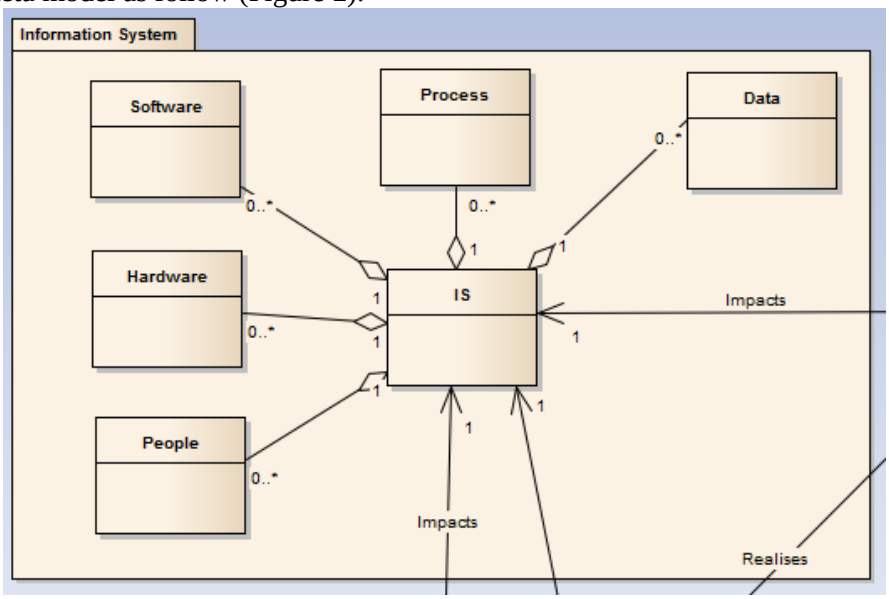

Figure 2. Studied System Information System meta model (SSIS)

III. PROCESSING SYSTEM

The processing system gathers the services exposed by the partners participating in the collaborative projects, as well as mediation services, those ones present some useful functionalities like data translation and calculation utilities. Each partner, candidate for collaboration, should provide their services in accordance to the meta model below (Figure 3).

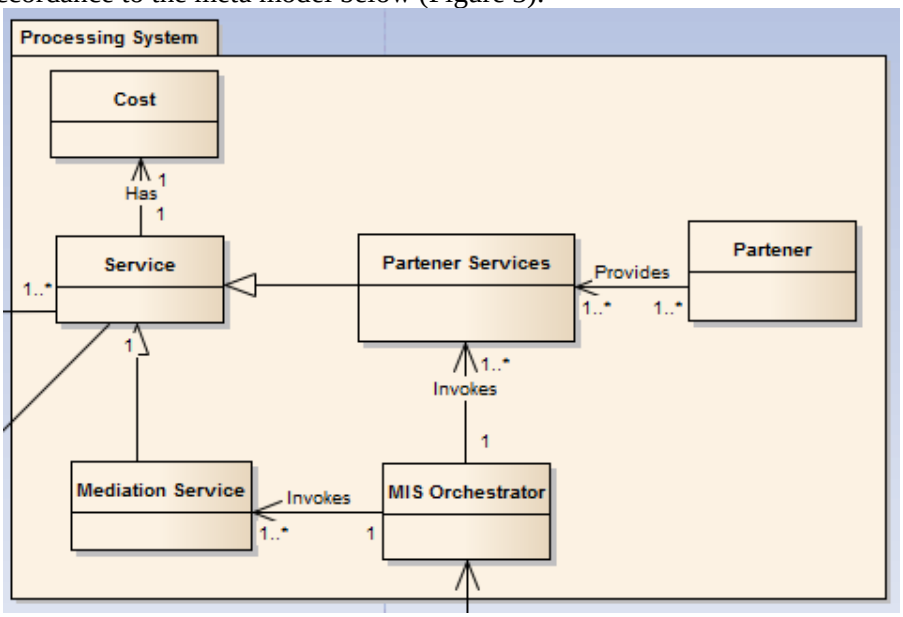

Figure 3. Processing System meta model (PS)

IV. OPPORTUNITY, INFORMATION AND PROCESSING SYSTEMS RELATIONS

The *information system* (Figure 2) of the organization initiating the collaboration is impacted by the activities' outputs of the business *opportunity* (Figure 1), these ones are realized through mediation and/or partners' services (Figure 3). We represent these interactions through the following meta model (Figure 4).

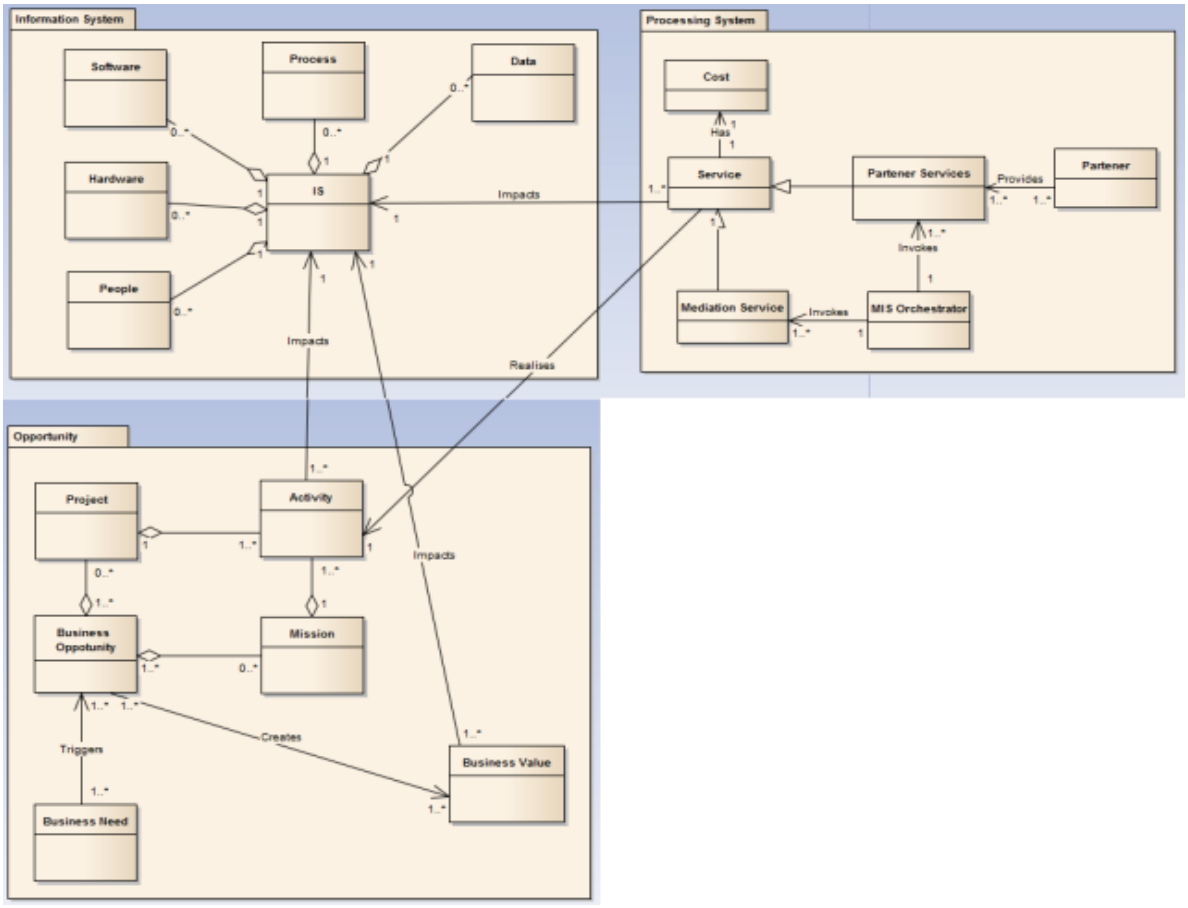

Figure 4. Opportunity, Information And Processing Systems interactions

V. COLLABORATIVE PROCESS

The generated collaborative process should respect the meta model described below (Figure 5, [12] [13]), this one represents the collaboration as an arrangement of finalized set of activities performed by distributed partners' services. This composition is represented through a business management process which is described in accordance with BPMN 2.0 specifications [8].

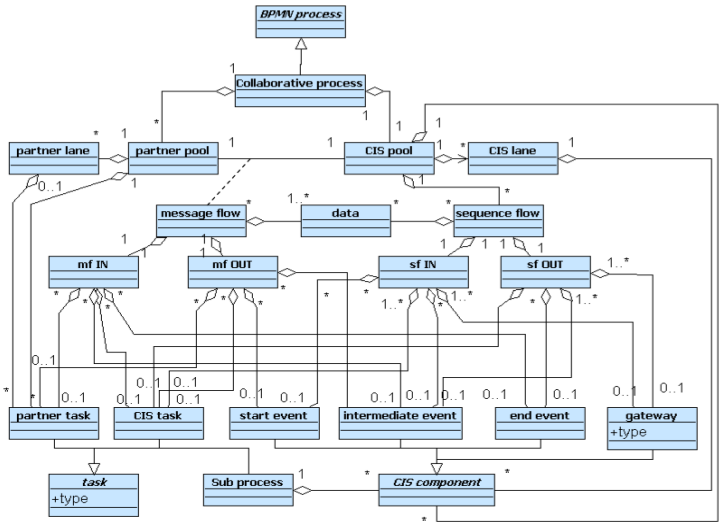

Figure 5. Collaborative Process Meta model (CP)

The collaborative process is composed of:
• A unique pool named *SIM_pool* representing the mediator. The logical operators belonging to the collaborative process (e.g. sequence flow, gateway, event, etc.) defining the dynamics and the order of activities can only belong to this pool.
• Each partner in the collaboration is represented by a *pool*, this pool can contain only *lanes*, each lane represents a division of the partner, and these ones contain only activities, named *Partner_task*.
• The partner's service, represented by *Partner_task* can be related via message flow with a mediator service named *SIM_task*. These messages flow model the sequencing and the information transfer between the partner and the mediator.

VI. GENERATION APPROACH OF THE COLLABORATIVE PROCESS

In this section we present our five-step approach allowing the deduction of the collaborative process.

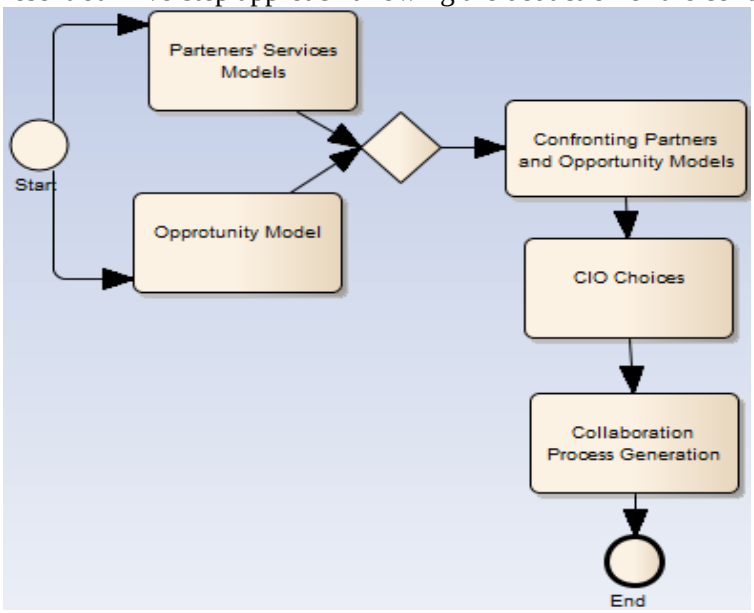

Figure 6. Collaborative Process Generation Approach (CPGA)

Step 1: In this step, we collect the set of activities (in charge of performing projects and/or missions) that the business opportunity initiator would like to achieve. That information is recuperated in accordance with the SSO Meta model (Figure 1), this information is properly extracted from the model and injected into an ontology in respect of OWL 2 specification [11] (the mechanism of extraction, transformation and injection will be explained in our future work)
Step 2: This step consists of recovering, for each partner, candidate to participate in the collaborative process, the information on their services before representing them in the form of models that meets the PS Meta model (Figure 3), all this information is injected in the ontology [6].
Step 3: In this step we confront through our ontology, the information issued from the *opportunity* model (set of activities to be done to respond to the business need) to the information extracted from the *processing system* models (partners' services and the activities accomplished by those services).
The objective of using of ontology is to find the semantic matching between the activities issued from the **Step 1** to those issued from the **Step 2**, in the purpose to find the candidate services for the business collaboration, this selection can't be done efficiently without using semantic web rule language SWRL [10]. The first type of rules (1) are used to spread semantic links between activities [15][16], for this purpose we defined two kinds of relations, *Like* relation which mean that the semantic link between two activities is very close and *Near* relation which mean that the semantic link is proximate but not very close. The second type of rules (2) are used to recuperate services which can achieve a given activity [15][16], two type of relations are defined, *Achieve* relation which means that a service can perform an activity with high performance, and *CanAchieve* relation wich means that a service can perform an activity with less performance.

- Rules allowing the propagation of semantic links between activities :

Activity(?x) /\ Activity(?y) /\ Activity(?z) /\ Like(?x, ?y) /\ Like(?x, ?z) ➔ Like(?y, ?z)
Activity(?x) /\ Activity(?y) /\ Activity(?z) /\ Like(?x, ?y) /\ Near(?x, ?z) ➔ Near(?y, ?z)
Activity(?x) /\ Activity(?y) /\ Activity(?z) /\ Near(?x, ?y) /\ Near(?x, ?z) ➔ Near(?y, ?z)
(1)

- Rules allowing the deduction of services that can perform an activity:

Service(?x) /\ Activity(?y) /\ Activity(?z) /\ Like(?y, ?z) /\ Achieve(?x, ?y) □ Achieve (?x, ?z)
Service(?x) /\ Activity(?y) /\ Activity(?z) /\ Near(?y, ?z) /\ Achieve (?x, ?y) □ Can Achieve (?x, ?z) (2)

Once done, the nominated services are extracted from the ontology and submitted to the business opportunity initiator to select the appropriate ones (see **Step 4**).

Step 4: Once the nominated set of services are deducted from the steps above (**step 3**), the business opportunity initiator (represented by its chief information officer CIO or its steering committee SC) choose the appropriate subset of services for collaboration as well as their order depending on their cost and provenance (partner).

Step 5: The inputs of this steps are the chosen services for collaboration and their order, those ones are the parameters for an algorithm (this algorithm will be defined in our future work) which is responsible for the construction of the business process that should respect the CP meta model (Figure 5).

VII. CASE STUDY

To illustrate our approach we suggest looking over the following case study. It consists of redesigning the information system (the opportunity) of 4D company (a multinational company based in Paris), this decision is the consequence of the need expressed by the SC of 4D to improve the company's performance and market share (business need), this opportunity gives birth to the following project and mission (see corresponding model in Figure 7):

- Auditing the existing information system (mission)
    - Information system cartography
    - Redesign existing processes
- Design new processes

  Setting up an ERP (project)
    - Data Migration
    - ERP setting
    - User training

To meet this business opportunity 4D Company selected the following partners:

- SIS consultant
- IT6 Office
- Atos SSII

Step 1: The project and mission described above are represented in the model below in accordance to the SSO meta model (Figure 1). The information contained in this model will be injected into the ontology.

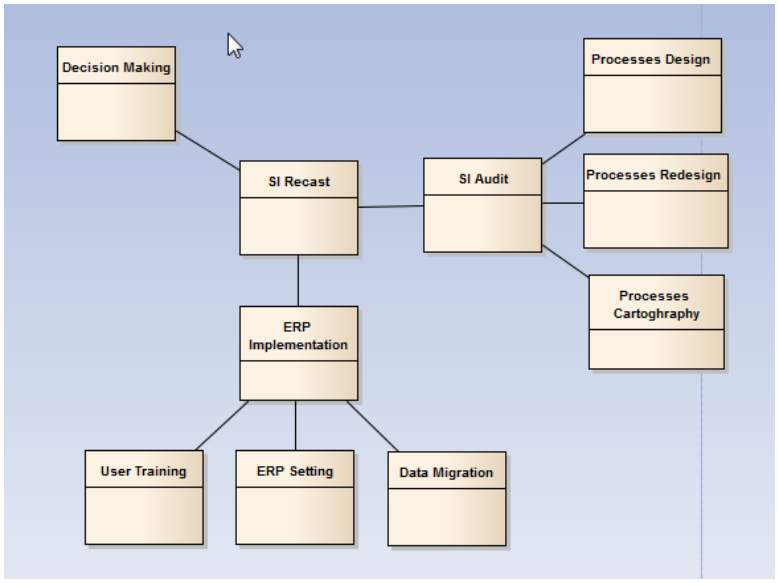

Figure 7. 4D business opportunity model

Step 2: In this step we represent, for each partner, candidate to participate in the collaborative process, the information on their services in the form of models that meets the PS Meta model (Figure 3), all this information is injected in the ontology.

In our case study, three partners are selected for collaboration, these partners are presented respectively with their models:

- **SIS consultant** exposes three services for collaboration, those services *Service_BPE, Service_BPR and Service _IT advice* realise respectively the following activities *Process design, Process Redesign and IT advice*. We notice that each service realises one activity (Figure 8).

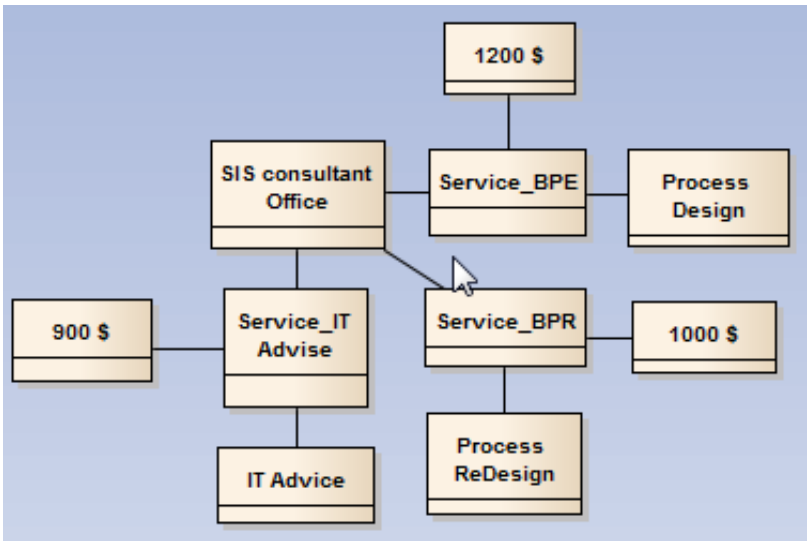

Figure 8. SIS consultant Office Model

- **IT6 Office** exposes three services for collaboration, those services *Service_Support & Training, Service_ERP and Service _audit* realise respectively the following activities *Support & Training, ERP Setting and SI Audit*. We notice that each service realises one activity (Figure 9).

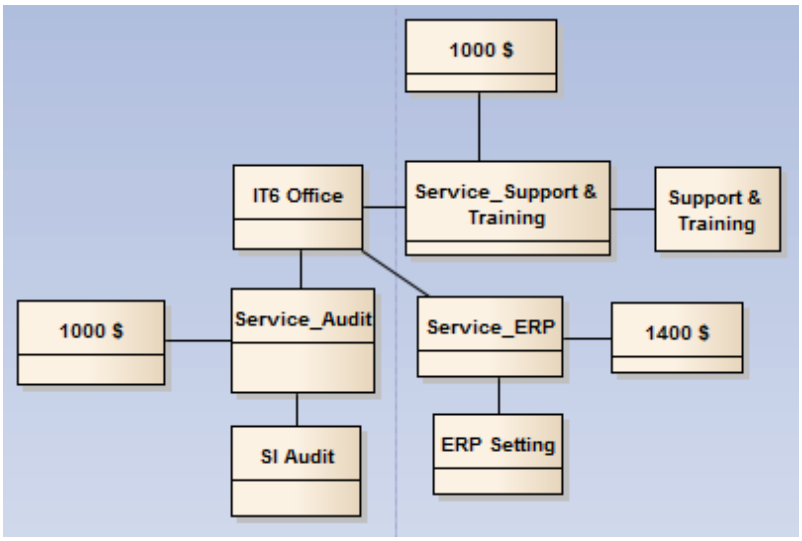

Figure 9. IT6 Office Model

- **Atos SSII** exposes three services for collaboration, those services *Service_Data Management, Service_QA and Service _DEV* realise respectively the following activities *Data Management, Testing and Dev and setting*. We notice that each service realises one activity (Figure 10).

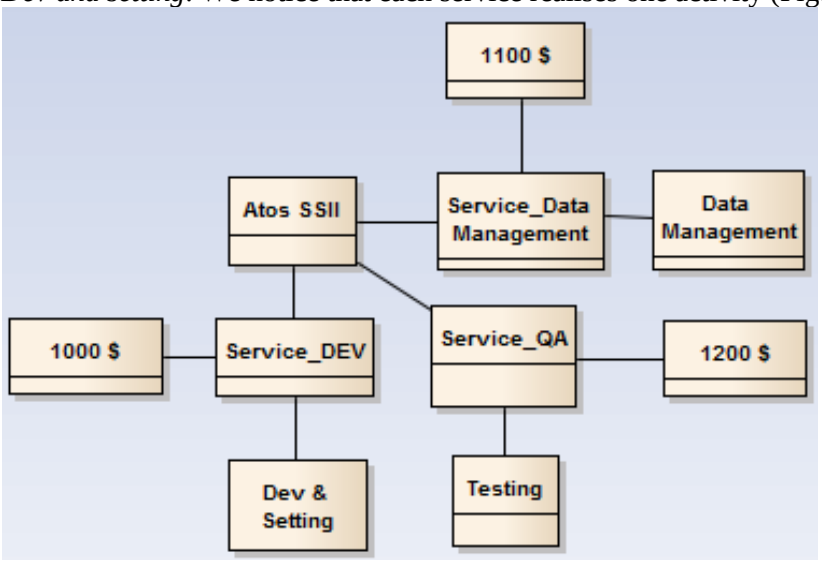

Figure 10. Atos SSII Model

Step 3: The opportunity activities and partners' activities will be extracted from the ontology and sent to the SC via the following interface, the steering committee can then define the semantic mapping between these activities.

Figure 11. Semantic mapping interface

Once the semantic links manually defined via the interface above (Figure 11), this new knowledge (matching between partners' and opportunity activities) will be injected into the ontology. This will trigger the execution of rules (1) and (2).

Step 4: Only the nominated services deducted from the (**Step 3**) are displayed by order of pertinence in the column Service, this means that for a given activity the service selected on top of the list matches better this activity. Otherwise the matching can be changed through the column "Choice" where the SC can map activities to the corresponding services. The execution order of activities can be done via the column "Priority" (Figure 12).

Priority	Activity	Service	Partener	Cost	Choice
	Cartoghraphy	Service_Audit	IT6 Office	1000 $ per day	☑
		Service_IT Advice	SIS consultant	900 $ per day	☐
	Design	Service_BPE	SIS consultant	1200 $ per day	☑
		Service_BPR	SIS consultant	1000 $ per day	☐
		Service_IT Advice	SIS consultant	900 $ per day	☐
	Redesign	Service_BPR	SIS consultant	1000 $ per day	☑
		Service_BPE	SIS consulant	900 $ per day	☐
	Migration	Service_Data_Management	Atos SSII	1100 $ per day	☑
		Service_IT Advice	SIS consultant	900 $ per day	☐
	ERP Setting	Service_ ERP	IT6 Office	1400 $ per day	☐
		Service_ DEV	Atos SSII	1000 $ per day	☑
	Users Training	Service_Support & Training	IT6 Office	1000 $ per day	☑
		Service_IT Advice	SIS consultant	900 $ per day	☐

Figure 12. Service selection interface

Step 5: Once these services selected, and the execution order of activities defined (and thus service), the process of creating the business process is launched. The creation of this business process will be handled by mean of an algorithm which is responsible of the orchestration of the partners' services in the purpose to build a collaborative service oriented information system.

VIII. RELATED WORK

Our Approach has several advantages. It is graphical, which allows the collaboration initiator to import descriptions of partners' services as well as opportunity activities and represent them clearly in class diagrams. Furthermore, our approach is based on semantic mapping which eases the matching between partners' services and the activities of the business opportunity. Another advantage is that our approach provides a semi-automatic way to generate the collaborative business process. These features are the keys that make our method simple and exploitable (Table 1).

Table 1. Comparison between collaborative approaches

Approach	Design type	Aspect	Automation Degree	Base modeling
Our approach	Graphical	Behavioral, functional and semantic	Semi-automatic	Business process
Bordbar approach [1]	Graphical	Behavioral	Semi-automatic	Activity diagram
Lim approach [4]	Natural language	Semantic	Automatic	Workflow

IX. CONCLUSION AND PERSPECTIVES

In this report we proposed an approach for the semi-automatic generation of the collaborative process of a business opportunity, the result corresponding to the CIM level in the MDA approach, CIM can then be transformed into PIM and PSM [12]. In this article it was assumed that there's always a one to one correspondence between a service and an activity, and that the partners' information systems architectures are service oriented.

The next step of our work consists of creating an ontology that will deduct partners' services to use in collaboration by means of achieving the semantic bridging between the activities offered by partners' services and the activities of the business opportunity. Once the services selected, and the execution order of services defined, the process of creating the business process is launched trough an algorithm that we will define in our future work.

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