INTEGRATION OF DIFFERENT CONTEXTS IN COLLABORATIVE DECISION MAKING IN NEW PRODUCT DEVELOPMENT

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ABSTRACT

The notion of context seems to be a growing subject in the engineering sciences. Nevertheless, the definition of the context depends on the subject and the field of application. In this paper, we point out different definitions of the context in the engineering and cognitive sciences. Here we present our research concerning the collaborative decision-making in the early stages of the new product and process development. The study presented in this paper is a result of collaboration with PSA Peugeot Citroen, one of the French car manufacturers. Within the conceptual model of collaborative decision-making, we propose to integrate the information concerning three different contexts: decision, project and enterprise context. The aim of this model is to help and support the project team in project management. Therefore, we propose the consideration of context in project management.

Keywords: context, collaborative decision-making, new product development

1 INTRODUCTION

Several studies have shown that the notion of the context is a growing issue as well as strong dependency between the design and new product development activities and their context [1, 2]. The definition of the context and developed modelling approaches are numerous and can be very different.

The object of our research work concerns the collaborative decision-making in New Product and Process Development (NPPD) and more particularly the early stages of NPPD. This work was realised in collaboration with PSA Peugeot Citroen, one of the French automotive constructers. In order to develop an adequate tool for project team support in NPPD, we have developed a conceptual model of collaborative decision-making. Within this model, we have defined and integrated three different contexts influencing the collaborative decision-making process.

Therefore, we propose a following organisation of this paper. First part of the paper concerns different approaches, definitions and representation of the context. The second part exposes the Project Definition Phase, as this research work is a fruit of collaboration with PSA Peugeot Citroen in this phase, as well as the specificities of collaborative decision-making in this phase. In the third part, we propose the integration of three different embedded contexts that were evaluated important to define: the decision, project and environment context. In the end, we present our conclusions and research perspectives.

2 WHAT IS CONTEXT?

The concept of context has been an object of different studies [2-4]: linguistic, semantic, modelling, philosophy, information systems and artificial intelligence. There are several definitions depending on the research and the domain. Brézillon [5] has already pointed out the difference in the approaches in cognitive and in engineering sciences that were explored during the two workshops on context at

IJCAI-93 and IJCAI-95. *"The cognitive science view is that context is used to model interactions and situations in a world of infinite breadth, and human behaviour is key in extracting a model. The engineering view is that context is useful in representing and reasoning about a restricted state space within which a problem can be solved"*. Nevertheless, Brézillon [5] states that the differences in the definition of the context come from different positioning of these two scientific domains. Therefore, the both scientific domains face the same problems concerning its definition. However, as the approach in cognitive sciences is human centred it is therefore difficult to represent.

The identification and representation of the context are not uniform. Hereby, we give a brief review of the existing definitions and possible representations of the context. Longueville [3] explores the question of context within the engineering studies and defines the context is *"something that encircles and gives a sense to another thing"*. He also underlines [2] the importance of context modelling within the tools that are enforcing the communication and collaboration between different actors in order to achieve the mutual understanding. Hasher gives a following definition [6]: *"The context is a collection of relevant conditions and surrounding influences that make a situation unique and comprehensible"*.

One of the fields that concerned the notion of context is related to the situation theory. Situation theory is a programme with the objective to develop a "unified mathematical theory of meaning and information content" [7, 8] in the 80' introduced the ideas constituting the context theory. The two basic concepts are infons and situations. Infons are basic information units and are denoted as following

$$<<P, a_1,..,a_n,i>>$$

where P is a n-place relation, a_1, a_n different objects and i is the polarity (0 or 1) (meaning true or false). Situation are first class objects and are denoted as *s* support α (s $|$ = α) meaning that the infon α is true for the situation *s*.

Moreover, Edmonds [9] proposes the following definition of the context: *"the abstraction of those elements of the circumstances in which a model is learned, that are not used explicitly in the production of an inference or prediction when the model is later applied, that allows the recognition of new circumstances where the model can be usefully applied"*. The definition is illustrated in the figure 1. This definition of context is linked to the possibility for knowledge transferring.
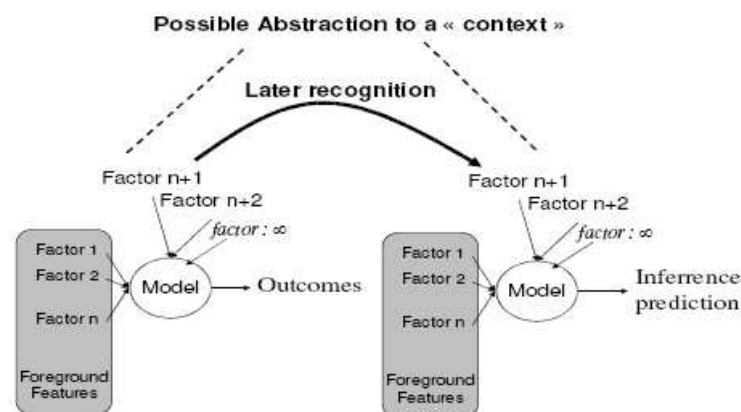

Figure 1.Context definition given by Edmonds [9]

The field of artificial intelligence has been particularly fruitful in the research concerning the context. The main research question in this area is the relation between the knowledge and the context [10]. Pomerol and Brézillon [4, 10] suggest that there are three types of context in the process of problem solving: proceduralised context, contextual knowledge and external knowledge. The proceduralised context is used is a context shared by those who participate in the problem solving and in this process is directly but tacitly used. The contextual knowledge concerns the context that is not directly used in the problem-solving process. The authors consider the proceduralised context as a contextual

knowledge activated and structured to make diagnosis, decisions and actions. The external knowledge represents the context that has nothing to do with the current decision-making but is known by many of those involved.

Longueville [2] on the other hand adopts a more pragmatic approach defining three levels of context necessary to integrate: explicit context, implicit context and overall context. The explicit context is possible to formalise and is represented as additional parameters of the model. The implicit context is not fully formalisable. It is a result of the learning process and can be represented partially as additional information. The overall context concerns the surrounding context that is complex and hard to recognise.

Furthermore, independently of the definition of the context most of the authors agree upon the fact that the context is very important for the decision-making process [3, 4, 10, 11]. Brézillon and Zaraté [11] emphasize the fact that *"making one context explicit can improve in a consequential way interaction among the members of the firm"*. Therefore, in our research, we therefore tried to identify the factors influencing the collaborative decision-making process in NPPD in order to explicit the context. Our approach is not human centred as the research in artificial intelligence is. The necessity to explicit the context is also underlined by the difficulty concerning the different points of view in collaborative decision-making which will be explained in detail further in this paper.

3 COLLABORATIVE DECISION MAKING IN THE PROJECT DEFINITION PHASE

The object of our study is collaborative decisions in the New Product and Process Development. This work is done in collaboration with PSA Peugeot Citroen within the Project Definition Phase. In PSA Peugeot Citroen, the Project Definition phase is the first phase of New Product and Process Development. Identification of the client needs during the market research phase represents a starting point for the Project Definition phase. This phase is characterised by numerous relationships between different actors contributing to the NPPD process and a considerable uncertainty issues to be dealt with.

We have already partially exposed our work concerning the collaborative decision-making in the Project Definition phase [12, 13]. Therefore, this phase as well as its specificities has already been discussed. Nevertheless, here we give a brief overview because we find necessary to explain this phase in order to define the collaborative decision-making and its context.

At the very beginning of this phase, different enterprise departments give the global guidelines for the definition of project objectives to the project team. Some of these departments are following: marketing, production, innovation, and strategy. The given guidelines represent the transcription of strategic orientations of the enterprise, given by different fields. The project team has also to take into account the results of market segmentation and targeting, as well as to integrate the client needs. The relationships between different objectives in the decomposition process are very complex (see figure 2).
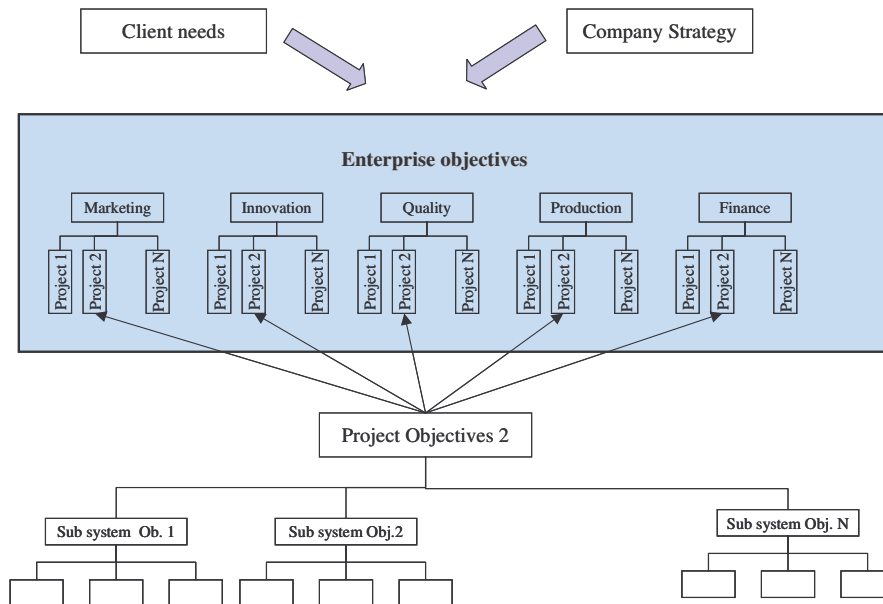
Figure 2. Project objectives' decomposition process in PSA Peugeot Citroen

The process of project objectives' definition of is also a collaboration process between the enterprise departments, responsible for enterprise objectives and different knowledge poles, representing the experts in specific domains. The responsibility for the project results is project teams', but in order to do so, the project team has to create the cohesion between these two levels. Every step of this process is done in collaboration and negotiation with one or both levels. As enterprise departments have a strategic vision concerning one field, thus having the global overview, and the knowledge poles have more operational vision involving feasibility, different problems can arise: conflict apparition, incomprehension due to different backgrounds and language used, difference in points of view concerning the same problem, different objectives to attain.

Collaborative decision-making is a decision-making where different representatives of upper stated levels decide upon one particular problem concerning the project and its definition. Every actor in this decision-making has a specific knowledge and information of the problem. Moreover, every actor is responsible for project objectives' definition in one project field. Therefore, as these different actors have different knowledge, information and vision concerning the problem, the collaborative decision-making can be a "fat-soil" for conflict apparition.

In the scope of collaborative decision-making, the notion of context is highly important. The perception of one collaborative decision will be influenced by the individual, by the knowledge and the culture of the group that he/she is a part of, and by the level on which one is situated. These different perceptions of the same problem result in conflicts that can jeopardise the project. Therefore, explication of the context of one collaborative decision is important because of:
- It represents the possibility for information sharing;
- The same perception of the context contributes to the unification of the vision concerning the same problem in the project.

4 DIFFERENT CONTEXTS IN COLLABORATIVE DECISION MAKING

In order to define the collaborative decision making as well as necessary information, we have developed the conceptual model with the aim to support the project team in the management of the Project Definition phase. This model is constituted of four different views: Objectives, Transformations, Process and Environment [14]. In this paper we will focus on the Environment view because it is where we integrate the notion of the context/

We have identified three different environments that influence collaborative decisions in New Product and Process Development: Decision environment, Project environment and Enterprise environment. We identified these three environments with regard to the influences of different systems in the NPPD process observed on the field. Each of these environments is identified by its context, determining the influencing factors of collaborative decision-making, and different actors relevant for collaborative decision-making. Figure 3 illustrates that it is important not to see these environments as separate and distinct entities as they are interdependent and embedded. Our objective is to identify the most pertinent elements influencing the collaborative decision-making and thus essential to take into consideration while deciding.
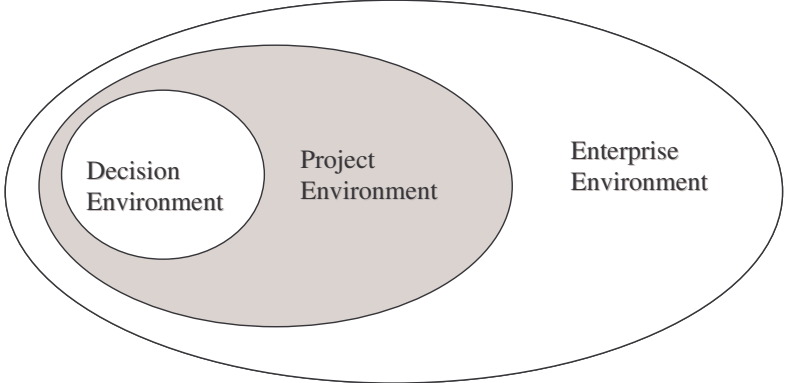

Figure 3.Three different environments influencing collaborative decision-making

In view to the definition of the Environment as well as different environments identified, we propose an Environment View that is presented in the figure 4. Every environment is defined by the corresponding context and the actors that are participating. In order to represent the context we used the proposition given by Edmonds [9], and we tried to identify the factors in each environment that influence the collaborative decision making.
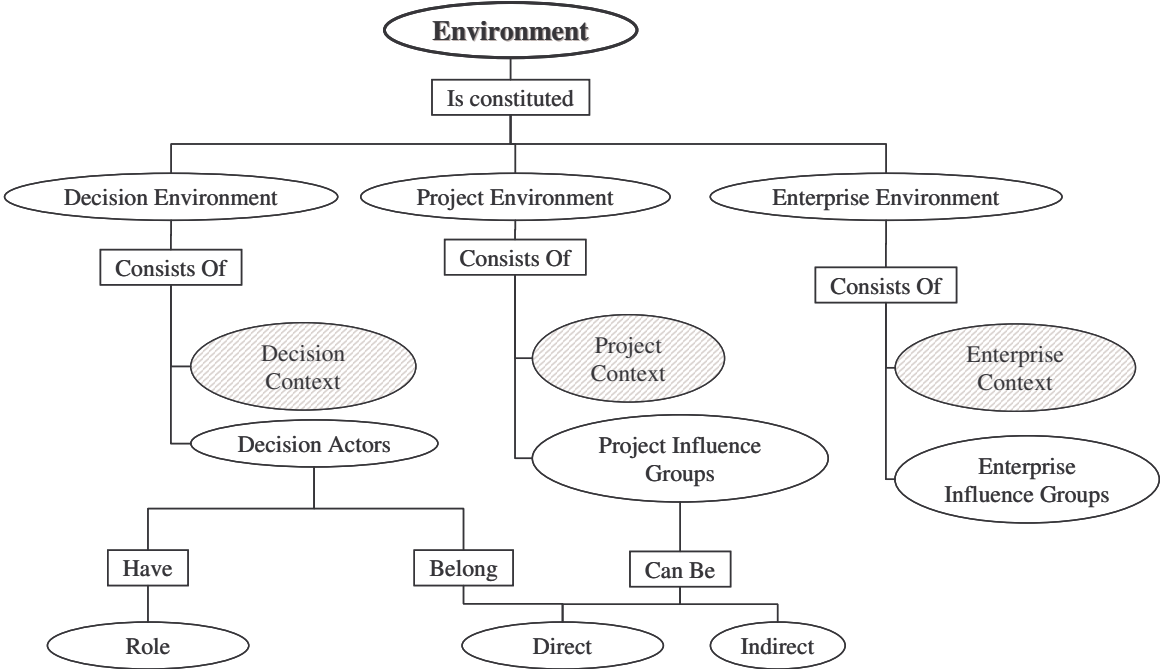

Figure 4. "Environment" View in Collaborative Decision-Making Mode l[13]

As it is presented on the figure 4, the global context of collaborative decision-making is defined by three different contexts: decision, project and enterprise. In this part of the paper, firstly we present different context and the factors that constitute each context. For every context we illustrate the

importance of the context in the collaborative decision making process. Afterwards, we present different actors and their roles.

We identified three factors influencing collaborative decision-making that constitute the Decision context based upon the literature research [15-17] and empirical observations:

- Decision-making risks,
- Uncertainties and
- Decision importance.

The homogenous vision concerning these three factors is important for collaborative decision-making. As collaborative decision-making is subject to different value judgments, different decision-making criteria and different decision objectives, it is necessary to "negotiate" or determine these factors in view to have a better vision concerning the problem. For example, the decision concerning the vehicle style does not imply the same risks for style department and for engineering department. If a style department draws a sports car, with sharp lines and very close to the ground, for engineering department just a question of windshield concerns the risks of production techniques: is it possible to produce a windshield with a high resistance and with the high inclination angle.

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 with a large part of the market and influences the enterprise image or if the objective is to develop a vehicle for a new market niche. In the first case, the innovation aspects 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 Enterprise environment concerns globally the enterprise and all departments working with the project on the product and process development. Enterprise context relates to directives given by different enterprise departments. These directives reflect enterprise strategic orientations. Each department give its directives to the project. Depending on the project, some of them are more important that others which are considered to be "standard".

The different contexts should not be considered independently, because they are embedded as we stated previously. That is when just one context changes, the other ones also change, thus altering the global context for one collaborative decision.

Every environment is also defined by the actors. These actors participate directly or indirectly to the definition of the context. The Decision actors are persons participating in the collaborative decision-making process. We identified three types of decision actors in view to the degree of participation, observed and identified on the field, in collaborative decision-making:

- Collaborative decision-making pilot,
- Decision makers and
- Contributors.

A *collaborative decision making pilot* is a person responsible for the collaborative decision-making, i.e. the decision in question contributes to the objectives' definition within the domain of his responsibility. The pilot is also a person being 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 collaborative decision-making pilot and decision makers are members of the groups of direct influence on collaborative decision-making, because they are deciding the solution of the problem. *The contributors* are project members detaining the information important for the clarification of certain aspects of collaborative decision-problem of making but do not have the responsibility to decide on the solutions (the domain of their responsibility is not directly concerned).

They are members of project groups of indirect influence because they are not deciding but are brining a clarification to the problem.

The actors identified in the project environment can be members of:

- Direct Project Influence Groups or
- Indirect Project Influence Groups.

Project influence groups are different decision-making groups [3] in the project development. The terms direct or indirect refer to their implications on collaborative decision-making. If the decision is in their responsibility and concerns the field that they are to develop, then we call these groups *Direct project influence groups*. If the decision does not concern their field of development and the actors of these groups, do not have the knowledge to decide upon the problem, we call them *Indirect project influence groups*. Nevertheless, there is never an entire independence of development fields. Indirect Project Influence Groups can detain clarifying information without which it is impossible to have a global view of the problem.

Actors in the Enterprise Environment are members of the *Enterprise influence groups*. The influence that these groups will have upon collaborative decision-making depends mostly upon the importance of strategic orientations for the project. If these orientations are decisive for the project, then they become the constraints.

5 CONCLUSIONS

In this paper, we discussed the problem of context definition and representation in different scientific fields. In order to help the decision-makers in the Project Definition phase, the first phase in NPPD, which is very sensitive phase for the project success, we developed the conceptual model of collaborative decision-making. Within this model, we propose to integrate the important factors influencing collaborative decision-making that define three different contexts: the decision context, the project and the enterprise context.

Identification and modelling of these three contexts has already been implemented in PSA Peugeot Citroen. These three embedded contexts help the project team to construct a unified vision of one problem within the project, supported by explicitly defined factors. Therefore, the collaborative decision-making is facilitated when it comes to apparition of different conflicts like ones concerning the collaborative decision-making preferences, different decision-makers' judgement values or different information concerning the problem. It is also a way to transmit the knowledge of one project to another and to capitalise it. Moreover, the representation of global context through three different contexts permits to have a relatively "dynamic" vision of the context. That is if one of the context changes, the global context of one collaborative decision will change and thus the decision-making. In this case, the same decision will have different impact and importance in different projects.

The presented study has several perspectives:
- We find necessary to continue to work on the notion of context as well as its definition. As we have already pointed out, there are several definitions of the context and no coherence between them. This fact shows the novelty of the research field and the necessity to produce more results in order to obtain the maturity in the field.
- It is also important to work on the dynamic aspect of the context. In this study, we adopt a rather pragmatic approach by identifying the influencing factors. Nevertheless, we have not explored the impact of one collaborative decision on different contexts and how to consider it in the scope of project management.

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