

DESIGN, SENSE-MAKING AND NEGOTIATION ACTIVITIES IN THE “WEB SERVICES” STANDARDIZATION PROCESS

Francesco Virili
Università degli Studi di Cassino
Via Mazzaroppi, 1 – 03043 Cassino (FR), Italy
Tel. +39-0776- Fax +39-0776-
francesco.virili@eco.unicas.it

Università Cattolica del Sacro Cuore di Milano
Via Necchi, 5 – 20123 Milano, Italy
Tel. +39-02-7234-2427. Fax +39-02-7234-3793
francesco.virili@unicatt.it

ABSTRACT

This study constitutes a preliminary attempt to refer to Design, Sense-making and Negotiation activities in the investigation of an ongoing standardization process. The D-S-N model, recently proposed by Fomin, Keil and Lyytinen, integrates fragments of theory to better understand standardization processes. The three typologies of activity are explained on the basis of designers' cognitive behaviour theory (D=design); sense-making theory (S=Sense-making) and actor-network theory (N=Negotiation). We are applying the D-S-N model (still under development by the authors) on the “Web Services” case study, by analysing the emergence of a series of technological standards for distributed software components. The preliminary results of our ongoing analysis of the Web services standardization process seem to confirm the validity of the D-S-N approach, and encourage to proceed extending and deepening the investigation.

Keywords: standardization processes, technology, diffusion, adoption, Web Services.

INTRODUCTION

The D-S-N model, recently proposed by (Fomin, Keil and Lyytinen 2003) and still under development by the authors, integrates fragments of theory to better understand standardization processes. The three typologies of activity are explained on the basis of designers' cognitive behaviour theory (D=design); sense-making theory (S=Sense-making) and actor-network theory (N=Negotiation).

To better understand the nature and the interaction of the D, S and N-type activities identified in the model, we investigate the “Web Services” standardization process, orchestrated by the W3C consortium. The choice of the Web Services case study comes from two main reasons. First, this technology is one of the most relevant recently appeared in the software market (for example, it is at the basis of the Microsoft .Net platform, their core strategic investment of the last years). Second, the main standardization activities in the W3C consortium usually occur via face to face meetings, distributed meetings (teleconferences) and mailing lists. For the WS standardization process, all the main sessions transcripts are available on line. However, this potentially rich set of information has not been analysed before.

The preliminary results of our ongoing analysis of the Web services standardization process seem to confirm the validity of the D-S-N approach, and encourage to proceed extending and deepening the investigation. The paper is organised as follow: in the following section, the D-S-

N model is presented and discussed; then, after some methodological notes, the Web Services case study is presented and the exploratory analysis of the sample transcripts and documents is accomplished. Three out of five of the statements outlined by (Fomin, Keil and Lyytinen 2003) are briefly analysed here. Some preliminary conclusions and indications for the completion of the research work are offered in the final section.

THE D-S-N MODEL

The D-S-N model is a preliminary attempt to define a “process model of standardization” (Fomin, Keil and Lyytinen 2003). Its basic assumption is that any standardization process may be characterized by three typologies of activities: design (D), sense-making (S) and negotiation (N).

The “Design” activities are accomplished during the rational analysis and definition of the technical specifications and physical properties of the technology object of standardization. The “Sense-making” activities are accomplished in order to prefigure situated scenarios of the potential uses of the new technology. The “Negotiation” activities involve the different groups of stakeholders participating in the standardization process (technology designers, vendors, users) with their proper interests and visions.

Three different streams of literature are referred to in the D-S-N model: the designs activities are interpreted in the light of rational planning studies (Simon, 1981); the concepts developed by (Weick, 1995) are used to deal with the sense-making activities; the negotiation activities are taken into account on the basis of the actor-network theory, (Latour 1995; Callon and Law 1989).

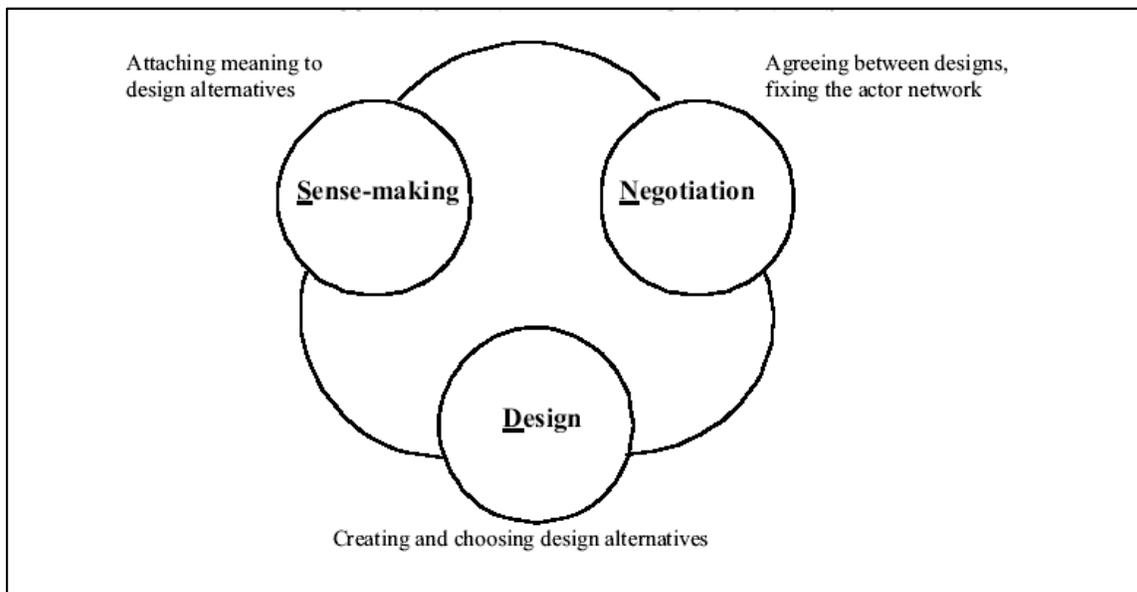


Figure 1: Standardization activities according to the D-S-N model. From (Fomin, Keil and Lyytinen, 2003, page 10, figure 1)¹.

¹ One of the reviewers noticed that “attaching” meaning could sound like meaning was not present in the D cycle. It would be better to say that new meanings are produced in the S cycle, so that Sense-making could be better regarded as “negotiation of meaning” rather than “attachment of meaning”.

Figure 1 illustrates how the three components of the D-S-N model reciprocally interact in the standardization process. According to the authors, the D, S, and N-type activities do not follow any coherent linear and sequential development, but rather a series of iterative, irregular cycles, and in a recursive way, usually starting at a general level of specification of the technological standard and getting into more detailed versions over time.

However, the D-S-N analytical framework is still under development: in (Fomin, Keil and Lyytinen, 2003) it is applied to three cases of standardization in the telecommunications sector but such empirical application is still entirely exploratory.

METHODOLOGY AND RESEARCH QUESTION

Our aim is testing the explanatory power of the D-S-N model in order to challenge and eventually refine it. The research question is: "How can the D-S-N model explain the Web Services standardization process?" Web Services is an emerging standard technology for distributed software development that is capturing increasing attention by the market.

From the methodological point of view, the choice of election is a case study (Yin, 1994), structured and analysed with a phenomenological perspective. The empirical investigation has been conducted limiting theoretical constraints as much as possible, trying not to enslave the case to the theory. Therefore our approach is eminently exploratory, although still connected to the chosen theoretical framework.

The connection between theory and observation was accomplished taking into account the five main statements proposed by (Fomin, Keil and Lyytinen 2003):

1. Standardization processes can be broken into design, sense-making, negotiation activities.
2. Design, sense-making, and negotiation can unfold in a non-linear fashion.
3. To proceed the cycle of design, sense-making, and negotiation needs to be complete.
4. D-S-N are recursively organized.
5. The D-S-N model results more appropriate than linear sequential models, to explain standardization processes.

The work presented here is still in progress. At the moment, the empirical investigation of the "Web Services" case study is still partial and it takes into account only the first three statements. The aim of the project is to investigate also propositions 4 and 5 and to carry out the present analysis more in depth. These five propositions are just a preliminary outcome of an early version of the D-S-N theorization. In the final analysis, further developments of the studies on the subject will be considered. Moreover, a wider sample of documents with the transcripts of the standardization working groups meetings, teleconferences and mailing list will be examined, by using more extensive and accurate text analysis methods.

THE WEB SERVICES CASE STUDY

What are Web Services

On the 11th of April, 2001, 52 companies conveyed at a workshop in San Jose, California. Among them there were well known names in the IT industry like IBM, Microsoft, Sun, HP, SAP, Computer Associates, Oracle, Cisco, Novell, Adobe, Nokia, Ericsson, Fujitsu, and also big IT "power users" like Boeing, Chevron, Reuters, Charles Schwab and others. The aim of the San Jose workshop was to arrange a common definition of an emerging technology, so called "Web Services". For this purpose, 64 position papers were presented and discussed. That day has marked the official start of the process of standardization of the so-called " Web Services ". The

San Jose workshop is wholly documented at the Web address:
<http://www.w3.org/2001/01/WSWS²>.

The "Web Services" architecture is based on a complex system of technical specifications, on which companies like Microsoft, IBM and Sun Microsystems have made heavy investments (Sullivan and Scannell 2001). For instance, the vision of the "software as a service" underlying the Microsoft architecture ".Net ", (formulated and announced in the year 2000 and now adopted all over the main Microsoft products), is dependent on the success of the Web Services technology. The Microsoft vision was initially raising doubts and skepticism among observers (Deckmyn 2000).

What are Web Services? The underlying idea is very simple, and it is an evolution of the "component based" software development paradigm, that was already known and implemented by Microsoft (COM, DCOM models), by IBM (SOM model) and for the Unix platforms (CORBA model). According to this paradigm, software applications may be modularly "assembled" combining several standard software "bricks". In the past, the component-based software development was severely limited by the fact that the small "software bricks" built according to models like DCOM or CORBA were not documented and often difficult to use.

A DCOM software component is basically a black box which accepts data and messages in input and gives back results as output. What is usually difficult, especially if the component was written by somebody else, is to deeply understand the component functionalities (what it does) and how it is intended to be used. Therefore, it is not easy to build a software application as a "puzzle", just assembling software components built by third parties according to the traditional models like DCOM.

The architecture of the Web Services was born to overcome the limitations of the traditional component based software, adding new potential uses, leveraging the Web as a mean of communication. The basic aim was to create an on line market of software components, based on three elements: an on line directory; a standard system of documentation to describe the software component; a set of communication rules to access the software components via Web.

All these three aspects (i.e. the index, the language of description and the Web access protocol) were missing in the classical models like COM and CORBA and have been proposed with the Web Services architecture. Using Web Services it is possible to decide that a specific part of a software application (for instance the function that produces a fiscal code) could be located out of the application itself: when it is necessary to call for the functionality, the application sends data to be elaborated over the Web to the remote software component (e.g. the customer details) and gets back the results (e.g. the fiscal code). This idea, briefly mentioned here, is called by-the experts "functional decomposition" (Castro-Leon 2002).

In synthesis the Web Services standard is based on two fundamental principles:

- 1) the functional decomposition of the applications in several independent software components;

² For instance, the 64 positions papers are publicly accessible to the address: <http://www.w3.org/2001/03/WSWS-popa/>, and it is possible to access the records of the discussions <http://www.w3.org/2001/04/wsws-proceedings/minutes>, to download the program and presentation slides <http://www.w3.org/2001/03/wsws-program> and to consult the mailing list archives, at the address <http://lists.w3.org/Archives/Public/www-ws>.

- 2) the use of the WWW infrastructure for inter-application communication: software application are enabled to access remote software components over the Web.

For an analysis of the important strategic implications for the organizations see e.g. (Hagel III and Brown 1999; Hagel III and Singer, 2001); some peculiar aspects of Web Services in eGovernment are depicted in (Virili and Sorrentino 2002); the potential use of Web Services for knowledge sharing in the Public Administration is treated in (Bolici, Cantoni, Sorrentino and Virili 2003), while an analysis of the potential impact of this technology on the information systems development methodologies in the emergent organizations is conducted in (Bello, Sorrentino and Virili 2002). For a basic introduction and a review of the most important technical concepts refer to (<http://www.Webservices.org/index.php/article/archive/61>).

The W3C consortium and its role

The W3C consortium (the acronym stands for WWWC, that is World Wide Web Consortium) was founded in 1994 and it is still directed by Tim Berners Lee, the inventor of the Web,

"[...] to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability. W3C has around 450 Member organizations from all over the world and has earned international recognition for its contributions to the growth of the Web. [...].

W3C concentrates its efforts on three principle tasks:

- **Vision:** W3C promotes and develops its vision of the future of the World Wide Web [...].
- **Design:** W3C designs Web technologies to realize this vision, taking into account existing technologies as well as those of the future.
- **Standardization:** W3C contributes to efforts to standardize Web technologies by producing specifications (called "Recommendations") that describe the building blocks of the Web. W3C makes these Recommendations (and other technical reports) freely available to all." (from <http://www.w3.org/Consortium/#background>³).

The organizational structure of the W3C

"To meet its goals (universal access, semantic Web, Web of trust) while exercising its role (vision, design, standardization) and applying its design principles (interoperability, evolution, and decentralization), W3C process is organized according to three principles: vendor neutrality, coordination and consensus" (from <http://www.w3.org/Consortium/#background>).

These three organizational principles have been used for planning and to draw the organizational structure of the W3C, illustrated in the so-called "process document" (<http://www.w3.org/Consortium/Process/>), that describes in detail the organizational structure of the consortium (Members, Advisory Committee, Team, Advisory Board, Technical Architecture Group), the activities and the working groups for each activity.

Every technology object of standardization in the consortium W3C corresponds to an "activity". For each activity there may be several workings groups, each one focused on the production of a technical specification.

The attention is here focused on the "Web Services Architecture Working Group", which has the objective to define the technical specifications of a standard architecture for the Web Services.

³All the text cited is directly reported from the referenced web page; the ellipses [...] indicate that a part of the original text was skipped at that point.

Every working group has one or two leaders. To get job done, there are two modalities of interaction in the groups: the first one is the mailing list; the second one is group meetings (they can be either face to face (F2F) or distributed, i.e. via teleconference). The charter document specifies that "to be effective every working group should have from 10 to 15 active participants" (charter of the group WSA, section 4.5).

The F2F meetings don't have a predetermined frequency, they are settled by the group leader according to the matters to be treated, to the deadlines and the opportunities of co-location of side events (e.g. conferences, other W3C meetings, etc.). The distributed meetings are scheduled at least once a week (twice when required by the deadlines). The participation to the F2F meetings is limited, on invitation of the group leader. Guests or external experts may be occasionally invited. All these forms of discussion and negotiation (mailing list, F2F meetings and teleconferences) are recorded, and the scripts are publicly accessible via the working group Web site⁴.

This collection of documents, eventually integrated with external information sources like specialized press articles and news, may be used for the application and verification of the D-S-N model. At this research stage, a systematic analysis of all the available material was not yet accomplished; however, a preliminary exploratory analysis was carried out on the basis of a limited sample of the available documents.

In the following sections the first three statements proposed by (Fomin, Keil and Lyytinen 2003) for the D-S-N model are verified.

Statement 1: standardization processes can be broken into design, sense-making, negotiation activities

A preliminary verification of this statement could be done on the basis of the definition of the "ideal role" of the W3C, as reported at the beginning of the previous section, "The consortium W3C and his role". The role of the consortium is centred on three fundamental points, "Vision, Planning and Standardization." We could argue that these points closely reflect the three constitutive hinges of the D-S-N model: the promotion of the W3C vision could be regarded as a sense-making (S) activity; planning as a design (D) activity, while production of technical specifications (that have been shared by all the members) usually requires an intense activity of negotiation (N)⁵.

Therefore, the D-S-N model seems to well explain the three fundamental hinges selected by the consortium as the basis of its activities, confirming their different nature but also their intrinsic and reciprocal connections.

⁴ The WSA group meeting transcripts are published at the address <http://www.w3.org/2002/ws/arch/#records>. For the teleconferences sometimes the log files are directly published "as they are" (like in the distributed meeting of April 18th, 2002: <http://www.w3.org/2002/ws/arch/2/04/18-minutes>); more often, they are edited to make them more readable (as for instance in the first distributed meeting of the group, held in February the 6th, 2002: <http://www.w3.org/2002/ws/arch/2/02/06-minutes>).

⁵ As noticed by a reviewer, assertions here are often simply stated and not justified. The same is true in most of the samples reported from the transcripts: there is much assertion and too little analysis. This is due to the preliminary and exploratory nature of this report. The author is planning to carry out the analysis on a more solid and methodologically grounded basis, using text analysis techniques.

The recordings of a few distributed meetings are now taken into consideration. The first distributed meeting was held on February the 6th, 2002. In figure 2 the transcription is reported, as from the original records published in <http://www.w3.org/2002/ws/arch/2/02/06-minutes>.

- Distributed Meeting, February the 6th, 2002: Agenda**

 1. Roll call, scribes for minutes/action items (11.00 + 5)
 2. Agenda review, and AOB (11.05 + 5)
 3. Review of [Charter](#), modus operandi and initial plan of work (11.10 + 15)
 4. F2F planning (11.25 + 10)
 5. Call for editors (11.35 + 10)
 6. Round table discussion, initial requirements gathering (11.45 + 35)
 7. Subteam formation and next steps (12.20 + 10)

Figure 2: First distributed meeting of the WSA group: agenda (from <http://www.w3.org/2002/ws/arch/2/02/06-minutes>).

The meeting is planned from 11 to 12.30. What kind of decisions have been taken? There is a series of organizational duties (points 1 and 2: roll call, nomination of the scribe, agenda review; point 4: organization of a F2F meeting; point 5: call for editors). The most interesting topics are in the second part of point 3 (initial plan of work) and at point 6 (round table discussion, initial requirements gathering).

Thereafter, as regard to the initial plan of job, the chair of the group (Chris Ferris, from Sun Microsystems) proposes:

We need requirements and a framework. With the framework we can address how the parts fit together.

We are at the very beginning of the group activity, and it is not yet clear what should be done in order to produce the specifications of the Web Services architecture, (the objective of the working group). The two fundamental elements to define the architectural specifications are: the requirements and a framework. The definition of these two unknown elements is the main activity of sense making of the group. How to proceed? For the framework there is a proposal of a group member:

Roger Cutler - brought up are there other frameworks already available. we need to understand what other groups are doing.

Cutler proposes to start verifying the already available frameworks, also trying to understand what the other working groups are doing. Concerning the requirements, the initial requirements'

gathering is planned in agenda at point 6: the participants start to freely launch some proposals for the architectural requirements. We include here a fragment of the transcript:

Igor Sedukhin - they are trying to stay neutral - meaningful architecture standards. for the technical side they are concerned about management and security.

Roger Cutler - messaging and reliability are important - they are concerned about co-ordination with other groups such as OASIS - and to keep things understandable.

Sandeep Kumar sees an evangelizing role for this group. how to we evangelize this to our own organizations and partners. technically - the messaging and transactions - orchestrations and routing of services.

Yin-Leng Husband - Web services architecture... co-ordination of ws framework. co-ordination between ebXML and w3c...

Dave Hollander - we need to make this understandable to "the normal person" this needs to be understandable to avoid arcane known.

The transcription could go on, there were 33 interventions in that occasion. The following teleconference, held on February 14, 2002, had in agenda the review and the discussion of the requirements proposed in the previous meeting. One of the group members, Daniel Austin, collected and synthesized them into a high level architectural goals list that was submitted for discussion.

Daniel Austin has synthesized[3] the high-level goals and concerns expressed in last week's telcon. We'll discuss this list and refine it such that we can have as a baseline a core set of goals that can be used to guide our work going forward.

Daniel's list is intended as a discussion starter.

- a) interoperability and reduction of divergence among vendors
 - b) extensibility and modularity to encompass the future evolution of Web services
 - c) platform independence with no assumptions regarding communication among architecture components
- [...]

From Daniel's note:

Proposed Goals for the Web Services Architecture Working Group

To develop a standard reference architecture for Web services that:

AG001 ensures the interoperability of Web services software products from different implementors based on well-defined standards

AG002 provides modularity of Web services components, allowing for a level of granularity sufficient to meet business goals

AG003 is sufficiently extensible to allow for future evolution of technology and of business goals

...

The whole list comprises 14 architectural goals, only the first three (AG001, AG002, AG003) are reported here above. At this point an articulated discussion was initiated, finally bringing to the shared definition of the preliminary basic architectural elements. It is important to underline two aspects:

First, the “choral” nature of the group negotiation process: decisions are generally taken with the consensus of everybody. For instance around 40 group members participated in the initial requirement gathering discussion; almost half of them advanced proposals or at least expressed opinions. Therefore, this working group was able to collect contributions from a quite large community. We should also consider that the results were then submitted for evaluation and suggestions to an even wider assembly, through the mailing list.

Second, some typical sense-making activities could be identified in accordance to the D-S-N model: the objective AG002 for example prefigures the need for an appropriate level of granularity of the Web services components, in order to meet business goals. Here the actors are foreseeing the future components “at work”, pointing out that it should be possible to combine more components in a modular fashion, in order to achieve growing levels of dimension and complexity, to meet business goals in a flexible way.

This futuristic scenarios, where a new technology will be used in creative ways, requires a sense-making effort that (Fomin, Keil and Lyytinen, 2003) call "proactive". Therefore, in these two distributed meetings, we may identify “S” and “N”-type activities. “D”-type activities of rational design and planning, instead, are typically accomplished during the production of the architectural specifications, whose last version is published in <http://dev.w3.org/cvsWeb/~checkout~/2002/ws/arch/wsa/wd-wsa-arch.html>.

Statement 2: the nonlinearity of the standardization process

According to the model the D, S and N-type activities don't necessarily follow a linear and sequential path, but they can alternate cyclically without any particular pre-arranged order (with the exception of statement 3 below). In the Web Services standardization process the alignment of interests seems to play an important role in the composition of the actor-network system, driving the process in a non-linear way. This is testified by the words of Bob Sutor, IBM's director of standards strategy, who defends IBM from the accusation of willing to impose royalties on the Web Services technologies:

"If you look at what IBM has done, and it's certainly true that IBM and Microsoft have taken a leadership position in terms of driving these standards, all the specifications have ended up in standards organizations. SOAP and WSDL, which are at the core of Web services, are at the W3C and both royalty-free. WS-Security, which we brought to OASIS in June, is also royalty-free. I really don't think there's any merit to any of those concerns." (Maclsaac 2003, pag. 11).

The standard definition group in the initial phases of the standardization process was much smaller and not coordinated by the W3C consortium: simply IBM and Microsoft reached an

agreement to jointly develop a first version of some (but not all) of the technical specifications. Only later they decided to extend the negotiation by opening it to the W3C consortium. Therefore, the standardization process could not follow a linear development, because in the initial phases the activities of sense-making, negotiation and planning were accomplished in a smaller group, while subsequently the decisions have been discussed in a wider assembly.

Statement 3: the first D cycle is preceded by S and N

A synthetic and effective update of the status quo of the Web Services standardization process is depicted in (Kotok, 2002). Kotok's report can show what could happen when statement 3 is not verified, that is when the rational planning activities precede, instead of following, those of sense making and of negotiation⁶.

Kotok comments the announcement of December the 18th, 2002, about the availability of new technological standards for the Web Services. According to Kotok, there is no lack of commitment or investments on Web Services technologies by IT companies. What is actually lacking is a common vision that would allow the development of a unique and common shared technological system, available for everybody. Instead, the general specifications that currently define Web Services architecture have been developed independently by the single actors. This means that the D activities of rational planning happened before the sense-making and negotiation cycles were closed⁷.

As Pavel Kulchenko effectively states, "Facing the need of standardization in this field, different competitors have proposed their own sets of specifications as a basis of a complete Web Services architecture: Microsoft with the "Global XML Web Services Architecture" (the basis of Microsoft .Net); IBM [...] with the "Web Services Component Model" (WSCM); Sun with his "Open Net Environment" (Sun ONE) and HP with his "Services Framework Specification" (Kulchenko 2002, pag. 1).

Kulchenko lists and classifies 23 different Web Services specifications, dividing them in four categories. The lack of a unique and shared vision of the Web Services technology is, according to Kotok, due to the nature of the process of negotiation itself, that is characterized as emergent and bottom-up rather than planned and top-down, as it happened for other technologies.

In the light of the D-S-N model, the bottom-up nature of the Web Services standardization process could be due to the fact that the D activities of rational planning started before the initial cycles of sense making and negotiation were closed, violating the condition stated in statement 3 above. This phenomenon did not happen, for example, with the standard ebXML:

"One can contrast the methods used in the development of Web services specifications with those of the ebXML consortium, as a case study of these two approaches. For Web services, individual companies or small groups of companies wrote the first versions of the specifications,

⁶ This statement is somehow challenging, and it has been revised in later versions of the D-S-N studies. One of the most evident aspects here, as noted by two reviewers, is that the sense-making and negotiation activities could happen in different social worlds: for example, "there could have been plenty of S and N" in Microsoft and IBM *before* the D-S-N process started in the W3C consortium. It may be necessary to expand the analytical framework to take into account the different levels of analysis involved at different points in the D-S-N process.

⁷ As noticed by a reviewer, the notion of "closure" of a D-S-N cycle may be unclear. How do we know when the process is closed? More investigation should be devoted to better understand this issue, also in the light of concepts mediated by the actor-network theory and of the further developments of the D-S-N studies.

to get them in the hands of the implementers and in the public consciousness. The companies then handed them over to the World Wide Web Consortium (W3C) or OASIS for standardization. The ebXML initiative began as a joint UN/CEFACT and OASIS endeavor, and spelled out the overall architecture for its e-business specifications. Individual industry groups and solutions vendors then began recommending or implementing the specifications." (Kotok 2002, pag. 2).

PRELIMINARY CONCLUSIONS AND RESEARCH DIRECTIONS

The D-S-N model seems to be a potentially interesting analytical tool, for its ability to gather three fundamental determinants of standardization processes that no single theory has jointly analyzed till now: rational planning (D=Design), sense making (S), and negotiation (N) activities. The Web Services case study may represent a good field of investigation to confirm the explanatory power of the D-S-N model: the preliminary empirical indications seem to be encouraging.

This analysis is still ongoing: a wider sample of documents with the transcripts of the standardization working groups meetings, teleconferences and mailing list is taken into account, using more extensive and accurate text analysis methods.

ACKNOWLEDGEMENTS

I want to acknowledge the "Dipartimento Impresa e Lavoro" of the University of Cassino for funding publication and diffusion of this research. I would like to thank Prof. Pontiggia for addressing, supporting and stimulating my work on standardization. Many thanks also to Prof. Sorrentino and Dr. Bello: we discovered together the "Web Services" technology, and it was a pleasant and fruitful experience. I would like to acknowledge also the valuable and determinant support received by Dr. Beccalli, who substantially helped me to improve the manuscript. Thanks also to Prof. Camuffo for suggestions and support received at a preliminary presentation of this work at an Italian workshop.

REFERENCES

- Bello M., Sorrentino M., Virili F., *Web Services and emergent organizations: opportunities and challenges for IS development*, Proceedings of ECIS 2002, European Conference on Information Systems, Gdansk (Poland), 2002.
- Bolici F., Cantoni F., Sorrentino M., Virili F., *Cooperating Strategies in e-Government*, Proceedings of eGov, International Conference on eGovernment, Prague, 2003.
- Callon M., Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay, in J. Law (eds.), *Power, Action and Belief: A New Sociology of Knowledge?*, Routledge, London, 1986, 196-229.
- Callon M. and Law J., On the construction of sociotechnical networks: Content and context revisited, *Knowledge and Society*, 8, 1989, 57-83.
- Castro-Leon, E., A perspective on Web Services, *WebServices.org*, 18/02/02, <http://www.Webservices.org/index.php/article/articleprint/113/-1/61/>
- David P.A. and Greenstein S., The Economics of Compatibility Standards: An Introduction to Recent Research, *The Economics of Innovations and New Technology* 1:1/2, 1990, 3-41.
- Deckmyn D., Nothing but .Net? Nope, *Computerworld online*, 23 June 2000, 3-41, <http://www.pcworld.com/resource/printable/article/0.aid.17409.00.asp>.
- Fomin V. and Keil M., *Standardization: bridging the gap between economic and social theory*, Proceedings of ICIS, International Conference on Information Systems, 1999, 206-217.
- Fomin, V., Keil, T. and Lyytinen, K., Theorizing about Standardization: Integrating Fragments of Process Theory in Light of Telecommunication Standardization Wars, *Sprouts: Working Papers on Information, Environments, Systems and Organizations*, Vol 3, Winter 2003, <http://weatherhead.cwru.edu/sprouts/2003/030102.pdf>.

- Hagel III, J. and Brown, J.S., Your Next IT Strategy, *Harvard Business Review*, October 2001, 106-113.
- Hagel III, J. and Singer, M., Unbundling the Corporation, *Harvard Business Review*, March-April 1999, 133-141.
- Hanset, O., Monteiro E. and Hatling, M., Developing information infrastructure: the tension between standardisation and flexibility, *Science, Technology and Human Values*, Vol. 11, N. 4, Fall 1996, 407-426.
- Kotok, A., Web services standards are good, but a Web services vision is better, *WebServices.org*, 30/12/02, <http://www.Webservices.org/index.php/article/articleprint/826/-1/3>.
- Kulchenko, P., Web Services Acronyms, Demystified, *XML.com*, 01/09/2002, <http://www.xml.com/lpt/a/2002/01/09/soap.html>.
- Latour, B., *Social Theory and the Study of Computerized Work Sites*. Proceedings of IFIP WG 8.2, 7-9 December 1995, Judge Institute of Management Studies, Cambridge University, Cambridge, UK, 1995.
- Maclsaac, E., Web Services: Where We Are and Where We're Going, *Websphere Advisor Magazine*, Jan/Feb 2003, page 10, 2003, <http://advisor.com/doc/11585>.
- Simon, H.A., *The new science of management decision*, Prentice-Hall, Englewood Cliffs, 1977.
- Simon, H.A., *The Sciences of the Artificial*, MIT Press, Cambridge, MA, 1981.
- Sullivan, T. and Scannell, E., Microsoft, Sun Vie for Web Services, *InfoWorld*, 23 October 2001, <http://www.pcworld.com/resource/printable/article/0,aid,67566,00.asp>.
- Virili F. and Sorrentino M., *Reconfiguring the political value chain: the potential role of Web services*, Proceedings of eGov 2002, First International Conference on eGovernment, Aix en Provence, 2002.
- Weick, K. E., *The social psychology of organizing*, Addison Wesley, Menlo Park, CA, 1969.
- Weick, K. E., *Sensemaking in organizations*, Sage Publications, Newbury Park, CA, 1995.
- Williams, R. and Edge, D., The Social Shaping of Technology, *Research Policy*, 25(6), 1996, 865-99.
- Yin, R.K., *Case Study Research: Design and Methods*, Sage Publications, Newbury Park, CA, 1994.

Authors' biography

Francesco Virili, PhD in Information Systems, is Assistant Professor in Organization Science by the "Università degli Studi di Cassino" (Italy). He is also teaching Information Systems at the "Università Cattolica del Sacro Cuore di Milano". He has published research on data mining systems; on e-business models; on standardization processes; on e-Government applications and projects. He is also making research on technology diffusion and adoption models and on information systems development methods and practices.