Management of calls for proposals within self organized enterprises network

Lynda MEKAOUCHE
Laboratoire des Sciences de l'Information et des Systèmes (LSIS)
UMR – CNRS 6168
Université Paul Cézanne
Avenue Escadrille Normandie Niemen
13397 Marseille Cedex 20 - France
Phone: (33) 04 91 05 60 10
Fax: (33) 04 91 05 60 33
Lynda.mekaouche@lsis.org

Fouzia OUNNAR, Patrick PUJO, Norbert GIAMBIASI
Laboratoire des Sciences de l'Information et des Systèmes (LSIS)
UMR – CNRS 6168
Université Paul Cézanne
Avenue Escadrille Normandie Niemen
13397 Marseille Cedex 20 - France
Phone: (33) 04 91 05 60 10
Fax: (33) 04 91 05 60 33
{fouzia.ounnar, patrick.pujo, norbert.giambiasi}@lsis.org

Abstract

The emergence of specialization in the industrial world implied involving several enterprises in the development of products. As a result, enterprises are obliged to fit into a supply chain network in order to ensure their survival. The objective of this study is to improve the customer-supplier relationship. This paper presents a new approach to customer-suppliers relationships where customers launch Calls For Proposals to which the set of the entities (customers, suppliers) get self organized in order to better respond to the Call For Proposal (CFP) and to better exploit the capacity of each supplier. This paper focuses on the detailed description of our approach.

Keywords: Control, Self Organization, Customers-Suppliers Relationship.

Introduction

The evolution and the development of the economical world lead to a new competitiveness in the industrial area. Consequently, both the economical environment and the customer requirements have also evolved. In this context, several industrial companies try to improve their performances, to maximize their profits and to reduce their stocks by reducing time and costs and increasing the diversity of products and their quality. However, more complex products are being offered on the market making this solution insufficient and requiring the integration of the company in a collaborative network (Brito and Roseira, 2003). The companies nevertheless, focus only on their basic trades, and apply the outsourcing to a part of their activities, involving a new form of organization based on externalization (Ounnar and Pujo, 2001). Despite the externalization phenomenon, the companies tend to gather to realize a joint project by forming a supply chain network which goal is to optimize the project through customer satisfaction.

Many studies have been conducted in order to set up approaches and tools witch allow the study of corporate networks. Previous research focused mainly on the supply chain optimization in order to improve its performance and management (Bruzzone, Mosca and Revetria, 2002; Fu and Piplani, 2001; Lauras, Parrod and Telle, 2002) On the basis that “the negotiation is indispensable for a given company to impose and convince its industrial area of its competences and capacities” (Anderson, Holtström and Oberg, 2003), others were rather based on the relation between firms with an aim of improving the cooperation and coordination by the control of these relations, (Bisignano and Palermo, 2003; Despontin, Briand and Esquiral, 2001). Lastly, other studies addressed both the modeling of the corporate network and methodologies for modeling this type of network (Burlat, 2004; Villa, 1998). In addition, the improvement of the Customer-Suppliers (C-S) relationship requires the participation and the contribution of each partner (Ounnar et al, 2004). Indeed, one could notice over the last years the development of the concept of "the industrial partnership", which seeks companies’ cooperation.

Within this context, our approach suggests a C-S relationship control where all entities (C-S) partners, communicate on the same medium of communication and negotiate to respond as best as possible to the customers requirements. In other words, our approach suggests to respond to calls for proposals launched by the customer, and to exploit in better ways the suppliers’ capacities.

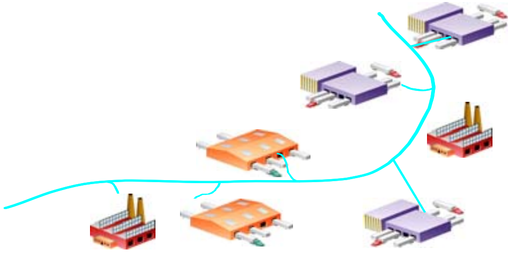

Figure1. Corporate Network

To each supplier we associate a decision-making centre named "Autonomous Control Entity" (ACE), through which he can self evaluate his performance in order to be able to take part to negotiations within a self organized network. This centre allows a supplier to become an intelligent production unit able to operate in self organization with other companies to seek the best response to a CFP launched on the network. This paper focuses particularly on the study of the "Autonomous Control Entity" (ACE). Firstly, a detailed description of the different modules is provided as well as the goals and the modules’ operations and the interaction between them. Secondly, the proposed methods are described in order to seek the best response to a given CFP by emergence.

Description of an Autonomous Control Entity (ACE)

An ACE is made up of four modules: Communication Module, Interaction Module, Optimization Module and Planning Module.

Communication Module

It is used to communicate with other partners via an extranet. The latter allows the reception and the diffusion of the CFPs as well as the responses to CFPs.

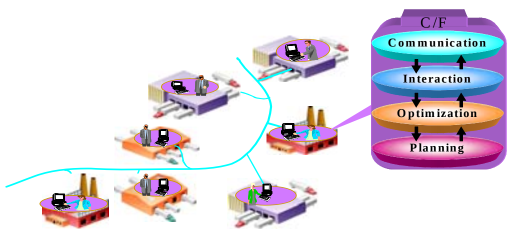

Figure2. Autonomous Control Entity associated to a Corporate Network

The communication is structured around the communication protocol for sending messages, known as "network of contract" (contract-net) (Smith, 1980). The principle consists in diffusing a CFP message about an order and then in comparing the received offers (responses) to attribute a contract to the entity which proposes the best offer.

Interaction Module

It ensures the assignment of orders to the various entities in the network. This assignment is based on decision-makings linked to the competition between these entities (suppliers). The decision-making mechanism is based on impartial and common rules and criteria applied to all entities. The choice of an entity is based on observing the best response to a call for proposal for the execution of a task. The main functionalities of this module are summarized in two points:
1)- The publication of information about the calls for proposals. The response to the calls for proposals received through the communication module towards the optimization module or vice versa.
2)- The sorting of entities according to the received offers (updating the CFP): for each received new offer, the corresponding call for proposal is updated if the received offer is the first one or if it is better than the best offer already received.

The order assignment process is inspired by the Contract Net Protocol (CNP). In CNP, the initiating entity sends out a Call for Proposals. Each participant reviews feasible CFP's and bids. The initiator chooses the best bid and awards the contract to the its participant and rejects the other bids. This process ensures a temporarily centralized management of the sent CFP. Compared to this basic operation, we suggest several solutions to enrich and simplify this protocol: Indeed, the idea is to minimize the number of interactions and messages, and to remove any risk of blocking in the case of disturbances in the communication system among entities. The CFP is always launched by an initiator entity for all the participants, with a deadline. Each participant studies all the messages concerning this CFP and builds its answer according to the contents of these messages. The entity answers as soon as possible and only if its proposal is better than those already sent on the network.

Optimization Module

The performance evaluation is based on a multicriteria method and particularly the Analytic Hierarchy Process (AHP) method (Ounnar, 1999). AHP is a powerful and flexible tool of decision-making for complex problems involving multiple qualitative and quantitative criteria. The method helps decision-makers to structure the significant components of a problem in a hierarchical tree-like structure. The results are then synthesized by reducing complex decisions into a series of simple comparisons and arrangements. AHP is thus a decision-making process that directly interprets the data by forming judgments through a scale of measurement inside a hierarchical structure.
On the basis of qualitative or quantitative criteria, AHP method ensures to classify CFPs, according to the capacity of the entity to treat them. Among the quantitative criteria, one could mention the operating time of the CFP. This data is obtained from the planning module.

Planning Module

The planning module calculates the operating time of a call for proposal. The calculations are performed using an analytical method based on various planning states of the production system. The operating time is calculated on the basis of the insertion of this one at the planning level. Initially the analytical method allows the studying of different possibilities of insertion of this CFP. According to the available place the method find the best possible insertion. Secondly, it sends the founded operating time to the optimization module.

This module also updates the different states of CFPs. A CFP can be in one of the following states:
- Negotiated CFP: characterizing the fact that we have no information about its assignment.
- Engageable CFP: characterizing the fact that an entity is the most successful on an order (the offer is better than the best of the received offers).
- Pre-engaged CFP: a CFP is pre-engaged if it is “engageable” and it is selected as being on the top of the CFP list. The entity accepts temporarily this CFP. This CFP will become “Engaged” if there is no overbid.
- Engaged CFP: the entity appropriates definitively the “pre-engaged” CFP on its planning at its engaged date.

• Refused CFP: specify the fact that no proposition was made for this call for proposal.

In addition, the planning module can receive, from the interaction module a suppression order of a call for proposal on which it was engageable. Indeed, being engageable on a given call for proposal, the entity can receive a better answer concerning the same CFP coming from the one of the network partners. So the interaction module launches an order of suppression of this CFP towards the planning module. The planning module removes the concerned CFP, and then reevaluates all the remaining calls for proposals. From this reevaluation, improvements can beings obtained at the level of the operating time of certain calls for proposals. It then sends the new dates to the optimization module in order to recalculate the performance for the considered CFP.

General operation of an ACE

The suggested approach increases the autonomy of the network entities. Entities common goal is to ensure collectively the distribution of the orders coming from various customers and respecting the interests of each one. This only happens if, the entities have the capacity to negotiate and communicate among them..

A partner can be a customer, a supplier or both. One of the customers launched a CFP on the network. This latter will be provided with a certain number of information such as: name of the transmitting entity (customer), description of the requested product, the quantity expected by the customer, lead time of end of negotiation, delivery lead time, etc …All the ACEs which are connected to the network will receive this CFP. Once the CFP received by a given ACE, via its communication module, the latter transmits the received information to the interaction module. The interaction module will check the feasibility of the CFP in technical term and then transmit the CFP to the optimization module. The optimization module starts the application of the selected multicriteria method: Analytic Hierarchy Process (AHP) in order to obtain a classification of all the CFPs received, according to the entity capacity to treat them. The application of this method requires a set of qualitative or quantitative criteria (Ounnar and Pujo 2005). Among the quantitative criteria, appears operating time of the CFP. This data depends on the planning state and on the availability of equipments. We propose to obtain this data by the execution of an analytic method at the level of the planning module. This latter calculates the operating time of the CFP by studying the various possible states of insertion of this one in the entity planning. This result will thus be transmitted to the optimization module in order to finish the application of the multicriteria method. The interaction module compares then this performance with regard to the best actual performance and then sends it on the network if it is the best one (see Figure 3).

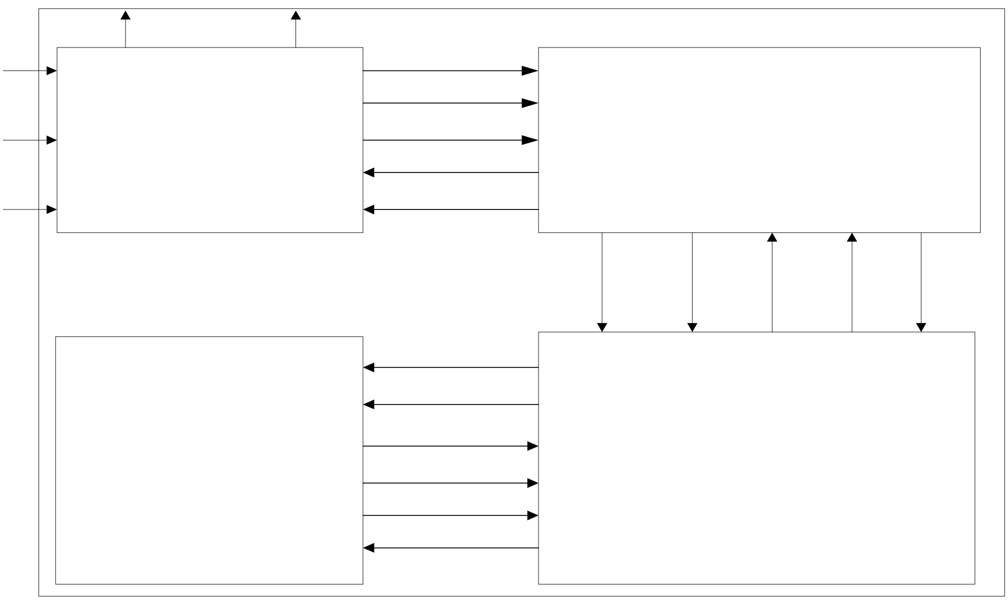

Figure 3. General operation of an ACE

The various messages circulating on the network can be summarized as follow: CFP, RCFP, LCFP (Local Call for Proposal which is diffused by the entity), RLCFP (Response to Local Call for Proposal, response proposed by a given network partner), ERCFP (Entity Response to a Call for Proposal which is a proposed response to a CFP launched by a given partner).

The suggested approach make the whole component of the network operating in a self organization mode in order to respond to the CFP launched by a given customer on the corporate network, with impartial criteria and rules for all suppliers. Thus, each supplier self evaluate his performance with regards to the CFP launched and then they emerge the best response for this CFP. As it was mentioned above the concept of self evaluation is based on the application of a multicriteria method. The following section presents the multicriteria method.

Description of the Multicriteria method

Nowadays, the selection of a supplier is made on the basis of multiple criteria and involves more than one person (Tan, Kannan and Handfield, 1998). The consideration of multiple conflicting objectives in a decision model has made the area of multiple-criteria decision-making (MCDM) very challenging (Muralidharan, Anantharaman and Deshmukh, 2002). Decision-making using multiple criteria provides a decision-maker with tools that allow the resolution of a decision-making problem when several (and often conflicting) point of views have to be taken into account. The use of methods incorporating multiple criteria allows the integration of a number of constraints, and assists in finding the most appropriate solution. A survey of methods using multiple criteria (Ounnar and Ladet, 1999; Ounnar, 1999) concluded to select a method called Analytic Hierarchy Process (AHP) presented by Saaty (Saaty, 1980). AHP has advantages over other decision-making approaches (Vergas, 1990; Weldey, 1990). These include its ability to: (i) handle tangible and intangible attributes; (ii) structure the problems hierarchically to gain insights into the decision-making process; and (iii) monitor the consistency of the judgments of a decision-maker.

Description of the AHP algorithm

The following section describes the AHP algorithm:

Step 1 : Decomposition of the current problem into a hierarchical structure
1- Definition of the general objective (level 1).
2- Definition of the different decision making criteria (Level 2).
3- For each criteria define the according indicators (level 3).
4- Definition of the alternatives (level 4).

Step 2: Establishment of binary comparisons
It consists of the comparison between two elements of the same hierarchical level, and then square matrices are filled with these evaluations of comparisons. Otherwise, each element (i,j) from the matrix represents a judgment or a comparison of a couple belonging to a same level. In our study we exploit the AHP method as follow:
- In case of qualitative data, we exploit the values scale (1-9) introduced by Saaty (see Table 1).
- In case of quantitative data, we exploit real values.

Numerical Values	Definition
1	Equally important
3	Slightly more important
5	Strongly more important
7	Very strongly more important
9	Extremely more important
Reciprocals	Used to reflect dominance of the second alternative as compared with the first.

Table 1. Scale of Measurement for AHP (Saaty, 1980)

The objective of this comparison is to specify the importance of a given element compared another one. The comparison value is noted A[i,j], accordingly, A[j,i]=1/A[i,j] and A[i,i]=1
The pair comparison allows obtaining the element relating importance with regards to another element (of the same level)

Step 3: Calculation of the vector of relative importance of a level with regards to a superior level
The vector of relative importance expresses the elements ranking of the same level compared to each element of the superior level. The latest are determined by the following formulas:'

$$w = \frac{A * e^t}{e * A * e^t} \quad où \quad e = (1, 1, ..., 1) \qquad (1)$$

The considered step is repeated by replacing the matrix A by its successive powers (A2, A3, …) in the formula (1) still the difference among vectors of relative importance is null.

Step 4 : Verification of the judgments coherence
A great advantage from this method is that it computes a "Consistency Ratio" (CR) which allows the evaluation of the calculation carried out. It verifies if the attributed scale values (1-9) are coherent.
CR =CI/RI. (2)
where: the deviation from consistency is represented by:

$$CI = \frac{(\lambda_{\max} - n)}{(n-1)} \quad où \ \lambda_i = \frac{\sum_{j=1}^{n} (a_{ij} * w_j)}{w_i} \ \forall\, i \qquad (3)$$

n : number of compared elements.
W : vector of relative importance which is obtained at the precedent step.

In order to determine how good is the result, we divide it by the corresponding value RI (Random Index) (See Table 2). if C.R. > 0.1, it recommends to the decision-maker to revise some judgments. Thus, AHP doesn't require from the decision-makers to be coherent but it supplies him with an incoherent measure and allows the reduction of this incoherence.

N=number of compared elements	2	3	4	5	6	7	8	9	10	11
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Table 2. Random Inconsistency Index (RI)

Step 5: Calculation of vector of relative importance of the latest level (alternatives) compared to the first level (global objective)
The latest step of the algorithm allows obtaining the vector giving the relating importance of the alternatives compared to the global objective (level 4 with regards to the level 1). This aggregation principle consists in carrying out matrix products. The final result is a classification of considered alternatives.

Illustration

As an illustration, we consider a network composed of three suppliers (S1, S2 and S3) and two customers (C1 and C2). The customers launch three Calls For Proposals on the network (CFP1, CFP2 launched by C1 and CFP3 launched by C2). As it was described above all the suppliers which are connected to the network (S1, S2 and S3) will receive these CFPs.
At the reception of these CFPs each supplier starts the application of the AHP method in order to evaluate his performance to respond to these CFPs. Indeed, in order to explain the self evaluation of a given supplier with regards to a received CFPs we describe in the following section the application of the AHP method at the level of the supplier S1.
The application of this method is based on the set of information coming from two sources. Some are included in the concerned CFP others are in the supplier production system. Table 3 summarizes the data needed for launching the AHP method at the level of a supplier (S1).

		Supplier S1 Customer C1		Customer C2
Criteria	**Indicators**	CFP1	CFP2	CFP2
Delay criterion C1	Lead time (I11)	6	30	5
	Order delivery time (I12)	3	2	2
Cost criteria C2	Order cost (I21)	1017	681	733
	Delivery cost (I22)	309	94	121
Quality criterion C3	Rate of conformity (I31)	0.98		
	Respect of a referential (I32)	2.3		
	Rate of customer satisfaction	0.93		
Reliability criterion C4	Conformity in quantity of the orders (I41)	0.96		
	Respect of delivery times (I42)	0.9		
Strategy criterion C5	Allowance of a deferred payment(I51)	3		9
	Degree of privilege (I52)	3		5

Table 3. Summary table of the data

Figure 4 represents a decomposition of the current problem into a hierarchical structure.

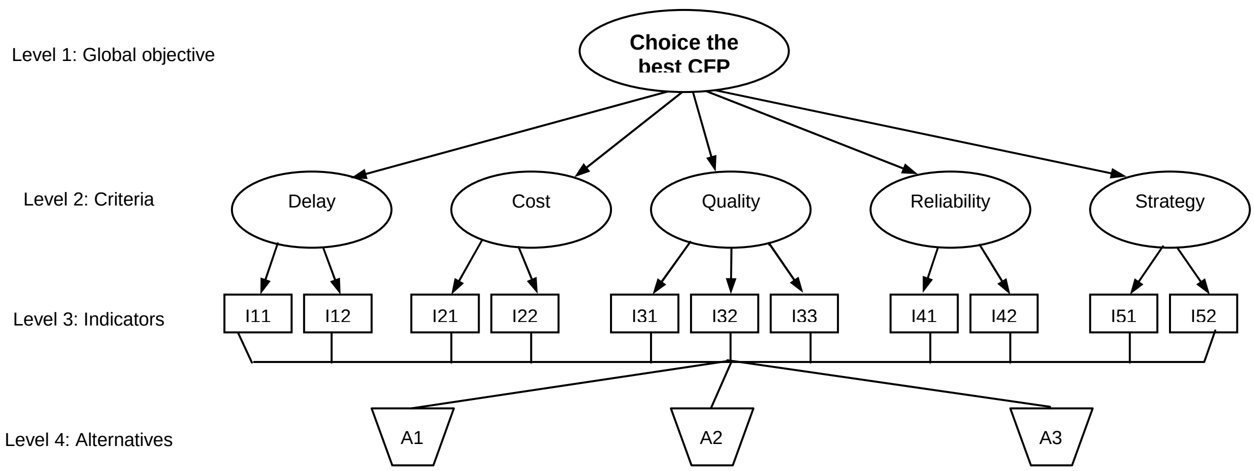

Figure 4. Hierarchical process of decision-making

Establishment of the binary comparisons and determination of the vector of relative importance: In our example we have considered that the relative importance among delay, cost and quality criteria is equal. The latest are slightly more important than reliability and strongly more important than strategy criteria (see Table 4).

Criteria	Delay	Cost	Quality	Reliability	Strategy
Delay	1	1	1	3	5
Cost	1	1	1	3	5
Quality	1	1	1	3	5
Reliability	0.33	0.33	0.33	1	5
Strategy	0.2	0.2	0.2	0.2	1

Table 4. Relative importance of criteria

Calculation of the vector of relative importance noted CrOg: it consists of the establishment of a criteria classification compared to the global objective (see Table 5).

Calculation of the vector of importance relative noted ICr_k: On the bases of the matrices expressing the importance of a given indicator with regards to the corresponding criteria, this step consists of calculating the importance of the indicators of a given criteria with regards to this criteria.
Indeed we have to establish five vectors from five matrices which correspond to the five criteria. As an example we present in the table 6 the vector of importance relative (ICr_1) of the indicators I_{11} and I_{12} with regards to the corresponding criteria (C_1).

	Og
C_1	0.2773
C_2	0.2773
C_3	0.2773
C_4	0.1221
C_5	0.046

Table 5. Vector of importance relative (CrOg)

	C_1
I_{11}	0.75094
I_{12}	0.24906

Table 6. Vector of importance relative (ICr_1)

Importance of the alternatives with regards to the indicators: Same as in the preceding step. On the basis of the eleventh matrices which expresses the importance of the alternatives with regards to a given indicators, we have to calculate eleven vectors of relative importance corresponding to the indicators.
This priority vector is noted: MI_{ij}. In order to obtain the vector of importance relative of the alternatives with regards to the indicators: it is necessary to establish the matrix $MInd_k$ (indicator k) where each column of this matrix is represented by a vector of importance relative of the corresponding indicator (ICr_1, ICr_2, ICr_3, …).

	MI_{11}	MI_{12}
CFP1	0.4167	0.25
CFP2	0.0833	0.375
CFP3	0.5	0.375

Table 7. $Mind_1$ matrix

Importance of the alternative with regards to the criteria: it consists of the establishment of the matrix MCr_k (criteria K) (see Table 8) where: $MCr_k=MInd_k*ICr_k$.

	C_1
CFP1	0.37518
CFP2	0.15596
CFP3	0.46886

Table 8. MCr_1 matrix

In order to obtain the importance of the alternatives compared to the global objective it is necessary to establish the matrix MCr, where each column of this matrix is represented by a column matrix MCr_k obtained above, corresponding to the criteria k (see Table 9). Then, we calculate the vector MOg which returns the importance of the alternatives with regards to the global objective (see Table 10).
This vector is calculating by using the following formula:
$MOg=MCr*CrOg$, where: $MCr=[MCr_1, MCr_2, MCr_3, MCr_4, MCr_5]$.

	C_1	C_2	C_3	C_4	C_5
CFP1	0.37518	0.22955	0.333	0.333	0.26058
CFP2	0.15596	0.40876	0.333	0.333	0.26058
CFP3	0.46886	0.36166	0.333	0.333	0.47875

Table 9. MCr matrix

From the table 10, we can establish the classification of the CFPs (CFP1, CFP2 and CFP3) compared to the capacity of the supplier S1 to treat them. Thus we can conclude that the supplier S1 is better on the third CFP (CFP3).

	Og
CFP1	0.31268
CFP2	0.30159
CFP3	0.38533

Table 10: Vector of importance relative MOg

Note that this classification process is held on the level of each entity belonging to this partnership. Indeed, these partners enter into a negotiation phase in order to seek the best response to a given CFP. Thus the best answer is obtained by emergence.

Conclusion

The objective of this study is to improve the decision making structure at the level of the customers-suppliers relationship. Indeed, the principal aim of the suggested approach is to obtain a balance between load/capacity at the level of one supplier and to achieve a smooth load between the various suppliers with a further objective to propose an equitable system between network suppliers. For that, we have associated for each supplier a decision making centre Autonomous Control Entity (ACE). This centre allows to the supplier to self evaluate his performance compared to a given CFP launched on the network. For that, a multicriteria method (AHP method) was used in order to choice, among several CFPs, the CFP which ensures the best performance for the entity. If another entity provides a better performance according to this CFP, the entity suppressed this CFP and used AHP again in order to identify another best CFP. This approach allows the suppliers to take part to the negotiation and then to obtain the best response by emergence.

The Autonomous Control Entity described in this paper was modelled (Mekaouche et al., 2005) using DEVS (Discrete EVent system Specification) formalism developed for modelling and simulation of discrete events dynamic Systems (Zeigler, 1984). Introduced by Zeigler, DEVS (Discrete Event system Specification) allows the specification of the discrete event models. DEVS enables the development of robust model representation, based on atomic models concepts and on higher-level models representation closed under coupling. This enables a hierarchical modelling, where atomic models are considered as black boxes. Indeed, these models will be used as formal specifications in the system realization. Further works will focused on a simulation of these models in order to validate the suggested approach.

Reference

Anderson, Helén. Holtström, Johan. and Öberg, Christina (2003), "Are magers or acquisitions expected to affect Customer and Supplier relationships ?. An analysis of decisions tacken by a competitive authority" *19th annual Industrial Marketing and Purchasing Conference, University of Lugano, Lugano, Switzerland.*

Bisignano, Angelopietro. and Palermo, Ofielia A (2003), "Fight environmental hostility! How negociation can govern firm-institutions relationships" *19th annual Industrial Marketing and Purchasing Conference, University of Lugano, Lugano, Switzerland.*

Brito, Carlos M. and Roseira, Catarina (2003), "A Model for the Understanding of Supply Chain Networks" *19th annual Industrial Marketing and Purchasing Conference, University of Lugano, Lugano, Switzerland.*

Bruzzone, Agostino G. Mosca, Roberto. and Revetria, Roberto (2002), "Web integrated logistic designer and intelligent control for supply chain management" *Proceedings of Summer Computer Simulation Conference.*

Burlat, Patrick (2004), "La modélisation des réseaux d'entreprises : quelques travaux actuels et perspectives" *Actes de la journée de synthèse GDR MACS, Aix-en-Provence, 21-22 octobre 2002.*

Despontin, Emmanuelle. Briand, Cyril. and Esquirol, Patrick (2001), "Premiers pas pour une aide à la coopération inter-entreprises aux niveaux opérationnels" *Actes des journées de synthèse du GRP, Tarbes, 25 octobre 2002.*

Fu, Yonghui. and Piplani, Rajesh (2001), "Aligning inventory control decisions in decentralized supply chain" *In 13th European Simulation Symposium, p 909-913.*

Harri, kulma I (2002) “Accounting in customer-supplier relationships:Developing cost management in customer-supplier relationships: three case studies” *Proceedings of the 3rd Conference on New Directions in Management Accounting: Innovations in Practice and Research. Vol 2. ss. 699-716. Brussels, Belgium.*

Lauras, Matthieu. Parrod, Nicolas. and Telle, Olivier, (2002) “Les relations industrielles: trois approches dans le domaine de la gestion des chaînes logistiques” *Actes des journées de synthèse du GRP,Tarbes, 25 octobre 2002.*

Mekaouche, Lynda. Ounnar, Fouzia. Pujo, Patrick. and. Giambiasi, Norbert (2005), “Customers – Suppliers Relationship Self Organized Control Modeling using DEVS formalism” IMACS’05*, Paris.*

Muralidharan, C. Anantharaman, N. and Deshmukh. S.G (2002), “A multi-Criteria Group Decisionmaking Model for supplier Rating” *The Journal of Supply Chain Management, p 22-33.*

Ounnar, Fouzia. and Ladet, Pierre (1999), “Managing breakdowns machines: A Petri net model and decision making process” *European Journal of Automation, Ed. Hermès: Modelling of Reactive Systems, 33 (8-9), (1999), pp. 977-994.*

Ounnar, Fouzia (1999), “Prise en Compte des Aspects Décision dans la Modélisation par Réseaux de Petri des Systèmes Flexibles de Production” *Thèse de Doctorat, Institut National Polytechnique de Grenoble, Laboratoire d’Automatique de Grenoble.*

Ounnar, Fouzia. and Pujo, Patrick (2001), “Décentralisation des Mécanismes de Pilotage de la Relation Donneurs d’Ordres/Fournisseurs” *Actes du 4e Congrès International de Génie Industriel, Vol 2, p 1175-1185.*

Ounnar, Fouzia. Pujo, Patrick. Mekaouche, Lynda. and Giambiasi, Norbert (2004), “Decentralized Self Organized Control of a Patnership Network in an Intelligent Supply Chain”. *In IMS International Forum 2004: Global Challenges in Manufacturing, Italy.*

Ounnar, Fouzia. and Pujo, Patrick (2005), “Supplier evaluation process within a self-organized logistical network” *In: International Journal of Logistics Management.*

Saaty, Tomas L (1980), “*The Analytic Hierarchy Process*”, McGraw-Hill.

Smith, Reid G (1981), “The contract net protocol: High-level communication and control in a distributed problem solver” *IEEE Transactions on computers, C629512°/ 1104-1113.*

Tan, Keah C. Kannan, Vijay R. and Handfield Robert B (1998), “Supply Chain Management: Supplier performance and firm performance”, *International Journal of Purchasing and Materials Management*, (34:3), pp. 2-9.

Vargas, Luis G (1990), “An Overview of the Analytic Hierarchy Process and its Applications”*, European Journal of Operational Research, (48), pp. 2-8.*

Villa, Agostino (1998), “Organizing a ‘network of entreprises’: an object-oriented design methodology” *Computer Integrated Manufacturing Systems Vol. 11, N° 4, p 331-336.*

Wedley, William C (1990), “ Combining Qualitative and Quantitative Factors – An Analytic Hierarchy Approach”, *Socio Economic Planning Sciences, (24:1), pp. 57-64.*

Zeigler, Bernard P (1984), “*Multifaceted Modelling and Discrete Event Simulation*” Academic Press, London.