INTERNATIONAL DESIGN CONFERENCE - DESIGN 2006
Dubrovnik - Croatia, May 15 - 18, 2006.

DESIGN 2006

INTEGRAL COLLABORATIVE DECISION MODEL IN ORDER TO SUPPORT PROJECT DEFINITION PHASE MANAGEMENT

M. Jankovic, J-C. Bocquet, J. Stal Le Cardinal and J-M. Bavoux

Keywords: collaborative decision-making, systems approach, new product and process development

1. Introduction

The Project Definition phase is one of the most important phases in the New Product and Process Development. This is also a collaborative decision-making phase. The existing project management tools do not permit adequate management of this phase. In this paper, we develop an integral collaborative decision-making model. The goal of this conceptual model is to identify the intrinsic elements for successful decision-making. Thus, this model was used to support the collaborative decision-making of the project team, but also to structure and manage Project Definition phase. Based upon this model, we developed a project management tool specifically for this phase in PSA Peugeot Citroen.
In the first part of the paper, we explicit the Project Definition phase and the influence of this phase on the project success as well as the collaborative decision-making. In the second part, we develop an integral collaborative decision-making model and more precisely the Environment View. In the end, we present a part of our application developed in collaboration with PSA Peugeot Citroen. This application is used for the project management of the Project Definition phase.

2. Project Definition Phase

New Product and Process Development (NPPD) is one of the key processes contributing to enterprise success and future development [Marxt and Hacklin 2004]. Identification of client needs during the market research phase represents a starting point for a Project Definition phase. In PSA Peugeot Citroen, the Project Definition phase is the first phase of NPPD cycle. This phase is characterised by numerous relationships between different actors contributing to the NPPD process and a considerable uncertainty issues to be dealt with.
The mission of the project team in this phase consists of defining coherent project objectives with regard to all constraints concerning the enterprise and the market. At the very beginning of this phase, different company departments give the basic guidelines for the project, declined from the enterprise strategic objectives in different domains, like marketing, production, innovation, etc. Results of the market segmentation and targeting are also taken into account in this phase as well as the integration of client needs. The project team has to take into consideration these objective guidelines and to define coherent project objectives, through the dynamic decision-making process reducing the gap between the enterprise knowledge and objectives (see figure 1).
The definition of the project objectives is done progressively through collaborative decision-making process, where different actors of the NPPD process decide within the limits of the fields that concern them. The number of different actors participating is highly elevated, because of the diversity of fields

concerned with this phase. Some of them are: marketing, innovation, strategy, production, architecture, motors design, etc. Every decision maker in this process is responsible for one field and has his specific objectives to attain (figure 2).

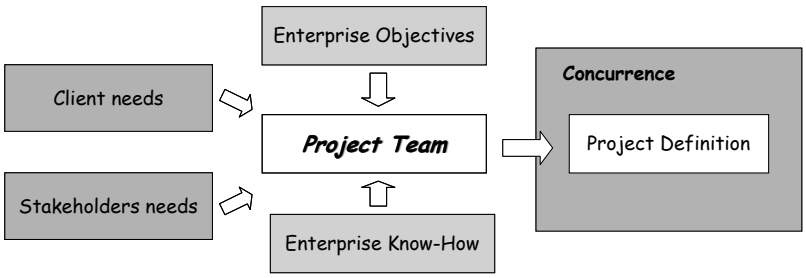

Figure 1. Project objectives definition context

Often these objectives are in conflict. The decision makers are experts in their respective domains and therefore have their specific point of view of the problem taking into account only the aspects that influence their own work. Apparition of the conflict in the collaborative decision-making is often due to these different value judgments as well as different priorities in the decision-making process. Thus, collaborative decision-making process is a process of collaborative considering alternative understanding of the problem, competing interests, priorities and constraints [De Michelis and Grasso 1994, Eugenio, Jordan, Thomason and Moore 1997].

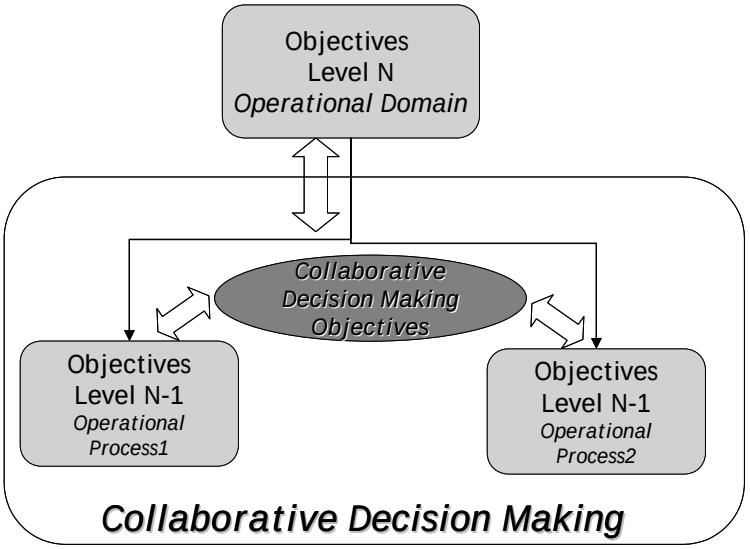

Figure 2. Objectives relationships in collaborative decision-making

Through the collaborative decision-making process the most of the strategic decisions concerning the project as well as the enterprise are defined. Based on these objectives, almost 80% of the product and process are specified in this phase [Whelton, Ballard and Tommelein 2002]. Defining the project objectives can also be seen as the engagement of enterprise resources. It is important to take into account the adequate information in this complex environment (figure 1) in order to define objectives that will assure the project success. In his research, Morris states that the main reasons contributing to the project success emanate from the Project Definition phase [Morris 1988]. These research results only confirm the importance of this phase for the entire NPPD process.

The project management methodology is project realisation oriented: project planning, resource management, etc. The research studies have mostly been treating the problems how to realise the

project in time, respecting the budget and obtaining the quality of the product defined at the beginning when the project content is already existing. Thus the companies are more and more confronted with the problem of managing the Project Definition phase without adequate methodology for the problems of this phase: non existence of the objectives, uncertainty, information acquiring, etc. These reasons are also the source of difficulties when it comes to project control in this phase. We have developed the integral collaborative decision-making model in order to help the project team during this phase. This model was also a base for defining the collaborative decision-making processes in this phase, important for the phase structuring and organisation.

3. Collaborative decision-making model

Collaborative decision-making is, as we already mentioned in the previous part, decision-making between different actors of the NPPD process, having different and often conflict objectives in the decision-making process. In the Project Definition phase, collaborative decision-making remains effective and rich way to exchange the necessary information in the NPPD process and to communicate. Information exchange and communication actively participate to the quality of the NPPD process and project success.

The quality of collaborative decision-making is upheld by the diversity of actors participating in the decision-making process, the diversity of knowledge of each of them and the information they have concerning the problem. These divers participations permit to one project to obtain a global overview of the problem and not to overlook the important aspects or influences. It is almost impossible, in the NPPD process of complex projects, such as vehicle development process, to imagine that a solution in one domain does not influence another domain or is not influenced by another one. For example when deciding the style of one vehicle it is of most importance to verify that his architecture correspond to the crash test. Diminishing the length for just 10 cm can diminish the safety of the conductor and the passengers.

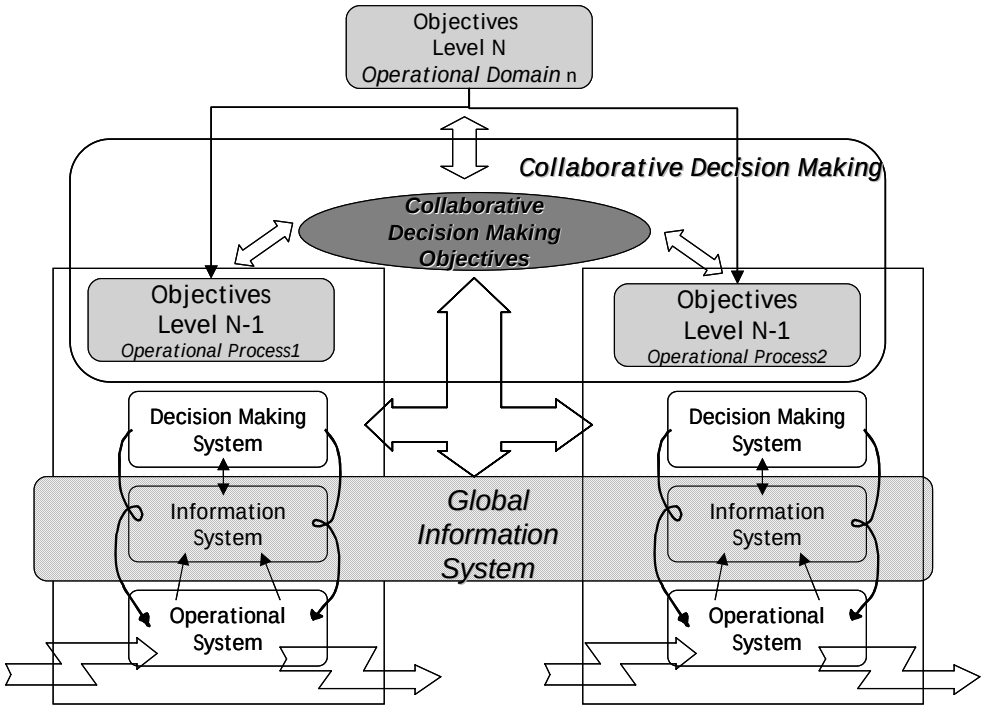

Figure 3. Collaborative decision-making – Systems approach

Paradoxically, the advantages that we exposed in the previous paragraph are also the sources of divers difficulties in the collaborative decision-making process:

- Collaborative decision-making represents a “fat soil” for different conflict apparition. By definition, the conflicts concerning the objectives in the decision-making participate to the proliferation of the difficulty in the process. The conflicts can have different sources: different personalities of actors participating, their different background, knowledge, etc.
- Even though this is also information-exchange point, it is very difficult to resolve the problems concerning the information acquisition, non-existence of certain information introducing the uncertainty effects, non-coherent information, etc.
- Participation of different actors, experts in divers domains, introduces the problems of value judgment, of existence of different decision-making criteria and priorities, etc.

In the field of decision-making, there are several methods dealing with uncertainty, fuzziness and multiobjective decision-making [Knosala and Pedrycz 1992]. This method is a based upon the alternative ranking identified by the preferences of decision makers and graduation of weights of criteria. Project Definition phase has several specificities:

- The objectives and thus the criteria in decision-making are un-defined or flue;
- Different fields participating in the decision-making are numerous (13 just on the global project level) and every field has its own criteria. The criteria between different fields are not the same;
- In this phase, the innovation is introduced in the vehicle development. The lack of necessary information adds a difficulty to alternative evaluation.

Thus, we have elaborated the elementary model of collaborative decision-making based on systems approach developed by Le Moigne [Le Moigne 1990] (figure 3).

Furthermore, we developed an integral conceptual model of collaborative decision-making. The modelling objective was to identify the intrinsic elements and information contributing and supporting the quality decision-making. Thus collaborative decision-making model is developed using the definition of the system [Le Moigne 1990] and has four distinct views (figure 4): Objectives, Environment, Transformations and Process. Further development of this framework consisted of these four views, often required the knowledge of divers domains. Some of the research domains used in our research and modelling are:

- Literature concerning the group problem solving [Aldag and Fuller 1993]: consideration of the problem solving process, different elements defining the decision-making context, decision process characteristics;
- Literature concerning the collaborative design [Rose]: notion of the conflict in collaborative design, different types of conflicts, different tools and approaches in conflict management;
- Literature concerning group decision-making [Brézillon and Zaraté 2004]: definition of the context in group decision-making, existence of different granularities of context in decision-making, relationships between different context.

The elements of the collaborative decision-making model, their relationships and model integrity were validated and complemented by observation and data collected on the field. Due to required limits of this paper, we expose only one view of the model – the Environment view (figure 5).

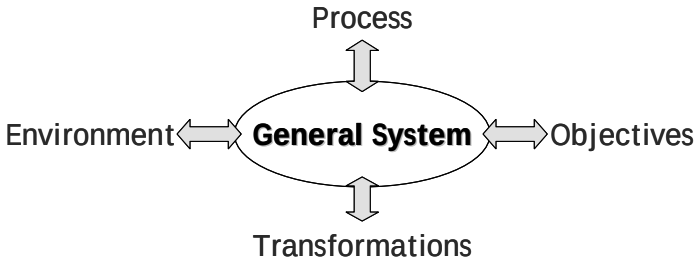

Figure 4. System definition – Le Moigne

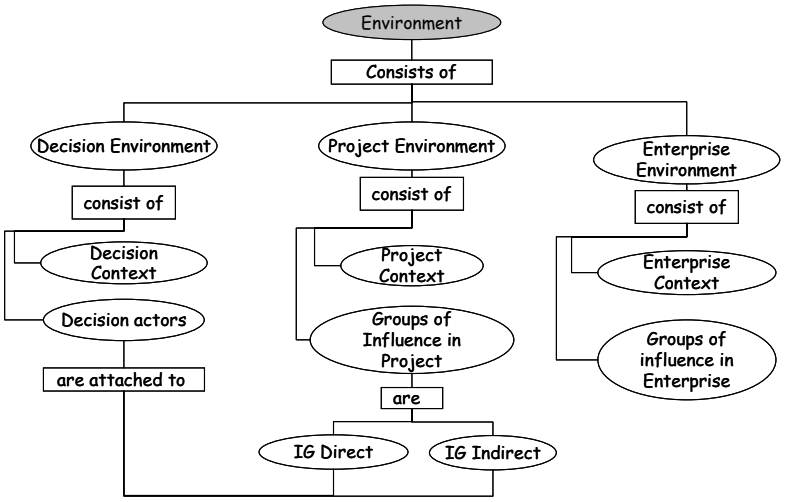

Figure 5. View "Environment"

Three different environments influence collaborative decisions: decision environment, project environment and enterprise environment. Each of these environments has their own context, determinant for the collaborative decision-making and different actors participating. It is important not to see these environments as separate and distinct entities. Our objective is to identify the most pertinent elements influencing collaborative decision-making and thus essential to take into consideration while deciding.

Previously we have evoked the problem of value of judgment of different actors participating, different decision-making criteria, etc. Different decision makers have different definition and different prospect of the problem. The differences are even more emphasized when different decision makers have different perception of decision-making risks, uncertainties connected to the decision-making or different perception of the decision importance for the entire project [Aldag and Fuller 1993]. These three factors, we thought most pertinent when defining Decision context, are important to identify before the collaborative decision-making.

In the collaborative decision-making, there are different actors participating in the process: collaborative decision-making pilot, decision makers and contributors. Decision-making pilot is a person responsible for the collaborative decision-making, i.e. the decision taken contributes to the objectives definition within the domain of his responsibility. The pilot is also in the best position to define the values of factors of the Decision context and has the lawfulness in front of the project team for an overall acceptance of these values. The decision makers are project members having knowledge and information necessary for collaborative decision-making. The contributors detain the information or documents important for collaborative decision-making but do not participate in the decision-making process (the domain of their responsibility is not directly concerned). The collaborative decision-making pilot and decision makers are members of the groups of direct influence on collaborative decision-making because they are participating in the decision-making process, while the contributors are member of the groups of indirect influence. The contributors do not participate in the decision-making process but the information they are detaining are of most importance for the quality collaborative decision-making.

In the Project environment, the project context is mostly determined by the project typology. The importance of one collaborative decision will be different in different projects. For example, certain decisions concerning innovation aspects do not have the same importance if the vehicle project has the objective to replace the vehicle having a large part of the market and represents an image the enterprise or if the objective is to develop a vehicle for a new market niche. In the first case the innovation aspect are of most importance because the product differentiation will be done with regard

to the innovation aspect, whilst in the second case it is important to develop a vehicle corresponding to customers needs.
The factors of the Enterprise environment can seriously inhibit or induce the collaboration in the design process [Rose]. For example, the work politics [Aldag and Fuller 1993] can encourage the collaboration, different types of organization can be adequate for the design process (the cross-functional is considered to be one of these organizations), etc. As we sad previously, on the very beginning of the Project Definition, different enterprise departments give the guidelines for the project. Some of these guidelines are so important for the enterprise strategy that they are considered as constraints in the design process. All these elements are important for the definition of the Enterprise context and influence the project definition phase.
The Environment view is just one view of the collaborative decision-making model and in no case it should be observed as separate part of the model. The views are interconnected and have the meaning only when they are observed globally.

4. Project management through collaborative decision modelling

The characteristics of the Project Definition phase as a collaborative decision-making phase, we already exposed, create new challenges for project manager and project management methodology. Previously we have already pointed out that the project management methodology is realization-oriented. It means that the starting point of project management methodology is a clear definition of project objectives, which are afterwards decomposed conformably to the adopted Product Breakdown Structure. Project objectives are decomposed to a level that enables a project team an understanding of the project complexity and defining the activities necessary to realize for the objectives attainment. This process is insufficient in the Project Definition Phase. This is a phase where the coherent project objectives are to be defined so that the project success is assured in the future. Moreover, the complexity of the vehicle development project complicates this definition process.
The operational needs of the project team only confirm these statements. The project team considered that there were no adequate tools permitting them to manage this phase. The project management methodology and tools deficiency as well as difficulty to structure this phase disables the project control during this phase. The only possibility for project control was at the end of the phase, which had significant consequences for the project. If the overall coherence of project objectives is not obtained in the end of the phase, the project delays were increased even for several months. It is unacceptable considering concurrent environment on the vehicle market where the time of entrance on the market is one of the factors influencing the project success.
In order to respond to upper mentioned problems, after the research for identification the operational needs of project team in PSA Peugeot Citroen, we developed a new tool for project team in MS Project. The objective of development of this application was to enable project management and control. The choice of MS Project was supported by the research results concerning the operational needs highlighting the need for the reduction of number of tool or application used by the project team. The developed application consists of two views: Decisional and Operational (figure 6). The Decisional view concerns collaborative decision-making in Project Definition phase. In this view there are three levels of granularity: collaborative decision level, collaborative decision-making processes and project collaborative decision-making process.
The collaborative decision level contains the necessary information concerning the quality decision-making. This level contains the information that we developed in the integral collaborative decision-making model mentioned in the previous part of this paper. Seventy-three decisions were identified and modelled. For example one of the decision can concern the production hypothesis of the project. This decision will depend upon the choice of strategy of work with project suppliers. On the other hand the production hypothesis will determine the economic plan of the project. Collaborative decision-making processes concern only one aspect of the project: economic optimisation, production, innovation, etc. There are 13 processes identified and they correspond to the project team structure. Every collaborative decision-making process is designed for one team member and represents all the decisions to be made in the definition of objectives of one project aspect. Collaborative decision-

making processes as well as their relationships are integrated into a global project collaborative decision-making process. The phase structure and the development logics are represented in this view.

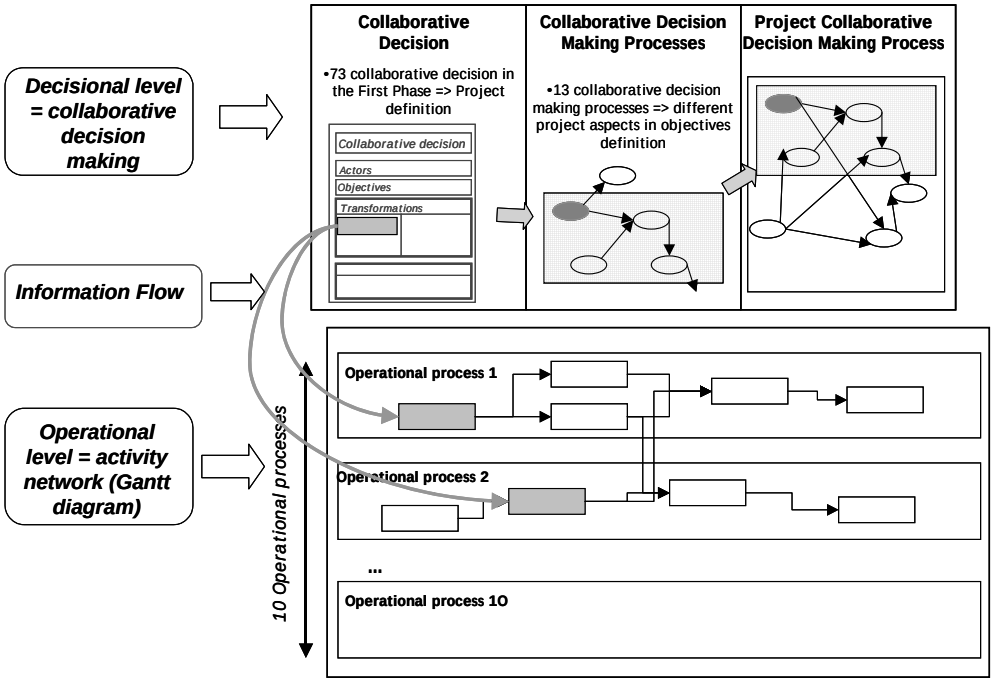

Figure 6. Application views in Microsoft Project

Levels that we identified and developed within the Decision view aim to support project team in the decision-making but also the management of this phase. We already exposed that the non-existence of the structure of the phase disabled the possibility to apply the standard project management methodology, i.e. to identify the activities to realize in order to attain the project objectives. Collaborative decision modelling permitted us identification of the activities to realize. The activities belong to the Operational view and constitute the operational processes as in the project management methodology. There are 10 processes in the NPPD in the Project Definition phase. Decisional view and Operational view are connected through the information flow.

5. Conclusions

In this paper, we have presented an integral model of collaborative decision-making. Collaborative decision-making is a delicate process of conflict objectives, competing interests and divers knowledge of numerous participants of NPPD process. The development of this model has an objective to help decision-making in this process by identifying elements necessary for quality decision-making: different types of conflicts that can emerge in this process, the important information, relationships between different objectives in decision-making, different environments influencing decision-making, etc. This model is used for the modelling of collaborative decisions in the Project Definition phase, but also to define and identify collaborative decision-making processes constituting the Project Definition phase. Thus, his purpose is double, to serve as a decision support and to manage the project in the Project Definition phase.

Results of the research give a possibility for several developments

- Development of a Decision Support System for collaborative decision-making in NPPD process. The field results have accentuated a need for appropriate information in collaborative decision-making. Thus, this kind of development can contribute to a better quality of decision-making.

- Development of a new project management methodology that will include not only activities but also different elements of NPPD process and their relationships. In this paper we have discussed the problems of existing project management methodology. It is important to control the realization of one project in order to attain the project objectives, but it is also important to develop a new approach dealing with the problems of project management when the project content and objectives are not existing.
- A new project management tool or application. Even though, the tool that we develop takes into account the decisions in the project management it is not enough for project management of complex project. In our opinion it is necessary to develop a new tools that enables incorporation of different elements of NPPD process (decisions, information, activities…) and possibility of different representation of project progress (decision view, operational process view, information flow view,).

References

Aldag, R. J. and Fuller, S. R., "Beyond Fiasco: A Reappraisal of the Groupthink Phenomenon and a New Model of Group Decision Processes", Psychological Bulletin, 113, 3, pp 533-552.

Brézillon, P. and Zaraté, P., "Group Decision Making: A Context oriented view", Proceeding of IFIP WG8.3 International Conference on Decision Support Systems DSS2004, G. S. R. Meredith, D. Arnott, S. Carlsson, pp 123-133.

De Michelis, G. and Grasso, M. A., "Situating conversations within the language/action perspective: the Milan Conversation Model", Proceeding of CSCW'94 Conference, ACM Press, pp 89-100.

Eugenio, B. D., Jordan, P. W., Thomason, R. H. and Moore, J. D., "Reconstructed Intentions in Collaborative Problem Solving Dialogues", Proceeding of AAAI-97 Fall Symposium on Communicative Action in Humans and Machines, AAAI Press, pp

Knosala, R. and Pedrycz, W., "Evaluation of design alternatives in mechanical engineering", Fuzzy Sets and Systems, 47, 3, pp 269-280.

Le Moigne, J.-L., "La modélisation des systèmes Complexes", Dunod, Paris, 1990.

Marxt, C. and Hacklin, F., "Design, Product Development, Innovation: All the same in the End? A Short Discussion on Terminology", Proceeding of International Design Conference - Design 2004, pp

Morris, P. W. G., "Initiation Major Projects - the Unperceived Role of Project Management", Proceeding of 9th INTERNET World Congress on Project Management, pp 801-813.

Rose, B., "Proposition d'un référentiel support à la conception collaborative : CO²MED (COllaborative COnflict Management in Engineering Design), Prototype logiciel dans le cadre du projet IPPOP", U.F.R. Sciences et Techniques Mathématiques, Informatique et Automatique, 2000.

Whelton, M., Ballard, G. and Tommelein, I. D., "A Knowledge Management Framework for Project Definition", Electronic Journal of Information Technology in Construction -ITcon, 7, pp 197-212.

Marija Jankovic
Ecole Centrale Paris, Industrial Engineering Laboratory
Grande Voie des Vignes, Chantenay-Malabry, France
Tel.: ++ 33 1 41 13 18 09
Fax.: ++ 33 1 41 13 12 72
Email: marija.jankovic@ecp.fr