Service System Modelling : a shared representation and a web-based tool for the collaboration of the telecoms' innovators

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Abstract. Today, enterprises have to be service oriented in order to adapt themselves to a more and more competitive context and to the socio-economic evolutions of the market. Their innovators (i.e. innovation actors) networks have to detect opportunities and propose the design of new solutions to answer (and anticipate) the customers' needs. Based on the Services Science Management and Engineering (SSME) discussions, we conceive the service as a "Service System". We suggest formalizing it with a mereological ontology of processual entities in order to preserve its dynamic and experiential dimensions. The Service System acts as an intermediary object aiming at the cooperation and creativity of the innovators during a co-design phase. Its formalization reveals all the possible service experiences and their actors' performances. A collaborative process and a web-based tool, based on the innovators' social network and the Service System's structure, are currently tested upstream of the process of services design of a French telecom operator. They have been created to support a services systems co-modelling approach and facilitate the innovators cooperation and creativity.

Keywords: Co-modelling, Innovators network, Services Science, Service System, Ontology

1. Introduction

The socio-economic and technologic evolutions of our society have introduced important challenges for enterprises. They have to be customer-oriented and service-oriented in order to adapt themselves to the major trends that disrupt the market (inversion of the market logic, customization of the offers, customers as co-producers, involvement within value networks, etc.). Moreover, they are more and more interested in sociological and sustainable challenges (aging populations, resources sharing, etc.). Services providers join this logic, but so do their corporate customers. They thus have to prove their capacity of innovation and adaptation to a constantly changing socio-economic context. One of our objectives is to take into account these main trends and withstand change by leveraging the benefit of the Services Science.

Services providers implement a process of innovative services design which starts with the research of opportunities within a customer's daily life or a more generic service situation. The design reasoning of their innovators (i.e. actors of the services innovation) is related to a complex and collaborative practice in which they share and co-create knowledge [1]. However, these innovators meet some difficulties because of the remote and inter-professional nature of their work and network. But the core problem is that they do not share a common vision of the "service" concept. Some of them focus their analysis on the operational business processes of the customer they want to address, other are more interested in marketing and economic issues and other propose some IT or telecoms functionalities/features without really connecting them to a real problem or situation. Therefore their collaborative network has to adopt an enlarged vision of the service situation (i.e. the customer's experience and contribution, the interactions between the customer and the provider, the contribution of the providers' partners, the short-term and long-term results, etc.). They have to adopt a kind of "top-down" approch based on the service situation description. It will compensate for the current approach which is rather a "bottom-up" approach and is essentially based on the creation of some lists of features. Then the question of the customer's experience will be approached from the upstream stages of the process of services design.

In a previous paper, we proposed a service reference model and a methodology aiming at the identification and characterization of the "Service Concept" and the "Service Delivery System" to leverage the innovators' knowledge upstream of the innovation cycle [1]. This required a description of the concept of service at a business and more abstract level than the one we usually find in the literature (especially in computer science, i.e. reusable technical functionality). Based on the proposal of the Services Science Management and Engineering discipline (SSME, intiated by IBM and some well known universities), we conceived (and still conceive) the service as a "Service System" [2][3]. Today, we define it as a complex phenomenon or a dynamic configuration of heterogeneous entities gathering all the "service" levels of analysis (offered services, business services, Information System services and Information Technologies services). We make the hypothesis that a Service System can be an intermediary and operational object for the inter-comprehension, the cooperation and the detection of new ideas within an innovators network during a co-design phase. Moreover, such a configuration of dynamic entities (called "processes" in a semantic and not operational way) reveals not only the overall field of the service experiences and their lacks or opportunities, but also the service actors' performances within different situations. We suggest formalizing the Service System with a mereological ontology of processual entities and we propose a semi-formal method to build the representation of each targeted Service System based on the innovators' knowledge and documentation.

This work is associated to a case study within the organization of a French telecommunication operator. This case study concerns the Service System of the remote monitoring of diabetic patients. A collaborative process and a platform (called OntoStoria[2]) have been created to support this co-modelling ontological approach. Their objectives are to help the innovators to identify some possible experts of a domain or customers segment within their network, to create a dynamics within their network and exchange some information/documentation/ opinions/etc., to share a common and enlarged vision of the services situations, to discover the associated field of experiences and communities, to detect some problems/lacks/etc. and to anticipate and answer the needs through the proposition of new solutions.

This paper is organized as follow. The section 2 introduces the identification of services and the modelling of Services Systems. The section 3 presents the formalization of a Service System as an extended mereological ontology. Then it describes the proposed collaborative method and tool. The section 4 describes the experiment we performed within the e-health ecosystem. The section 5 concludes this paper and gives some overviews.

2. Services Systems Ontologies to support innovators' collaboration

2.1. An intermediary and operational objet

The Service System is an artefact : the object of a co-production between a client and a supplier. But it is also an interesting object which can help the telecoms' (or more generally the services providers') innovators to work together despite their respective disciplines/business (marketing experts, sociologists, engineers, etc.) and the distributed nature of their network. Indeed, the Service System can be used as an intermediary object [4], in a metaphorical sense, for the coordination of these actors. It provides a unique and facilitating view which objectives are to minimize the misunderstanding between them by the co-modelling of the studied service situation, and to help them imagine and propose some "co-found ideas".

Moreover, the Service System is also a real operational object from a design perspective (as a building plan is not only a useful intermediary object to insure the coordination between the client, the entrepreneur and the architect, but also a plan that guides the building construction). It helps to make a bridge between the business and IT layers. Indeed, we can set up models transformations, such as in the business processes field where there are some existing methods and tools trying to make this link thanks to several models transformations [5]. The Service System model can thus reveal the underlying transactions of its functioning. It is thus an interesting operational tool for the design and the implementation of e-services.

Then the problem is: what is the best structure to represent its main concepts (see sub-sections 2.2 and 2.3) and how to aggregate the available resources (see section 3) ?

2.2. Mereological ontologies of processual entites

Various conceptual models of the “service” have been proposed (e.g. the service offer of Eiglier, the molecular model of Shostack, the system of characteristics and competences of Gallouj et al., etc.). But even if they are different, they still define the service by its content, its substance and do not consider its performative nature. In fact, most of the representations we can found in collaborative systems are also object-oriented representations. And it is the same for traditional ontologies that use static, concrete, countable and located entities. These ontologies generally consider the dynamics of these entities only as properties or secondary categories.

However, a Service System is a configuration or combination of dynamic and heterogeneous entities. These entities form “a service” at a given moment and in a given situation. In other words, it is a dynamic and performative phenomenon related to a customer's help request to a supplier to transform a reality or a property. This processing is realized by the interactions between (at least) the customer and the supplier. It is supported by the processes and resources of the supplier and it provides a unique experience to the customer who is involved as a coproducer. Thus, the Service System is a collection of procedural entities [6] (generally described in the services providers’ documents through an interactional and verbal form).

Then the question is: how to represent these kinds of informational collections of processes or procedural entities [6] which express a particular phenomenon (i.e. an experience)?

We propose an ontological alternative based on the principles of the Mereology (the theory of parts and wholes) [7] and the General Process Theory (GPT) (an interesting approach based on a new ontological category which is dynamic, concrete, non-particular and non-universal, “general processes”, and a mereological framework) [8]. The objective is to effectively take into account the dynamic dimension and space-related service experiences. As this is not the main object of this paper, see [9] for some arguments about the use of mereological and GPT principles. The resulting formal model and its construction method (see the section 3) explain and implement the information and knowledge surrounding the Service System that the innovators are studying. It helps them to identify some tracks of new services by the modelling and the simulation of dynamic situations and their scenarios, and the calculation of the service experiences (i.e. from the customer’s point of view).

2.3. Underlying the service experiences and communities

The resulting ontology is a good basis to extract all the possible scenarios in some particular spacetimes. The proposed Service System formalization preserves the information which is associated to each dynamic entity (actors, tools, interactions, etc.). This information is extracted from the corpus of documents at the same time as their entities (see 3.1). The GPT criteria help us to identify the interactions/relations between processual entities. We therefore are able to characterize each entity’s context, previous and next processes. It means that we study each dynamic entity with regard to the overall network/ontology and determine all the possible scenarios within the studied situation.

The service, in an expertiential perspective, appears as an “object” in a phenomenal sense, without any predetermined element or inference. It is based on space-time (moments) and entities’ relations that we are able to discover through the scenarios. The mereology in a processual paradigm aims at modelling these “moments” (underlying the relation of an agent to an object). Indeed, entities are not only processual but also “intentionals”. The analysis of these entities through mereological and GPT criteria (entities’ profiles, relations, verbal aspect, etc.) help to discover the actors of each moment or each part of the service situation, their roles and evolutions in the space and time. It and evolutions in the space and time. It therefore allows considering and calculating the clusterization (at list the approximation) of actors during each process or particular scene or the overall situation.

But, the extracted relations between processual entities have an impact on the relations between the actors. These actors do not have pre-determined roles but they inherit from the distribution of the situation (whole) into its processes/steps/episodes (parts). In other words, they inherit from their participation/implication in the processes. This can be useful for the innovators describing a service situation to detect some communities of the service arising from its actors' participations. This may enable them to better understand the situation and the involved relations between the "service players". And this can be a source of ideas for new solutions.

3. OntoStoria[2] co-modelling mechanisms and platform

3.1. A method based on social networks mechanisms and services systems structure

As introduced in section 1, the actual collaboration between the upstream actors of the service design is insufficient to reach the necessary sharing and co-creation of individual and collective knowledge, and to have an experiential view of the service. The innovators work as a virtual team in a network environment (such as the designers involved in a collaborative step of products concepts creativity [10]). The integration of folksonomies (resulting from the use of social tagging systems) [11], ontologies (from the semantic web) and social networks analysis [12] allows us to consider an adapted collaborative model supporting the innovators knowledge sharing. Moreover, the usual mechanisms of social networks (profiles, tags, etc.) help spreading their design reasoning through their network and then aggregate the information [1].

In an asynchronous and distributed way (it can also be used in a direct access by an innovator or a working group during a brainstorming for example), the steps are:

(a) Proposition of a research theme/topic (e.g. the house of the future) or a specific problem (e.g. how can we help citizens to become aware of the energy costs in their environment?) : an innovator or a group of innovators create a new project about the targeted service situation,

(b) Search for innovators/experts within the social network and diffusion of the Service System e-forms :
  i. the project creator launches a search (a query within the social network) to find some potential experts of the domain or some innovators that could potentially be interested (because of a previous work/ study in the domain or because they work in a related area of research)
  ii. the project creator read the list of the found innovators and select some of them (he can also add a person he knows thanks to an access to the enterprise's directory),
  iii. the e-forms (corresponding to the breakdown of the Service System models into forms) are sent to these selected innovators,

(c) Enrichment of the e-forms : each participant to the project is invited to enrich and tag the form, to join some documents which describe the service situation and to send back the form,

(d) Automatic extraction, aggregation and indexation of the information : the information and documents are extracted from the forms, the mereological relations are extracted and the Services Systems repository is enriched,

(e) Automatic generation of the Service System models and simulation/animation : based on the extracted parts-whole relations and information, the tool generate the mereological ontology and identify the possible scenarios in order to simulate them,

(f) Presentation of the result : the project creator can see the resulting model and simulation and he can send it to all (or some of) the involved innovators,

(g) Iterative process until they co-validate the Service System: the innovators can annotate the Service System model and propose a modification/evolution of its elements, then the application plays again the algorithms and generates a new model, the repository is enriched, an arbitration is done and so on,

(h) Detection of innovative ideas or possible adaptations of existing solutions: the innovators detect some problems/lacks/opportunities within the service situation/scenarios/experiences, the tool generates a deliverable (presenting the service situation) for the anticipation committee who decide if the proposed ideas/solutions can be transferred to the design and development team.

It is also possible to make some requests/queries within the Services Systems repository.

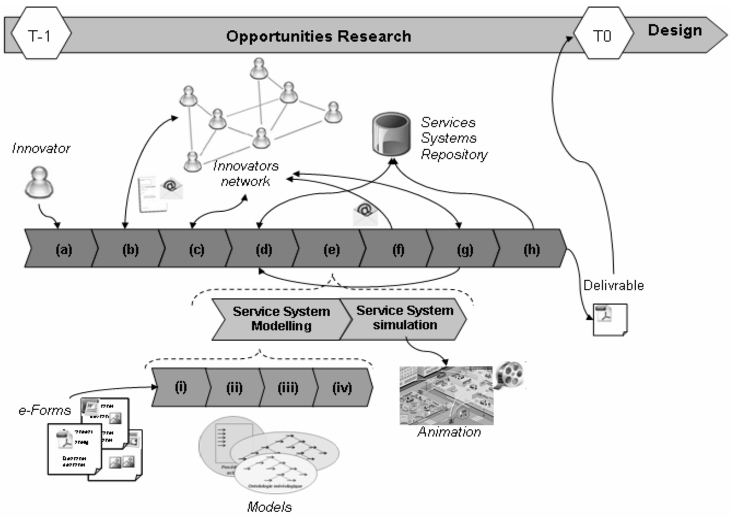

Fig. 1. OntoStoria² main processes to support the opportunities research phase

3.2. *Sub-processes to realize and simulate a "co-ontology"*

The innovators' knowledge and documentation are added to the e-forms during the step 'c'. Then during the step 'e', the tool implements the OntoStoria² method. OntoStoria² is based on a semi-formal semantic description of dynamic categories (see the bottom of the fig.1) implementing information and knowledge related to the studied Service System through four automatic main stages:

(i) Retrieving of the extracted information from the recorded e-forms (see step 'd'),

(ii) Aggregation of the key terms and proposition of the associated list to the innovators who can delete some of them, add other terms and select the terms that the tool will have to use in the next steps,

(iii) Use of the Galois Lattice rules to build a network of dynamic entities : this step is essential to move from the conceptual space to a pragmatic space, indeed the Galois Lattice uses the organic link between objects and actions and gives an access to a more dynamic space, four algorithms have been created based on:
- Rule 1: there are some triplets (O, A, I) where O is a set of objects, A is a set of attributes (i.e. actions which are applicable to the objects) and I is the binary relations between O and A,
- Rule 2: there are two "Galois connections" where *An* is the intension of *Oz* (*An* is all the subsets of A with which the objects of *Oz* have a common binary relation) and *Oj* is the extension of *As* (*Oj* is all the subsets of O with which the actions of *As* have a common binary relationship)?
- Rule 3: when the Galois connections are reciprocal, (if *Oi* is the extension of *Ai* and *Ai* the intention of *Oi*) then (*Oi*, *Ai*) is a "concept".
- Rule 4: the set of concepts is ordered thanks to the order relation (inferiority denoted $\leq$ and inclusion denoted $\subseteq$).

(iv) Extraction of the parts-whole relations and application of classical and mereological criteria [9] on the actions of the Galois Lattice for the generation of a mereological ontology (see an example on fig.3) :
- Identification of the entites' profiles,
- Connection of the parts to their wholes,
- Detection of possible common parts,
- Connection of the wholes to their own "macro-wholes",
- Specification of the interactions between parts and the interactions between wholes.

Let us note that there are some existing tools that segment and annotate a text, and then extract from it some relations such as the mereological relations (for examples see [13][14]).

This automatic sub-process uses the capabilities which are offered by the Mereology and the General Process Theory to provide an adapted description of the studied Service System [9]. To go further, we propose to simulate the modelled Service System through an animation. However the mereological ontology does not allow to easily create such an animation. It requires the identification and description of all successive episodes and configurations which could happen in the Service System universe (i.e. the ontology), the characterization of a typical customer's profile and goals, the simulation of the scenario, and the replay of the simulation with multiple user's profiles. The innovators can thus discover (through a kind of animations) almost all the service interactions that could happen in the real service situation. Then they can detect some opportunities or lacks and imagine solutions. Some existing solutions are sources of inspiration in this domain. For example OnMap (from Nomia) allows the generation of an ergonomic expression of processes: a simulation of the processes and their micro-world. We are also considering the creation of a semi-automatic generation of an animation via the Action Script language.

3.3. A collaborative platform to design Services Systems

To amplify the benefits of the Service System modelling and simulation, we are creating a Services Systems Design Platform. This web-based studio is based on the OntoStoria² method and mechanisms (see 3.1 and 3.2).

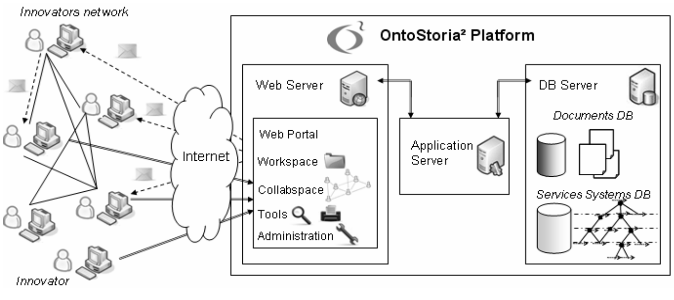

Fig. 2. Global architecture of the web-based studio

The interface of the studio consists of a (fig.2):

- Menu to access to the design space, the tools and help spaces, etc.,
- Design space to create a new Service System project (giving it a name, a description, some keywords and searching for innovators (see 3.1) to participate in the Service System description), open and read an existing project, open and modify an existing project,
- Collaborative space (in fact a collaborative space for each Service System project) to support the exchanges of the innovators,
- Tools space to realize a query on the Services Systems repository or to print some information,
- Projects and rights management space (which are available only to the administrator).

The community aspects of the platform are related to the :

- Access to the directory of the company's members and also to the social network of innovators to enable the creation of an opportunities research community for each Service System project,
- Ability of these involved innovators to exchange messages, ideas, opinions through the collaborative space associated with each project,
- Implementation of the OntoStoria² method which :
    - o is based on the elements and results presentation to the involved innovators who can add, delete and selection some elements,
    - o formalizes the Service System into a shared representation,
    - o gives an access to the service experiences and communities.

Moreover, we are considering another mechanism to connect the current described Service System to the existing company's offer and knowledge. Indeed, the addition of tags on the designed new Service System during its description could be very useful. The existing offer (telecoms and IT services) and the existing information, expertise and knowledge (K) are often already tagged within several information supports. It seems that the automatic connection between these tags and the tags of the current studied concept (C) of Service System (see C-K theory [15]) could not only raise automatically some elements from the innovators' community but also bring to the foreground some elements of the existente offer that may answer a need.

The next section presents an experiment of our model and processual perspective. But this studio will be the object of another complete experiment

4. Co-modelling and evaluation of an e-health Service System

4.1. Experiment on a Service System sample

We first experiment ourselves the OntoStoria² method with an e-health Service System: the remote monitoring of diabetics patients. This Service System has been the object of numerous studies and presentations [16], but it has not been represented in a consensual way. Its main stages are the calculation of the patient blood glucose rate, the addition of information by the patient on a PDA (Personal Digital Assistant), the automatic transmission of the results to a server (patients records) and the medical team access to this information via the Internet.

We used different kinds of documents as inputs: sales brochures, press articles and conferences presentations. The Service System key objects and actions were extracted from this corpus. As the result was sizeable, we only treated a sample in this first experiment. The algorithms, based on the Galois-lattice rules and the mereological and GPT [9] principles, were applied to this sample. The profile of each process, their part-whole relations and their dependencies helped us to generate the ontology (Fig.3).

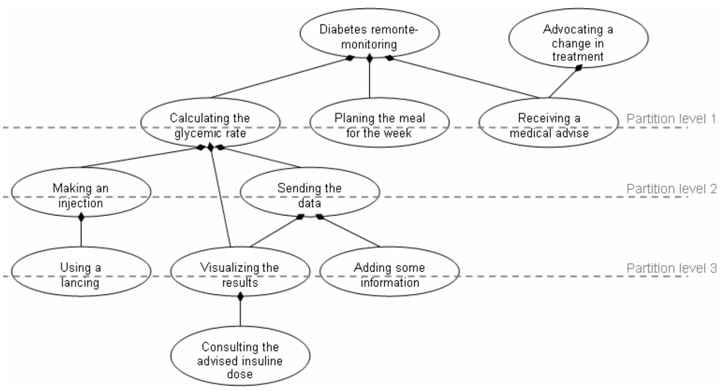

Fig. 3. Mereological ontology on the sample

Based on the global ontology, we then imagined all the possible scenarios of the Service System. These scenarios can help to identify new ideas of services / solutions (e.g. a classical voice server for the monitoring of older people who are not familiar with the web technologies).

4.2. Evaluation of the Service System object

Instead of evaluating the collaborative tool itself, our work is more interested (in a first step) in the evaluation of the impact of the proposed new process-oriented (process meaning dynamic and multi-located entities) paradigm and its ontological representation on the collaboration. The criteria used to evaluate this proposition are: the relevance of the service system as a intermediate and shared object, the adequacy of the mereological and processual principles for the representation of dynamic phenomena, and the usability of a simulation. In this paper, we only discuss the first one. Since the cognition is situated and distributed, and not related to an individual representation [17], we have proposed to use the Service System as an intermediate object [4] (see 2.1).

Then the question is: how well the Service System notion provides a shared representation and improves the interprofessional and remote collaboration?

We reused the Service System of the remote monitoring of diabetic patients. We brought together a group of innovators (engineers, sociologists and marketers) for an experiment. Some of them already know this field and others do not know it at all. They were initially asked to realize a telephonic brainstorming session (to recreate the inter-professional and remote context) about this theme. At the end of this meeting, we asked them to collectively answer a range of questions (e.g. do you feel you have reached a unanimous definition and representation of this service? have you shared your onwn knowledge and learned something? have you made some ideas emerge? etc.). A few days later, we presented them the concept of Service System (definition, dimensions, characteristics). Then, they were asked to realize a new telephonic brainstorming meeting, keeping in mind this new and common level of abstraction. At the end of this second meeting, we asked them again the same questions. We also asked them to indicate the differences they noted between the two sessions.

Thanks to their answers, several qualitative and quantitative measures have been realized: comparison of the exchanged information during the sessions, comparison of the users' perception of the process and the quality of the collective representation, number of ideas at the end of the sessions, processing time of the two sessions, etc. The results show that during the first test they did not understand each other because they used the term of "service" in a different way (the sociologist was interested in the potential help for the patient while the marketer tried to imagine the potential revenue and the engineer examined the technical features of the device). During the second test, the discussion was more effective, they used the same level of vocabulary and they agreed on a lot of elements to describe the service situation. Those who knew the service brought their knowledge and those who discovered it made relevant questions helping the discussion progess and the tracks emerge. We can conclude that the consideration of the Service System improves the collaboration and creativity of the actors.

5. Conclusion

To conclude, the notion of Service System represents an interesting and high level object of research from which it is possible to describe and implement services from various dimensions. It is a good way to answer the question on how to approach and anticipate the socio-economic and technical challenges and questions. It is also a concept which facilitates not only the cooperation and creativity of the innovators but also, at a more macro-level, the inter-comprehension and innovativeness of the various disciplines and levels of abstraction.

Moreover, our work introduces an alternative to the paradigm of the substance and the object orientation with a new paradigm based on processual entities whose arrangements (i.e. configuration, associations) form a phenomenon (giving access to the service field of experiences) in a given space-time. We therefore test the Service System formalization according to the principles of this new paradigm and the design and evaluation of a mereological ontology of processual entities. We already have tested our hypothesis and models on a sample stemming from the e-health domain. The utility of the Service System object and the mereological and processual principles have been proven on this sample. We now want to pursue our experiments on an overall Service System in order to verify the suitability of the GPT and OntoStoria² framework as well as the rest of the platform.

Finally, there are two still unresolved questions :

- What is the risk when the number of involved innovators is small (and that there are thus potentially few concepts)?
- Is this kind of model really easily understandable?

Our perspectives are related to this questions and the improvement of the proposed framework to create more suited views for both innovators and customers (i.e. one being related to the design of an offer and the other to an experience).

References

[1] Bugeaud, F., Soulier, E.: Services Systems to Leverage Innovators' Knowledge: The Telecoms Industry. In: Leveraging Knowledge for Innovation in Collaborative Networks, Luis M. Camarinha-Matos, Iraklis Paraskakis and Hamideh Afsarmanesh (eds.), *Springer Boston*, IFIP, vol. 307, pp.563-570, *Proc. 10th IFIP Working Conference on Virtual Enterprises (PRO-VE'09)*, Thessaloniki, Greece, October 7-9 2009.

[2] Spohrer, J, Maglio, P, Bailey, J, Gruhl, D.: Steps Towards a Science of Service Systems. In: *IEEE Computer*, vol. 40, pp. 71-77, 2007.

[3] Glushko, R.J.: Designing a service science discipline with discipline. In: *IBM Systems Journal*, vol.47, no.1, 2008.

[4] Vinck, D., Jeantet, A., Laureillard, P.: Objects and Other Intermediaries in the Sociotechnical Process of Product Design : an exploratory approach. In: J. Perrin and D. Vinck (eds.), The role of design in the shaping of technology, Vol.5, pp.297-320, *COST A4 Social Sciences*, Bruxelles: EC Directorate General Science R&D, 1996.

[5] ISICIL consortium: Gandon, F., Abdessalem, T., Buffa, M., Bugeaud, F., Comos, S., Corby, O., Delaforge, N., Ereteo, G., Giboin, A., Grohan, P., Herledan, F., Le Meur, V., Leitzelman, M., Leloup, B., Limpens, F., Merle, A., Soulier, E.: ISICIL: Information Semantic Integration through Communities of Intelligence online. In: *10th IFIP Working Conference on Virtual Enterprises (PRO-VE'09)*, Thessalonique, 07-09 October 2009.

[6] Soulier, E.: Storytelling, Plateformes Sociales et Ontologies de Processus pour la simulation du Mouvement. *Habilitation à diriger des recherches*, 2009.

[7] Varzi A.C.: Standford Encyclopedia of Philosophy Mereology, 2003-2009.

[8] Seibt, J.: Forms of Emergent interaction in General Process Theory. *Synthese*, vol. 166, pp. 479-512, 2009.

[9] Bugeaud, F., Soulier, E.: Conception assistée de Systèmes de Services (SdS) à l'aide d'Ontologies Méréologiques. Forthcoming publication in: *Proc. 21ème Journées Francopho-*

nes d'Ingénierie des Connaissances (IC'10), Nîmes, 08-11 Juin 2010.

[10] Volpentesta, A.P., Muzzupappa, M., Ammirato, S.: Critical thinking and concept design generation in a collaborative network. In: Pervasive Collaborative Networks, Camarinha-Matos L. and Picard W. (eds), *Springer Ed.: Boston*, IFIP, vol. 283, pp. 157-164, 2008.

[11] Limpens, F., Gandon, F., Buffa, M.: Linking Folksonomies and Ontologies for Supporting Knowledge Sharing: a State of the Art. *Technical Report, ANR Project*, ISICIL, 2009.

[12] Erétéo, G., Buffa, M., Gandon, F., Corby, O.: Analysis of a Real Online Social Network using Semantic Web Frameworks. In: *Proc. International Semantic Web Conference, ISWC'09*, Washington, USA, 2009.

[13] Girju, G.: Tutorial on Semantic Relation Extraction and its Applications. In the proceedings of the *European Summer School in Logic, Language and Information* (ESSLLI), Freie und Hansestadt Hamburg, Germany, August 4-15, 2008.

[14] Alrahabi M., Desclés J.-P. : EXCOM : Plate-forme d'annotation sémantique de textes multilingues", *TALN 2009*, Senlis, 24-26 juin 2009

[15] Hatchuel, A, Weil, B.: A new approach of innovative design: an introduction to C-K theory. In: *ICED*, Stockholm, 2003

[16] Franc, S., Dardari, D., Boucherie, B., Riveline, J.P., Biedzinski, M., Petit, C., Requeda, E., Leurent, P., Varroud-Vial, M., Hochberg, G., Charpentier, G.: Diabeo: an innovative Telemedicine system for the follow-up of type 1 diabetic patients. In: *DTM*, 2009.

[17] Salembier, P., Theureau, J., Zouinar, M., Vermersh, P.: Action/Cognition située et assistance à la coopération. In: J. Charlet (Ed.), *Ingénierie des connaissances (IC'01)*, Grenoble, 2001.