Journal of Network and Innovative Computing
ISSN 2160-2174 Volume 4 (2016) pp. 055-061

ACTOR NETWORK THEORY AS A COLLABORATIVE MODE: THE CONTRIBUTION OF GAME THEORY IN THE INTERESSEMENT PHASE

BENQATLA MOHAMMED SALIM[1], CHIKHAOUI DIKRA[2] and BOUCHAIB BOUNABAT[3]

[1] Al-Qualsadi Research & Development Team National
MOHAMMED V UNIVERISTY IN RABAT

benqatla.salim@gmail.com

[2] Al-Qualsadi Research & Development Team National
MOHAMMED V UNIVERISTY IN RABAT

chikhaoui.dikra@gmail.com

[3] Al-Qualsadi Research & Development Team National
MOHAMMED V UNIVERISTY IN RABAT
bounabat@ensias.ma

***Abstract*: Global Governance of projects requires cooperation between several actors. In general, such cooperation is ensured by building network collaboration between entities who want to collaborate. In spite of the existence of a number of works interested in collaboration network, only few of them were focused on how to construct a network. In this paper, we address this topic through Actor Network Theory. In particular way, we analyze interessement phase of ANT from a cooperative game point of view. Indeed, it's about negotiations between actors involved in business project. Our objective is to propose an approach of network establishment, by inciting actors through cost savings. For that, we use Shapley Value to answer the question: Which coalitions are likely to form in order to ensure best cost-saving objectives in ANT mode of collaboration? We propose also a graphical tool for visualizing networks and simulating their evolution.**

Keywords: Collaboration Network, Actor Network Theory, Cost-Sharing, Cooperative game theory, Shapley value

I. Introduction

When you submit your paper print it in two-column format, including figures and tables. In addition, designate one author as the “corresponding author”. This is the author to whom proofs of the paper will be sent. Proofs are sent to the corresponding author only.

Network perspective has been an important factor in inter-organizational project governance, and has consequently become a conspicuous concern for a large number of researches. The cooperation within business networks has become a key enabler for trading success.

Business Collaboration refers to the process where several companies work together in an intersection of common goals. A business collaboration network (BCN) enables companies to communicate and collaborate with their customers, partners and suppliers in a productive way [1]. This cooperation takes different forms, from simple information exchange, to business processes interoperability among independent enterprises [6], [11], and also in term of cost-sharing. In fact, independent businesses become able to collaborate in order to have benefic results for all [2].

The present research was conducted iteratively, this leads us to introduce Actor-Network theory (ANT) [3], [4] as a framework of collaboration, that helps us make sense to interaction evolution between different actors of the network. We use game theory as a cost-sharing arrangement whereby those actors are able to "translate" their goals (especially financials ones) into objectives that make sense to each actor. Then, to motivate eventual partners to join network (coalition is used too in this paper to describe an actor-network), Shapley value [10] is used in our framework as a fair cost sharing solution to respond the question: How the costs are divided between actors relative to their marginal contributions in an actor-network context?

The originality of this work is the use of ANT to build collaborative network, by inciting actors to choose the best coalition through cost saving applying Shapley values.

The main contributions of this work can therefore be summarized as follows:

- Cost sharing as incentive device in a actor-network mode of cooperation
- The formulation of the Actor-network building problem as a cooperative game, where players (actors) cooperate to reduce costs.
- The implementation of a graphical tool in order to design and simulate the actor-network evolution based on cost calculation approach

The paper is organized as follows: Section 2 presents the different concepts and theories used. Section 3 introduces the proposed cooperative network building game. Section 4 presents numerical application that calculates shared-cost between actors using Shapley Value in a realistic Actor-network context via developed platform. Finally, Section 5 concludes this paper.

II. OVERVIEW ANT

ANT was originally proposed by Michael Callon and Bruno Latour in the early 1980s to describe the creation and evolution of socio-technical networks [31]. The theory was later extended and formalized [29]; [30]. In its original conceptualization the theory focused on actors defined as: “any element which bends space around itself makes other elements dependent upon itself and translates their will into the language of its own” [31]. This translation of interests leads to the creation of networks of aligned interests.
Among the early applications of ANT in Information System (IS) research, [25] ANT was used to examine a variety of IS-related phenomena including the causes of failure of a large business process change initiative [33] and to examine issues related to standardization in IS [32]. ANT was also used for exploring a variety of organizational and business issues (e.g., Newton 2002).

III. CONCEPTS

A. *Business Collaboration Network*

The collaboration represents a challenge for public and private organizations. It is both a source of added value and leverage to a better functioning of organizations through improved operational performance. The possibilities offered by the platforms of the Information Systems grow increasingly to new forms of cooperation with partners. The business oriented architectures are among the most used forms to achieve the objective of global governance in a collaborative context.

Collaboration Network includes a set of cooperating entities, autonomous and heterogeneous, under different governance areas and working together. Collaboration refers to the act to establish a group of common interest in the short, medium or long term and work in synergy in an environment of trust for achieving common or complementary objectives [5]. This situation assumes the existence of a formal cooperation agreement representing the responsibilities of each member of network collaboration.

The economic environment of private sector is strongly growing; companies are facing increased competition and saturated markets. They must improve their productivity, profitability and show flexibility to the demands of the market while remaining at the top in their sectors of competence, also and above saving costs. In addition, customers are becoming more demanding of the products and services offered to them [7].

Similarly, the public government adopts more openness and a willingness to break with the functional barriers, organizational and technology in order to propose homogeneous and coherent services and could well serve users transparently [8]. Finally, the collaboration for the delivery of public services involves increasingly the use, to private organism as part of the Public Private Partnership PPP [9].

Faced with these challenges, inter organizational cooperation is justified as essential strategic imperative for better functioning [12], especially, in most cases; a single organization can’t satisfy customer requirements at a cost reasonable [13].

In such situation, any organization has an interest to rethink its ways of working and better organize them, either internally or in inter organizational framework. Such network of collaboration consists of a set of cooperating entities combining efficiently during the life of cooperation, tools and adequate resources to meet a common need [14].

Therefore new forms of collaborative spaces where various structures work and react together, appears in various forms such as virtual organization, network of organizations, organization of alliance, network organization extended, etc. The Figure 1, outcome of the reference model of collaborative networks established by the European research project "European Collaborative networked organizations leadership", which illustrates the possible forms of these networks and the relationships between them [15].

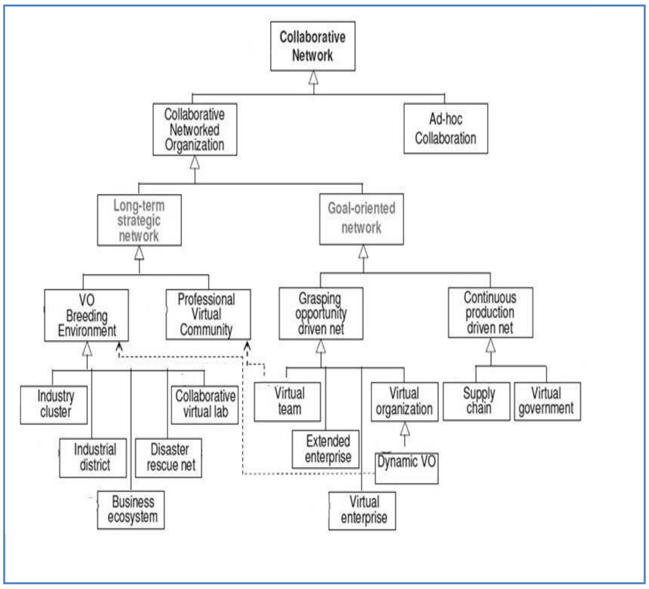

TABLE I. Main types of collaborative networks [22]

To analysis the constitution of the collaboration network process, we will mobilize the sociology of translation, also called Actor Network Theory (ANT). This theory is particularly pertinent in explaining the behavior of actors in collaborative networks, it consists of four steps: Problematization, Interessement, Enrollment, and Mobilization. In this paper we focus on the second phase which is the interessement of actor network using cost sharing and cooperative game.

B. Actor Network Theory (ANT):

The title of the paper is centered 17.8 mm (0.67") below the top of the page in 24 point font. Right below the title (separated by single line spacing) are the names of the authors. The font size for the authors is 11pt. Author affiliations shall be in 9 pt.

The theory of translation or sociology of translation known as Actor Network Theory: (ANT) was developed as part of research on the innovation process and is rooted in a socio-technical approach to organizations. The founders of this current, Akrich, Callon and Latour [23] have shown that successful innovation depends on the success of unprecedented association between multiple and different actors. From this association, mobilization and cooperation of all stakeholders will emerge a socio-technical network and a dynamic production that aim process efficiency and success.

The second important notion of ANT is the “Actant” Callon and Latour borrow this concept to semiotician Greimas. The latter replaces the term personage by the term actant, that “who does or endure an act”, because it applies not only to humans but also to animals, objects, concepts. The actants may be human or non-human and should be treated with the same importance as required by the principle of symmetry.

In order to reach a step of construction of a network, Callon and Latour defined an approach, inspired by ethnomethodology [27], which bears on a sequence of steps called the translation sequence. To translate is to “express in his own language what others say and want, to set up as spokesman” [3], but translate it is also, negotiate, perform a series of movements of all kinds and this to each sequence of the process, which can be defined in four main steps:

1. Problematization:

“The problematization or how to become essential?”, “The problematization, as its name indicates asking at first a problem. This is to raise awareness to a number of actors that are concerned by this problem, and that everyone can find satisfaction through a solution that translators are able to offer” [17], so problematization is the effort made by the actors to convince that they have the right solution[16]. It "describes a system of alliances or associations between entities, defining this, [their] identity and what they want" [18].

2. Interessement:

"The incentive devices or how to seal alliances", the incentive is in fact for Callon "all actions through which an entity is trying to impose and stabilize the identity of the other players who is defined in problematization" [17] incentive is the second phase, consists of "deployment speeches, objects and devices intended to attract and attach different players to the Network" [19].

It is building the interface between the interests of different actors and the strengthening of the relationship between these interests. In the area of strategy, it can be a system of alliances to ensure that the different members of the organization are involved in the strategic process.

The main thing is to translate the interests of other actors in order to get them to take part in the network. To translate the interests of others, we can either convince them that there are common interests and that the proposed solution also serves their interests or manipulate their interests and objectives or finally become unavoidable.

3. Enrollment:

"How to define and coordinate the roles", Enrollment is "the set of multilateral negotiations, beatings forces or tricks that come with sharing and allow it to succeed" [17].

For enrollment, each actor in the network is assigned a role. This role is related to the translation of their interests. For Callon, «the enrollment is to describe the set of multilateral negotiations, coups or intelligence accompanying sharing and allow it to succeed" [18] .The enrollment can thus be regarded as stabilizing the system of alliances set during the phase of the incentive. This system is the result of multilateral negotiations, trials of strength and stratagems [18]. It is during this phase to confront showdowns integrating new actors to the networks or by strengthening links between network members.

The enrollment phase is the key to the success or failure of innovation [18], but this phase is not studied formally in the literature on control.

4. Mobilization:

Last phase of translation, the mobilization is to gather its allies. It is the cockpit of the various interests in a way that they remain more or less stable [20], it raises the question of the representation of stakeholders and enrolled in the project which is then established as spokespersons of the groups they represent [21]. However, “everyone can act very differently to the solution proposed: the abandon, accept it as it is, change the modalities which accompany or statement that it contains, or even they will be appropriated in the transferring in a completely different context" [18].

In a particular way, incentive phase of ANT can be analyzed from a cooperative game with transferable utility point of view. Our objective is to set up the network by incenting actors through cost savings. For that, we use Shapley Value to answer the question: Which coalitions are likely to form in order to ensure best translation of cost-saving objectives in an actor-network context?

C. Cooperative games theory:

The cooperative game theory can be applied to the case where actors can achieve more benefit by cooperating than staying alone, it consists of two elements: (i) a set of players, and (ii) a characteristic function specifying the value created by different subsets of the players in the game [24]. The coalition formation problem is one of the important issues of game theory, both in cooperative and non-cooperative games. There are several attempts to analyze this problem. Many papers tried to find stable coalition structures in a cooperative game theoretic fashion. If we suppose that forming the grand coalition generates the largest total surplus, it is natural to assume that the grand coalition structure will eventually form after some negotiations [26]. Then, the worth of the grand coalition has to be allocated to the individual players, according to the contribution of each player [26]. We are interested in this work in cost-sharing between coalition members likely to form using Game theory as a device for ANT interessement phase

D. *Cost-Sharing for profit collaboration*

The call for projects is one of incentive mechanisms used to encourage actors in organizations and administrations to join forces and coordinate in order to submit, develop and make this public act together. The build of partnership and coalition intra and inter-departments appears a strategic decision to reduce costs and achieve the submitted projects. The rules of sharing common costs and benefits of cooperation are important factors of competitiveness, performance and motivation. Actor being rational; should join the coalition that provides the best gain, the lowest cost respectively. Indeed cost-sharing is a way to incite actors to join coalition whereby project managers are able to "translate" their goals (especially financials ones) into objectives that make sense to each actor. These allocations or shares should not determine by free and anonymous markets but rather by administrative rules and explicit mutual agreements descended from economic theories.

E. *Actor-Network building Game*

In our framework players are actors of network. To the extent that they may have common interests, actors are required to cooperate in advance to take and implement joint decisions, coordinate their actions and pool their winnings & cost. It appears a cooperative game where the actors come together to form coalitions, and all of whom seek to optimize the quality and cost of their own operations. They can, through cooperation, realize gains in the form of cost reduction. We can discuss it during the game in terms of the distribution of costs rather than gains. This is the approach taken here. Then costs are divided between the players relative to their marginal contributions.

To formalize the cost-sharing model with cooperative game in this coalition building process, we apply a concept of axiomatic solution, in this case the Shapley value.

Let N = {1 . . . n} be a finite set of players. A coalition is any subset of N. The set of all coalitions is denoted by 2^n.

A coalitional form concern on a finite set of players S{1, . . . , n} is a function v from the set of all coalitions 2^n to the set of real numbers R with v(∅) = 0. v(S) represents the total worth the coalition S can get in the game v.

F. *The use of Shapley value*

The Shapley value is a very common cost-sharing procedure in cooperative game theory essentially based on the so-called incremental costs [24]. The Shapley value of player i in the game given by the characteristic function V is the share of the surplus should be assign. It's a weighted average of the contributions of player i to reach of the possible coalition.

For example, consider a game with three players, i1, i2 and i3. Assume that player i1 is the first player of the game, i2 is the second player to join the game and player i3 is the last one. Player i1 is allocated a cost C({i1}), player i2 is allocated a cost C({i1, i2}) − C({i1}), and player i3 a cost C({i1, i2, i3}) − C({i1, i2}). The Shapley value assumes that the order of arrival is random and the probability that a player joins first, second, third, etc. a coalition is the same for all players. Assume that forces of each coalition are known in the form of the characteristic function V. The cost allocated to a player i in a game including a set N of players is given by:

$$\phi i(N) = \Big(\sum_{S \subseteq N; i \in S} \Big(\frac{(|S|-1)!(|N|-|S|)!}{|N|!} \Big(\big[C(S) - C(S \setminus \{i\}) \big] \Big) \quad (1)$$

|N| and |S| respectively, the total number of players and the one belonging to the coalition S.

An alternative equivalent formula for the Shapley value is:

$$\phi i(N) = \Big(\frac{1}{|N|!} \sum_{R} (v(\mathrm{P}Ri \cup \{i\}) - v(\mathrm{P}Ri)) \quad (2)$$

Where the sum ranges over all |N| orders R of the players and PRi is the set of players in N which precede i in the order R.

Choosing a method of cost allocation is not an easy thing. According to the literature Shapley value seems to be suitable to this context of actor-Network building game. In fact, Shapley imposes four axioms to be satisfied (Efficiency, Symmetry, Dummy and Additivity).

(i) Efficiency: players precisely distribute among themselves the resources available to the grand coalition. Namely, Efficiency: ∑i∈N φi(v) = v(N).
(ii) Symmetry: Players i,j ∈ N are said to be symmetric with respect to game v if they make the same marginal contribution to any coalition, i.e., for each S ⊂ N with i,j ∉S, v(S ∪ i) = v(S ∪ j). In another way if players i and j are symmetric with respect to game v, then φi(v) = φj(v).
(iii) Dummy: If i is a dummy player, i.e., v(S ∪ i)- v(S) = 0 for every S ⊂ N, then φi(v) = 0.
(iv) Additivity: φ(v+w) = φ(v) +φ(w), where the game v+w is defined by (v+w)(S) = v(S) +w(S) for all S.

The dummy, symmetry (meaning that two players have the same strength Strategic will receive the same gain) and efficiency make the Shapley value particularly attractive for treating the problem of equitable sharing of resources common to several economic agents.

G. *Example of cost sharing within a public institution with several actors*

An administration with several actors (department, partners, suppliers...) may wish to establish a methodology for the allocation of common costs that encourages collaborators to contribute to minimizing the common cost. As shown Shubik (1962), the allocation of common costs in the company can be seen as a cooperative game between different departments.

To fix ideas, consider the following example with three directions (A, B and C) of the same department that are in agreement with a company to perform backup sites. The project amounts to 10 million for each direction taken separately. For technical reasons, the service provider offers cost (reduced) respectively 16, 17 and 18 for joint contracts between A and B, A and C, B and C. The contract involving the three directions has a cost of 24. The cost function is given then by:

TABLE II. tableau of costs

Coalition	Cost
A	*10*
B	*10*
C	*10*
AB	*16*
AC	*17*
BC	*18*
ABC	*24*

The construction of a common backup site might be more profitable than building smaller sites. Indeed, the three directions get a fair deal, and are motivated to form a coalition since their cost parts are below their costs of going it alone. How costs should they are distributed among the three directions?

This issue can be described by a three-player game, N = {A, B, C} is thus obtained:

TABLE III. The characteristic function elements

Coalition	Gain
A	*0*
B	*0*
C	*0*
AB	*4*
AC	*3*
BC	*2*
ABC	*6*

Applying Shapley formula (1), there are six possible arrival orders (3!). They are listed in the following table which gives the marginal contributions according to each of them. For example, $P_A(ABC) = v(\{A\}) - v(\theta) = 0\text{-}0 = 0$, $P_B(ABC) = v(\{AB\}) - v(\{A\}) = 4\text{-}0 = 4$, etc.

The distribution of v (N) cost reduction according to the Shapley value is given by φ (v) = (2.5, 2, 1.5). In terms of cost sharing, the calculation is illustrated in Table III.

TABLE IV. calculing Shapley value

Entry order	Marginal contributions		
	A	*B*	*C*
ABC	0	4	2
ACB	0	3	3
BAC	4	0	2
BCA	4	0	2
CAB	3	3	0
CBA	4	2	0
Total	15	12	9
Shapley Value	15/6	12/6	9/6

This means that about 24 million, the directions A, B and C have to pay 7.5; 8 and 8.5 respectively.

IV. EXPERIMENTAL RESULTS

After completing this research, and in order to validate the approach presented in this paper, we developed a java platform composed of two modules; the first one allows to draw network as it is and design the different information about the actor network, the second module permits to calculate actors Shapely value and simulates coalitions costs.

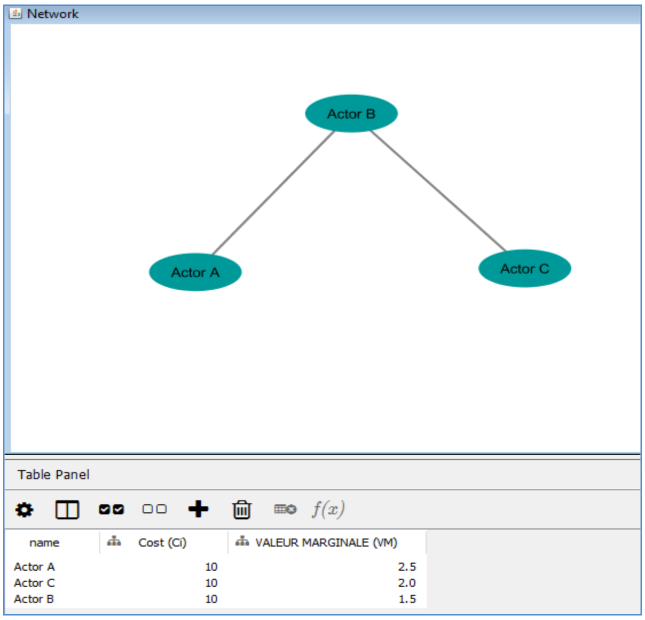

Figure 1. Marginal Values in ABC Coalition

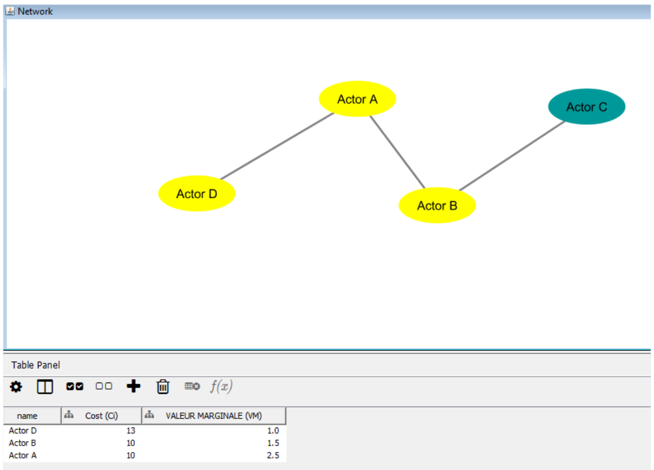

Figure 2. Marginal Values in ABCD Coalition

Numerical results demonstrate that our approach permits to achieve very effective cost allocations, thus representing an efficient framework for the conception of stable networks.

V. CONCLUSIONS

The primary purpose of this study is to enrich the network perspective in collaboration mode. We introduce the actor-network theory (ANT) perspective, which helps to understand the network for best governance.

We addressed in this paper the interessement phase of actor-network theory from a cooperative game point of view.

The build of partnership and coalition intra and inter-departments appears a strategic decision to reduce costs and achieve the submitted projects. This incentive approach could be introduced by the network administrator or the government authority in order to increase the users' cooperation level. The rules of sharing common costs and benefits of cooperation are important factors of competitiveness, performance, transparency and motivation.

The present paper has presented an approach of network establishment, by inciting actors through cost savings. For that, Shapley Value of cooperative game is exploited to determine the adequate coalition to form in order to ensure best cost-saving objectives in ANT mode of collaboration. The proposed work is supported by a software tool which enables to design network and calculate actor’s Shapley Value.

Apart from that, our present theoretical model still requires more elaboration on details, and the Shapely value that can be utilized to support interessement phase of ANT remains as a proposal in the case of financial objectives. Future work may require more empirical research with different types of actors and objectives.

References

[1] Sterling Commerce, Optimize and Transform Your Business Collaboration Network, Sterling Commerce white paper, (2010).

[2] F. Aisopos, K. Tserpes, M. Kardara, G. Panousopoulos, S. Phillips and S. Salamouras, Information exchange in business collaboration using grid technologies, Identity in the Information Society, 2009, Volume 2, Number 2, Pages 189-204, Springer, (2009).

[3] Callon, M. (1986). Eléments pour une sociologie de la traduction. La domestication des coquilles Saint-Jacques et des marins pêcheurs dans la baie de Saint-Brieuc. L’année sociologique 36 : 169- 208.

[4] Latour, B. (1987). La Science en action. Paris: La Découverte (édition de2005)

[5] Benali M., «Une modélisation des liens de coopération et des trajectoires d'évolution des réseaux d'entreprises», Thèse de doctorat en Génie Industriel de l’Ecole des Mines de Saint Etienne et de l’Université Jean Monnet. Novembre 2005.

[6] H. H. Sun, S. Huang and Y. Fan, SOA-Based Collaborative Modeling Method for Cross-Organizational Business Process Integration, Lecture Notes in Computer Science, 2007, Volume 4537, Advances in Web and Network Technologies, and Information Management, pp 522-527 (2007).

[7] Cullen P. A., «Contracting, co-operative relations and extended enterprises», Technovation, 20(7), 2000. pp. 363-372,

[8] Elmir B., Bounabat B., «Integrated Public E-Services Interoperability Assessment», International Journal of information Science and Management, Special issue, October 2010, pp. 1-12.

[9] Préfontaine, L., Richard, L., Sicotte, H., «Nouveaux modèles de collaboration pour la prestation des services publics État de la situation », Rapport de recherche préparé pour le CEFRIO, Canada, 2001.

[10] Shapley, L. S. (1953) A Value for n-person Games, in: ‘‘Contributions to the Theory of Games, II,’’ H. Kuhn and A. W. Tucker, eds., Princeton: Princeton University Press.

[11] B. Shishkov, M. Sinderen and A. Verbraeck, Towards flexible interenterprise collaboration: a supply chain perspective, Lecture Notes in Business Information Processing, 1, Volume 24, Enterprise Information Systems, III, Pages 513-527 (2009).

[12] Cullen P. A., «Contracting, co-operative relations and extended enterprises», Technovation, 20(7), 2000. pp. 363-372,

[13] Yusuf Y. Y., Gunasekaran A., Adeleye E. O., Sivayoganathan K., «Agile supply chain capabilities: Determinants of competitive objectives», European Journal of Operational Research 159(2), 2004, pp. 379-392.

[14] Chituc C.M., Azevedo A.L.: «Multi-Perspective Challenges on Collaborative Networks Business Environments», In 6th IFIP Working Conf. on Virtual Enterprises, Springer, 2005, pp. 25-32.

[15] ECOLEAD, «A Reference Model for Collaborative Networks» , ECOLEAD Consortium (IP-506958). Deliverable D52.3, 2007.

[16] Alcouffe, S., Berland, N., Levant, Y. (2008). Actor-Networks and the diffusion of management

accounting innovations: a comparative study. Management Accounting Research, 19(1): 1-17.

[17] GOULET F., 2008. L'innovation par retrait : reconfiguration des collectifs sociotechniques et de la nature dans le développement de techniques culturales sans labour. Thèse de doctorat en sociologie, école doctorale « Science de l'Homme, du Politique et du Territoire », Grenoble, 2008.

[18] Callon, M. (1986).Some elements of a sociology of translation: domestication of the scallops and fishermen of St. Brieuc Bay. In J. Law (Ed.). Power Action and Belief : a new sociology of knowledge ?: 196-233, London : Routledge.

[19] Callon, M. (2006). Sociologie de la traduction. In Sociologie de la traduction- textes fondateur (Eds Akrich, M., Callon, M., Latour, B.) Mines Paris.

[20] Mouritsen, J., Larsen, H.T., Bukh, P.N. (2001). Intellectual Capital and the "capable firm": narrating, visualizing and numbering for managing knowledge. Accounting, Organizations and society 26(7-8): 735-762.

[21] Dreveton, B., Rocher, S. (2010). « Lost in translation » : étude de la construction d'un outil de gestion dans une région française. Comptabilité, Contrôle, Audit 16(1): 83-100.

[22] ECOLEAD, 2007 ECOLEAD, «A Reference Model for Collaborative Networks » , ECOLEAD Consortium (IP-506958). Deliverable D52.3, 2007.

[23] Akrich, M. Callon, M. & Latour B. (1988). A quoi tient le succès des innovations ? Premier épisode : l'art de l'intéressement. Gérer et comprendre, 11, 15-29.

[24] Cooperative Game Theory(2007): Characteristic Functions, Allocations, Marginal Contribution the Adam Brandenburger Version

[25] Walsham G., Sahay S.: GIS for District-Level Administration in India: Problems and Opportunities, MIS Quarterly, 23:1, 39–66 (1999).

[26] Michel Grabisch, Yukihiko Funaki. A coalition formation value for games with externalities.Version r evis ee - Documents de travail du Centre d'Economie de la Sorbonne 2008.76 - ISSN :1955-.. 2011. <halshs-00344797v2>

[27] Garfinkel, H. (1967). Studies in ethnomethodology. Englewood Cliffs N.J. Prentice Hal

[28] L. S. Shapley and M. Shubik, Quasi-cores in a monetary economy with nonconvex preferences, Econometrica 34 (1966), 805-27. Pure competition, coalitional power, and fair division, Internat. Econ. Rev. 10 (1969), 337-62

[29] Latour B.: Reassembling the Social: An Introduction to Actor- Network-Theory, New York: Oxford University Press (2005).

[30] Law J.: Networks, Relations, Cyborgs: on the Social Study of Technology, published by the Centre for Science Studies, Lancaster University, Lancaster, UK, at www.lancs.ac.uk/fass/sociology/papers/law-networks-relations-cyborgs.pdf (2000).

[31] Callon M., Latour B.: Unscrewing the big leviathan: How actors macro-structure reality and how sociologists help them to do so. In K.D. Knorr-Cetina and A.V. Cicourel (eds.), Advances in Social Theory and Methodology: Towards an Integration of Micro and Macro-Sociologies. London: Routledge, pp. 277–303 (1981).

[32] Hanseth O, Jacucci E, Grisot M., Aanestad M.: Reflexive Standardization: Side Effects and Complexity in Standard Making, MIS Quarterly, 30:Special Issue, pp. 563-581 (2006).

[33] Sarker S, Sarker, S. Sidorova: Understanding Business Process Change Failure: An Actor-Network Perspective, Journal of Management Information Systems, Summer, 23:1, pp.51–86 (2003).

[34]

Author Biographies

MOHAMMED SALIM BENQATLA is a Software Engineer graduated from ENSA (2007) (National Higher School for Application Science), and is a "Ph.D. candidate" at ENSIAS since 2012. His research focuses on interoperability monitoring within business collaboration networks specially those involving public administration. He is an auditor of system information on the Administration of Customs and Indirect Taxes of the Kingdom of Morocco since 2009. He also oversees the IT operating activity in this department.

DIKRA CHIKHAOUI is a Software Engineer graduated from ENSA (2007) (National Higher School for Application Science), and is a "Ph.D. candidate" at ENSIAS since 2013. Her research focuses on maturity model of governance of information system involving public administration. She is a project manager of system information on the General Treasury of the Kingdom of Morocco since 2009.

BOUCHAIB BOUNANABT PhD in Computer Sciences Professor in ENSIAS, (National Higher School for Computer Science and System analysis), Rabat, Morocco Expert in National ICT Strategies and E-Government to the World Bank, IDB (Islamic Development Bank), ECA (Economic Commission for Africa), UNESCO, ISESCO, UNIDO (United Nations Industrial Development Organization) Candidate of the Kingdom of Morocco for the Secretariat-General of the Arab Information and Communication Technologies Organization, Member of the editorial board of the journal of Information and Communication Technologies and Human Development, Member of the board of Internet Society - Moroccan Chapter