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▶ **To cite this version:**

Marie-Anne Le Dain, Richard Calvi, Sandra Cheriti. ASSESSING A PROJECT TEAM'S ABILITY TO CO-DESIGN WITH SUPPLIERS. 2008. hal-00366664v1

HAL Id: hal-00366664

https://hal.science/hal-00366664v1

Preprint submitted on 9 Mar 2009 (v1), last revised 1 Apr 2009 (v2)

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1st Workshop on Journal Publishing for Non-Native English-Speaking Researchers in OM and NPDM – 30-31 October – Nice, France

ASSESSING A PROJECT TEAM'S ABILITY TO CO-DESIGN WITH SUPPLIERS

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Abstract:

Purpose – It is now acknowledged that Early Supplier Involvement (ESI) in product development confers a competitive advantage. However, the implementation of ESI has been further extended to consider successful product development, particularly through the Relationship Assessment Programme (RAP) model (Lamming et al., 1996), as an interactive process between a customer firm and a supplier. We adopt this point of view in our paper aiming at shaping the outline of customer's ability to co-design with suppliers in New Product Development (NPD).

Design/methodology/approach – We adopted an action research approach based on longstanding interactions between researchers and of six French industrial manufacturers for the co-construction of local knowledge which can finally serve to build *generic actionable knowledge.* The feedback provided by a case application of the tool in one industrial setting is described.

Findings – We introduce two dimensions to specify the customer's ability to co-design with suppliers: *Open-mindedness* and *Capability*. We propose a self audit tool based on a maturity grid approach to assess, via both these dimensions, the ability of a project team to successfully set up and manage the co-development project with suppliers.

Originality/value – Although Early Supplier Involvement has emerged in previously published studies as critical factor in improving performance in Product Development, the unit of analysis is often the supplier in terms of selection and interaction processes. In this context, the *absorptive* ability of the customer's project team has not been examined. Further, we propose a structured method to assess this ability and an associated tool empirically tested.

Practical implications – This tool will serve as a basis for defining the continuous improvement strategy needed to guarantee the success of the collaboration

Keywords:

New Product Development, Early Supplier Involvement, Maturity Grid Approach, Ability to Co-Design

Paper Type:

Research paper

1. Introduction

Firms in many industries are facing increased global competition and are operating in markets that demand more frequent innovation and higher quality. One approach many companies are taking to gain a competitive advantage is to involve suppliers earlier in the design phases. A large body of literature has identified the benefits of ESI in product development (Bidault et al., 1998, Clark et al., 1991, Handfield et al., 1999, Knudsen, 2007). However, such practice presents potential pitfalls and risks. For most authors, the major obstacle is the lack of managerial expertise needed in complex inter-organization configurations (Monczka and Trent, 1997). Thus, customer firms can only benefit from this extended innovation if they develop a specific competency in managing these inter-firm relations (Bidault et al., 1998, Wynstra et al., 2001). This specific competency must take into account the capacity of both the supplier and the customer to collaborate successfully. Indeed, when a customer wishes to develop a collaborative working relation with suppliers, he needs to select the suitable designer-supplier according to the objectives required within the co-development project. This selection requires an evaluation of the supplier's capacity in terms of innovation and technical expertise but also in terms of willingness to work effectively with a product design team (Mc Cutcheon et al., 1997; Emden, 2006, Schiele, 2006). However, successful supplier-customer relationships depend on the right balance between the supplier's capacity and the customer capacity to value, assimilate and utilize external knowledge. Cohen and Levinthal (1990) label this capability *a firm's absorptive capacity*. In their empirical study, this capability appears mainly as a byproduct of firm's R&D investment. But according to us, this capacity should not be limited to efforts in terms of R&D investments but should be completed by appropriate organizational and managerial capabilities to collaborate in design phases with suppliers. We argue that in order to improve the customer's *absorptive capacity* in an extended New Product Development (NPD) project, it's relevant to have an accurate measure prior to setting-up the collaboration.

This paper aims to present a self-assessment audit tool enabling a project team to evaluate its ability to co-design with the suppliers who are involved in a NPD project. In the first section, we discuss the issue of performance evaluation in the specific context of collaborative design in NPD and we present the PRAXIS project, the context in which this research took place. The research methodology is described underlining the genesis of the pilot tool. The framework of the audit tool is then presented. Insights from literature and our exploratory study are combined to identify, through the lifecycle of co-design collaboration, the six key process areas which form the basis of the audit tool. We explain the proposed dimensions - *open-mindedness* and *capability* - to specify the project team's ability to co-design with suppliers. Subsequently, maturity levels are defined to characterize improvement relative to the set of six process areas. We present the assessment tool and its potential use by a project team, and the feedback provided by a case application of the tool is then described in detail. Finally, the limitations and the implications for theory and practice are discussed.

2. From supplier evaluation to collaborative relationship evaluation

Several works in literature address the issues of how to manage Early Supplier Involvement (Dowlatshahi, 1998, Bidault et al., 1998, Handfield et al., 1999, Wynstra et al., 2001) in order to better identify and understand the relevant processes and enabler factors for the success of such involvement. As Araujo et al. argue (1999), these kinds of relationships require building an *interactive* interface which is always "*an outcome of decisions made on both sides of a dyad*" (p 506). Yet, there is little research which focuses on the *collaborative maturity* level (Fraser et al., 2003) and the influence of the competency of the customer's project team on the performance of supplier's involvement in NPD projects. This stance fits perfectly with the theory of performance relationship evaluation as presented by Lamming et al. (1996) in their RAP (Relationship Assessment Programme) model. For these authors, when customer and supplier work together in a collaborative way, sole evaluation of the supplier is not sufficient. The RAP model departs from the vast majority of vendor assessment models by focusing on the relationship as a unit of analysis rather than solely on the supplier firm side (Johnsen et al., 2008). It is thus necessary to assess the contribution of both parties in the exchange in order to improve the performance of the relationship. This is the starting point of the PRAXIS research project (Figure 1) which was carried out within the French Cluster "*Arve Industries Haute-Savoie Mont Blanc*"[1]. During this project, methods and associated tools were developed on the one hand to assess the ability of both partners – customer and supplier – to co-design (Working Packages WP1 and WP2 in Figure 1) and on the other hand to evaluate the performance of both partners throughout a product development project (WP2 and WP3 in Figure 1). Co-design ability evaluations of both partners were performed prior to establishing the collaboration, and the performance evaluations were also performed during and after the collaboration in order to measure the real co-design effort of both partners in a specific project.

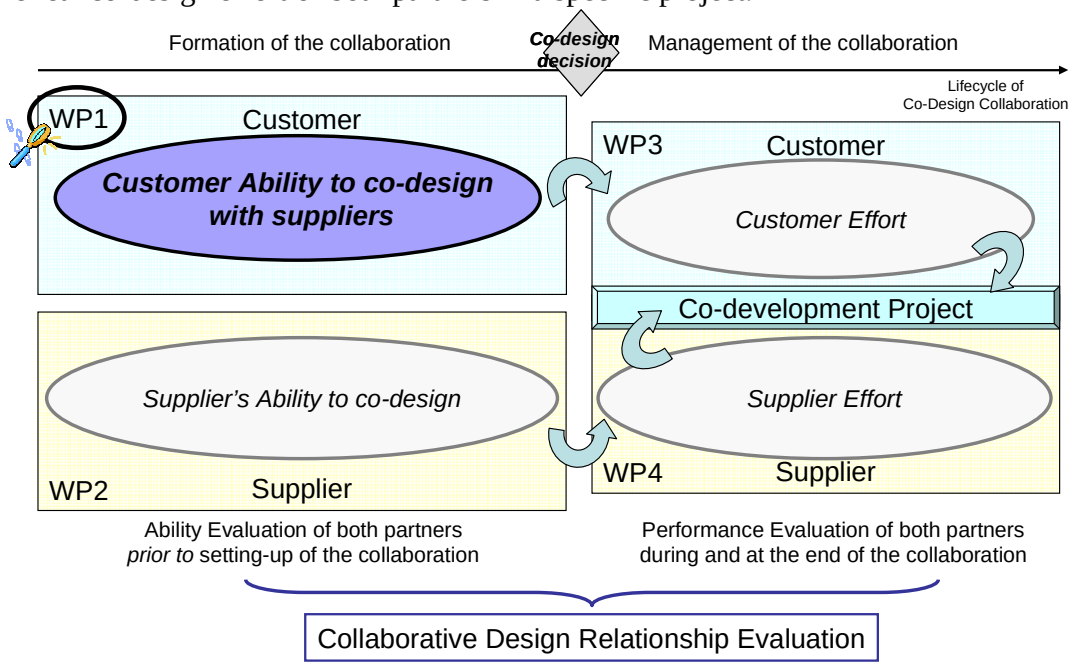

Figure 1: The PRAXIS Research Project

This question of how to evaluate the collaborative design relationship is all the more important since our primary interest in the PRAXIS project is not the relationship between OEM (Original Equipment Manufacturer) and first tier suppliers, contrary to the majority of research focus on co-design practices. The industrial partners of the project are mostly firms which, up until now, have retained control of all the design activities of their NPD projects. Their supply networks are composed of SMEs with poor experience and/or limited resources within design activity. In this context, our assumption is that all the "working packages" (Figure 1) are highly relevant for leading successful collaborative design relationships.

Thus, this paper is part of the PRAXIS research project and focuses on the foundation of Work Package 1. The main findings presented here are outcomes of an action research conducted within the Schneider Electric Company which is one of the partners of the PRAXIS project.

3. Research methodology

In January 2006, the Schneider Electric Company[2] launched the Tango project for the worldwide unification of methods and tools to facilitate and improve *key* and *challenger*[3] supplier involvement in product development. A senior researcher joined the Tango project team on a full-time basis to handle, in particular, development of methods and associated tools concerning the four Work Packages presented in Figure 1. In addition, a *mirror group* including the representatives of all the skills involved in product development was allocated to the Tango project. This included Purchasing, Electro Mechanic Design, Electronic Design, Soft Design, Industrialization, Project Quality, and Project Management.

In our research project, the goal is to build *generic actionable knowledge,* i.e. knowledge taking the form of generic propositional statements and/or principles which are mutually consistent for both researchers and practitioners (Avenier, 2007). For practitioners, this knowledge must be actionable in a concrete setting and for researchers it should be recognized as legitimate academic knowledge (Argyris, 1993). To meet theses objectives, we adopted an action research approach based on longstanding interactions between researchers and practitioners for the co-construction of local knowledge which can finally serve to build *generic actionable knowledge.*

3.1. Presentation of Schneider Electric's Tango Project

As *local actionable knowledge* (Avenier, 2007), with the Schneider-Electric Tango team, we co-constructed a collaborative design with a supplier road map (Figure 2) following the joint customer-supplier evaluation approach suggested by Lamming et al. (1996) through their RAP model.

The Tango Offer includes five key processes. For each process, methods and associated tools are proposed. They are described in greater detail as follows:

- *Design or Buy Design Decision (DoBD)*

The project team must make a decision about whether to transfer to suppliers the responsibility of concept design and/or engineering activities of the components, sub-assembly, parts, etc. Two tools are proposed to help the project team in this DoBD decision process:

- The *Supplier Involvement Matrix* (Calvi and Le Dain, 2003) enables identification of the type of relationship management needed for each product that the project team

wishes to contract out at the end of the DoBD decision process, and as a result the determination of whether such collaboration would be feasible or not. This decision is based firstly (a) on the supplier market and the ability of its players to hold the required responsibility for design, and (b) on the induced purchasing situation (buyer-supplier dependence). If the latter is considered as too risky, the project team should in-house the design according to the skills availability.

– *Schneider-Electric's Self-Evaluation of its ability to co-design with suppliers* enables the identification of the project team's strengths and weaknesses in collaborative design and then provides the definition of the improvement measures to implement in order to effectively lead the collaboration process.

- *Supplier Selection*

The supplier selection process within a collaborative design project covers the phase of potential supplier selection with regards to their expected innovative capacities and the phase of the final choice among these suitable suppliers. The proposed tools supporting both these activities are the following:

– The *design SAM* (Supplier Approval Module) audit enables evaluation of the supplier company's capabilities to design products, integrating its know-how and resources into New Product Development projects implemented by Schneider Electric. According to the results of this audit, the supplier will be retained or not as part of the Schneider Electric innovative-key suppliers' panel.

– A *co-design supplier selection grid* for the final choice of the suppliers. The criteria proposed in the grid enable the comparison of pre-selected suppliers thanks to their responses to the Request for Quotations and their ability to meet specific project needs.

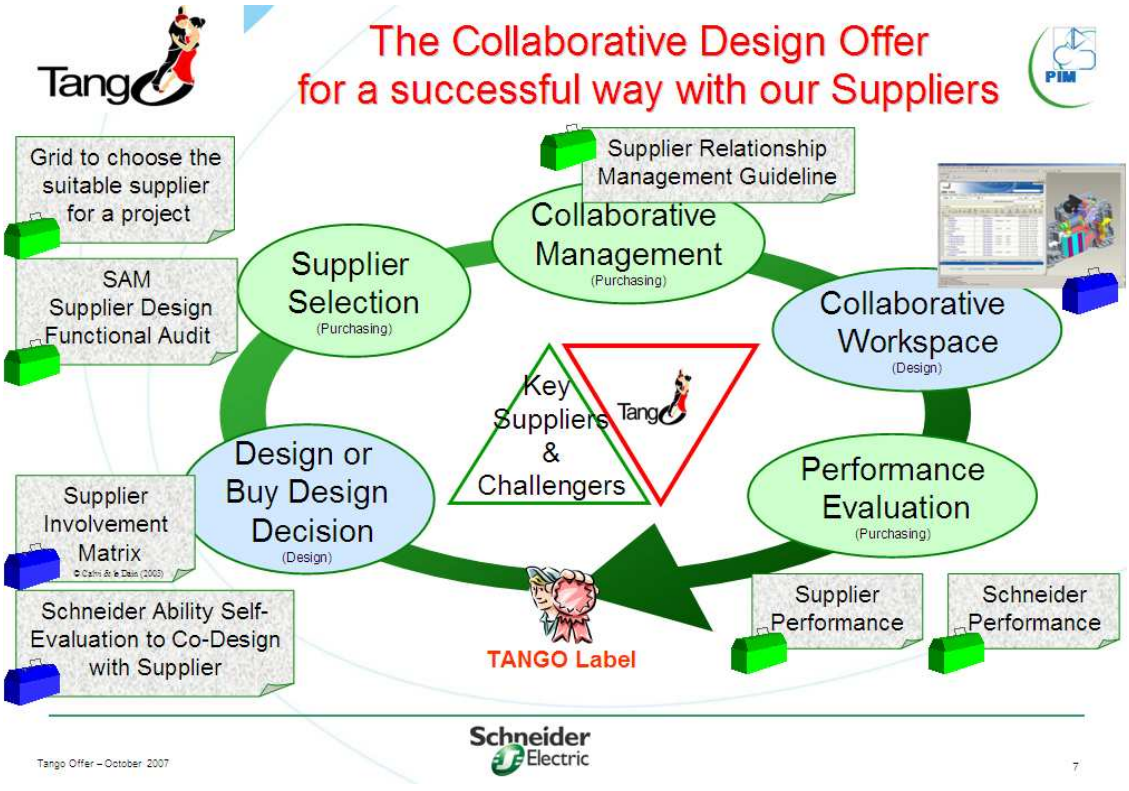

Figure 2: Schneider Electric's "Tango", a Collaborative Design Offer with Suppliers

- *Collaborative Management*

A set of guidelines on configuring the supplier relationship and on defining the coordination modes to set-up with supplier are available to support the process of supplier involvement in the NPDP. The proposed recommendations are adapted to each type of collaboration identified in the Supplier Involvement Matrix.

- *Collaborative Workspace*

Schneider Electric gives access to a secured collaborative workspace in order to exchange, share and manage information and files needed for a collaborative design with suppliers.

- *Performance Evaluation*

Performance of the relationship in the collaborative design project is determined according to the results of the following evaluations:

– The supplier performance evaluation which is performed by the project team throughout the project,

– The Schneider Electric evaluation performed by the supplier throughout the project.

Both these evaluations serve as a basis for defining the continuous improvement strategy needed within the two organizations - the supplier and Schneider-Electric project team - to guarantee the success of future collaborations.

3.2. "Genericization[4]" Process in PRAXIS Project: Application to the self-assessment audit tool

The self-assessment audit tool presented in this paper was primarily built with the collaboration of Schneider Electric and then discussed in workshops with the other PRAXIS industrial partners as explained below. The research is designed in three phases which are described below:

- Phase 1: Prototype Tool Creation

We carried out 50 interviews with Project Leaders for purchasing, design, quality and industrialization as well as Project Managers from Schneider Electric in order to analyze Schneider Electric practices and to understand their needs and to explore collaborative design difficulties experienced with their suppliers. Drawing from a literature review (Fraser et al., 2003, Echtelt, 2004, Wagner et al., 2006), and findings gained from these interviews we devised a preliminary proposition adopting a *grounded theory* approach (Strauss and Corbin, 1998, p 56) where "*the researcher begins with an area of study and allows the theory to emerge from data*".

- Phase 2: Pilot Tool Development

The prototype tool was discussed during workshop sessions with the *mirror group* at Schneider Electric. Their remarks were taken into account for the elaboration of the pilot tool presented in this paper.

- Phase 3: Generic Tool Validation

The remaining step in the research is the validation of the tool, which must be applied in a real-life setting within numerous project teams from each PRAXIS industrial partner in order to continuously improve its *usability*, and to verify its *completeness* and its *usefulness*. These three criteria are usually applied in similar managerial action research

in order to validate an assessment tool (Probert et al., 2000, Neely et al., 1996, Fraser et al., 2003, Moultrie et al., 2007). A questionnaire exploring these three criteria will be completed by each participant. A researcher will be present at each workshop to incorporate the feedback in order to incrementally improve the tool. The final version of the tool can thus be considered as *generic actionable knowledge i.e.* a meta-model which is (1) co-constructed with practitioners and (2) based on an easy-to-customize framework for each firm.

In this paper, we focus on the engineering work (phases 1 and 2) needed for the creation of the customer's ability assessment tool. The first feedback obtained following an application of the tool with a project team from Bosch Rexroth Fluidtech (phase 3) is then presented.

4. Development of the audit tool

The developed audit tool enables a customer's project team to evaluate its ability to co-design with suppliers in new product development projects. The objectives of this evaluation are twofold: First, at the beginning of the project, identifying the team's strength and weaknesses in collaborative design and then, defining the improvement measures to implement. This tool can be considered as a key element in risk management within extended NPD projects.

Our proposition is based on the maturity grid approach. More particularly, we draw inspiration from the application performed by Fraser et al. (2003) to audit the *collaborative maturity* in NPDP, as well as from the process capability and maturity models of CMMI[5] applied at Schneider Electric's Development Centers. When developing a maturity grid, two items have been specified: key "process areas" (with key points being examined for each of these activities) and maturity levels.

4.1. Key process areas important to successful Early Supplier Involvement in product development

Maturity models focus on improving key process areas in an organization by evaluating the level to which these processes are mastered. The studied organization is the project team in interface with the supplier[6]. The proposed process areas and their associated key points have been identified from literature and after validated by the practitioners of Schneider Electric as relevant to a successful Early Supplier Involvement in an NPD project. We chose these key process areas according to the *lifecycle of partnership model* proposed by Farrukh et al. (2003). This model allows the mapping of issues that are likely to arise at the different phases of the collaborative relationship, i.e. *preparation*, *formation*, *management*, *evolution* and *conclusion* phases. We thus defined six key process areas that take place in the following way within these five phases of the collaborative design relationship. For each process area, we present the key points used to develop the audit tool.

<u>Preparation phase</u>

(1) Supplier Involvement Value-Added Perception

While the concept and design engineering phases of NPD make up a relatively small part of total product development costs, both these activities lock in around 80 percent of the total product cost. Thus, decisions made early in the design process have a significant impact on the resulting product quality, development time and cost (Handfield et al.,

1999). Within collaborative design with suppliers, it is crucial to involve "*on time*"[7] suppliers during theses phases in order to benefit from their know-how and their technical knowledge within the decision process. The project team must understand (a) the interest and associated risks of an early integration and (b) its impact on the project's objectives. Thus, the project team members are audited concerning their perceptions of supplier involvement added value through both issues.

(2) Design or Buy Design Decision

In a context of extended design, the boundary of the *Make or Buy Decision* is not only limited to manufacturing activities but is also expanded to concept and/or product design and/or industrialization activities of the outsourced product. We label this decision as *Design or Buy Design Decision*. As Petroni and Panciroli (2002, p147) highlighted in their empirical study: this decision is critical because "*by choosing inappropriate levels of responsibility for suppliers, a customer may waste resources, urge suppliers to design highly customized parts when "off-the-shelf" parts are available and, most important, require suppliers to play a role that is beyond the scope that their technological base and competencies would allow*".

This decision has to be a systematic cross-functional decision (Echtelt, 2004) based on (a) the executive core competency vision, (b) the in-house skill's availability, (c) the degree of responsibility that the customer wishes to grant the supplier for the outsourced-product development (Wynstra and Ten Pierick, 2000), (d) the related collaborative development risk (Wynstra and Ten Pierick, 2000, Calvi and Le Dain, 2003), (e) the product architecture vision enabling a well-defined module with clear and simple interfaces (Fraser et al., 2003), and finally (f) a supplier market analysis. The systematic deployment of this decision process is one of the issues examined within this process area.

<u>Formation phase</u>

(3) Supplier Selection

The partner selection process in the formation stages of collaborative NPD is considered as a crucial topic whereas it is a neglected topic in the literature (Wynstra et al., 2003, Bidault et al., 1998, Goffin et al., 2006; Emden et al., 2006). Schiele (2006, p 928) highlights that "*selecting suppliers with a requirement for innovation has to follow different criteria that the selection of such suppliers whose product is only differentiated by its costs […] choosing suppliers who contribute to the process of innovation is largely left to intuition or good luck but is no result of systematic analysis and planning*". In addition, Wynstra and Van Stekelenborg (1996) or Culley et al. (1999) show that lists of approved suppliers may not necessary represent the most appropriate suppliers from the perspective of engineering designers. Choosing suitable suppliers in collaborative design to create synergistic value requires a professionalization of the supplier selection process. Thus, the project team's members are audited on the following three practices concerning the supplier selection: (a) the different members of the customer project team (designers, purchasing, project quality, industrialization...) should jointly define the background expected in the relationship (scope of technological base and competencies in terms of design, testing and manufacturing expected of the supplier, moment of the supplier's integration in NPDP, working conditions which must be respected by both the customer and the supplier in the project, identification of the most relevant selection criteria according to the project team's needs...) and must share it with the different pre-selected

suppliers, (b) suppliers should be selected on the basis of a broad assessment including their technical skills, their organizational skills (project management, knowledge management and learning training...), and their strategic orientation (development of an innovations strategy with their targeted customers, motivation and goal congruence) in the product development area (Ellram, 1990, Emden et al., 2006, Petroni and Panciroli, 2002). Finally (c) a risk assessment must be carried out in order to identify and manage the technical and commercial risks inherent to the NPD project (Fraser et al., 2003).

(4) Getting started in Co-Design

Once the supplier has been chosen, it is necessary for the partners to establish the ground rules which will be implemented within the collaboration (Calvi and Le Dain, 2003, Fraser et al., 2003), i.e. (a) a clear definition of the goals, roles, responsibilities and accountability of each partner (customer and supplier) with an effective communication of these expectations to both project teams, and (b) a joint identification and negotiation about the issues to be included in the contract (confidentiality agreement, deliverables expected from both the supplier and the customer, intellectual property and patent policies, risk- and gain-sharing, detailed planning,…) which should be seen as a basis for a win-win relationship, open to renegotiation, rather than as a mechanism against mistrust and opportunism. Finally (c) a clear identification of the shared methods and procedures between the members of both project teams to facilitate information and knowledge exchanges, joint decision-making, configuration and modification management. Due to its strong impact on the performance of the relationship, the customer's project team must be convinced by the importance of setting-up such an "*interactive*" interface (Araujo et al., 1999) at the start of the project.

(5) Need Specification

In the context of co-design which involves significant design input from a supplier, the later can "*contribute to the design process by helping customers meet functional requirements, without including excessive specification requirements that lead to unproductive additional costs*" (Humphreys et al., 2007, p44). Thus, two key points are examined concerning the audit of developing specifications: (a) to specify a "need" rather than "a solution" in order to fully benefit from the supplier's expertise in design, and (b) to take into account in the upstream phases of an NPD project relevant supplier suggestions and more particularly suggestions which induce an evolution in the customer specifications in order to more closely meet the necessary need.

<u>Day to day management, evolution and conclusion phases</u>

(6) Collaborative Design Relationship Management

This process area refers to the specific competency, which a customer must achieve, in managing a collaborative working relation with suppliers throughout the project. The first one concerns the customer's ability for (a) developing an atmosphere of trust and mutual learning to improve "*collaborative capabilities"* (Fraser et al., 2003). This atmosphere is based on the four following items: (a1) a mutual respect of the confidentiality of the provided information, (a2) a prompt response to all questions and/or requests for further information from the supplier, (a3) an ability to capture any relevant suggestions from the supplier and systematically explain the reasons why a suggestion is not taken into account and finally (a4) the capacity to create a cross-functional relationship at all organizational levels. The second specific competency concerns the customer's ability for (b) jointly evaluating the development performance of each party (the supplier and

customer) throughout the project (Lamming et al., 1996, Le Dain et al., 2008; Johnsen et al., 2008), and (c) capitalising upon past experience and setting-up the improvement program for the benefit of future projects (Echtel, 2004).

4.2. Ability level to co-design with suppliers

As mentioned earlier, the nature of the interface with the supplier in collaborative design is an "*interactive*" one (Araujo et al., 1999). For these authors, this "*interactive*" interface allows an open-ended dialogue based on how the customer and supplier can combine their user and producer knowledge in order to develop specifications together. Bearing this consideration in mind, the customer's project team must be immediately **convinced** by the potential interest of this kind of collaboration for the project and be **able to lead** the supplier involvement process methodically and with professionalism. Thus, for each process area, the ability of the project team to co-design with suppliers is evaluated on the basis of the following two dimensions:

- The *team's open-mindedness* regarding co-design with suppliers: According to Collins Dictionary someone is "*open-mindedness if he is willing to listen to and consider other people's ideas and suggestions"*. The goal here is to determine whether the team understands the benefits of co-designing with suppliers, and hence if it would be willing to collaborate from the earliest phases of the project,
- The *team's capability* to co-design with suppliers: The goal here is to determine whether the project team masters the practices, methods and/or tools needed to build and manage the relationship successfully.

We have constructed a scale of the team's ability combining these two dimensions (Figure3).

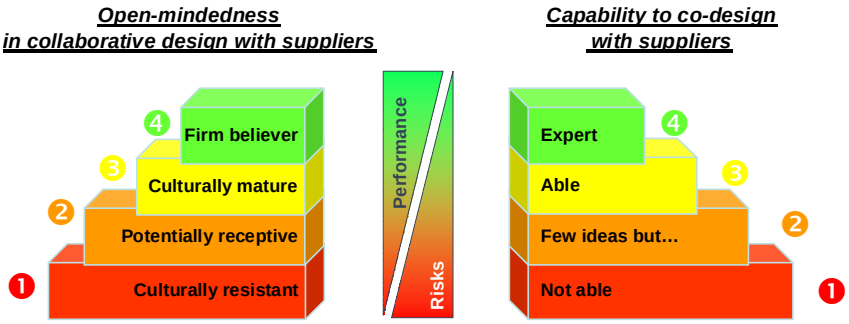

Figure 3: The Open-mindedness and Capability maturity levels of a project team in collaborative design with suppliers

The main message illustrated by the Figure 3 is that to achieve a successful collaborative design relationship (i.e. high performance and low risk), it is necessary to improve both the level of *open-mindedness* and the *capability* level of the project team.

Both these dimensions refer respectively to *goodwill trust* and *competence trust* identified by Sako (1992) as crucial when the supplier has a great deal of input into the customer's design (p149). We argue that the behavior (measured through *open-mindedness* level) and the competency (measured through *capability* level) of the customer's project team play an important part in the gradual building of trust which is considered as a key factor in collaborative design with suppliers (Bidault et al., 1998).

In a prescriptive way, we defined four different improvement measures according to the team's co-design ability levels (Figure 4).

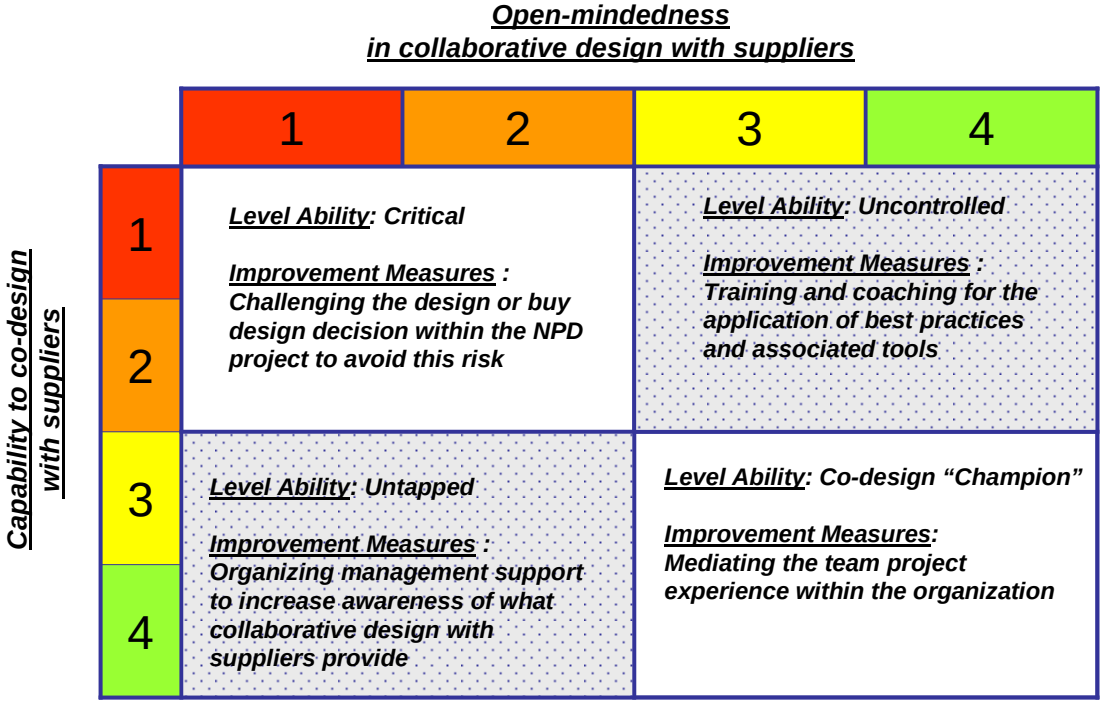

Figure 4: The different improvement measures according to the project team's co-design ability levels

In the "critical" case, the project's team is neither convince nor able to conduct in a fruitful and secure way the collaboration, then the design or buy design decision within the NPD project should be challenged. On the opposite, when both dimensions are high, the customer firm can promote the project's team as co-design" champion" and mediate their experience as a best practice within the whole organization. In the two other cases, the scores of ability are the same but there is an unbalanced level between *open-mindedness* and *capability*. According to us, the measures needed to improve each of these two dimensions are not the same:

- A lack of *open-mindedness* will mainly require management support and communication measures in order to increase awareness of what collaborative design with suppliers provide,

A lack of capability will mainly require training and coaching for the application of best practices and associated tools in order to encourage the use the available co-design process.

4.3. The self-assessment tool

The proposed self-assessment tool covers the six key process areas and contains 21 questions to quantify (scale from 1 to 4) both the levels of open-mindedness and capability.

To meet the required objectives of this audit tool as previously stated, the choice of a self-assessment tool is appropriate according to the definition given by the European Foundation for Quality Management: "*a self-assessment tool allows the organization to*

discern clearly its strengths and areas in which improvements can be made and culminates in planned improvements actions which can be monitored for progress" (Van der Wiele et al., 1995, p.14).

Figure 5 illustrates how the *open-mindedness* and *capability* levels are evaluated for some issues examined within the *Collaborative Design Relationship Management* area.

6. Collaborative Design Relationship Management		
	Audit about the *Open-mindedness* level of the project team	
Issues	*Do you agree with the following statements?* **1** = I do not agree at all, this is totally untrue **2** = I do not completely disagree, I but I am not entirely convinced either **3** = I agree **4** = This is obvious, I am convinced it is true	**Score (1-4)**
….		
(a3) Capturing suggestions from supplier	Customer's project team must not be afflicted by the syndrome NIH consisting in rejecting all externally-invented products.	
(a4) Creating a cross-functional relationship	Discussions and meetings, enabling an exchange of ideas and opinions between the various representative skills in the two project teams, are necessary to the smooth progress of the co-development project.	
etc. ……	**…..**	
	Audit about the *Capability* level of the project team	
Issues	*Is the project team capable of performing the following tasks?* **1** = Incapable, has no idea at all what to do **2** = Has a few ideas, but does not really know what to do **3** = Knows what to do, but cannot do the same thing twice as no formal method **4** = Knows what to do and is capable of doing it again	**Score (1-4)**
…..		
(a3) Capturing suggestions from supplier	Take into account any relevant suggestions from the supplier. Should the supplier's suggestions not be taken into account, systematically explain the reasons to the supplier.	
(a4) Creating a cross-functional relationship	Go beyond the bounds of intra-functional relationships (technico- technical, purchasing-sales, etc.)	
…..	**….**	

Figure 5: Example of detailed grid to evaluate the open-mindedness and the capability for Collaborative Design Relationship Management

A summary of the questionnaire results is proposed as illustrated in Figure 6. This summary overview allows the visualization of the *open-mindedness* level and the *capability level* of each function (project manager, purchasing project leader, technical project leader...) and of the project team as a whole for each process area. The objective of this summary sheet is to support a structured review of the project team, to share knowledge and to identify the strengths, weaknesses, and the areas to improve.

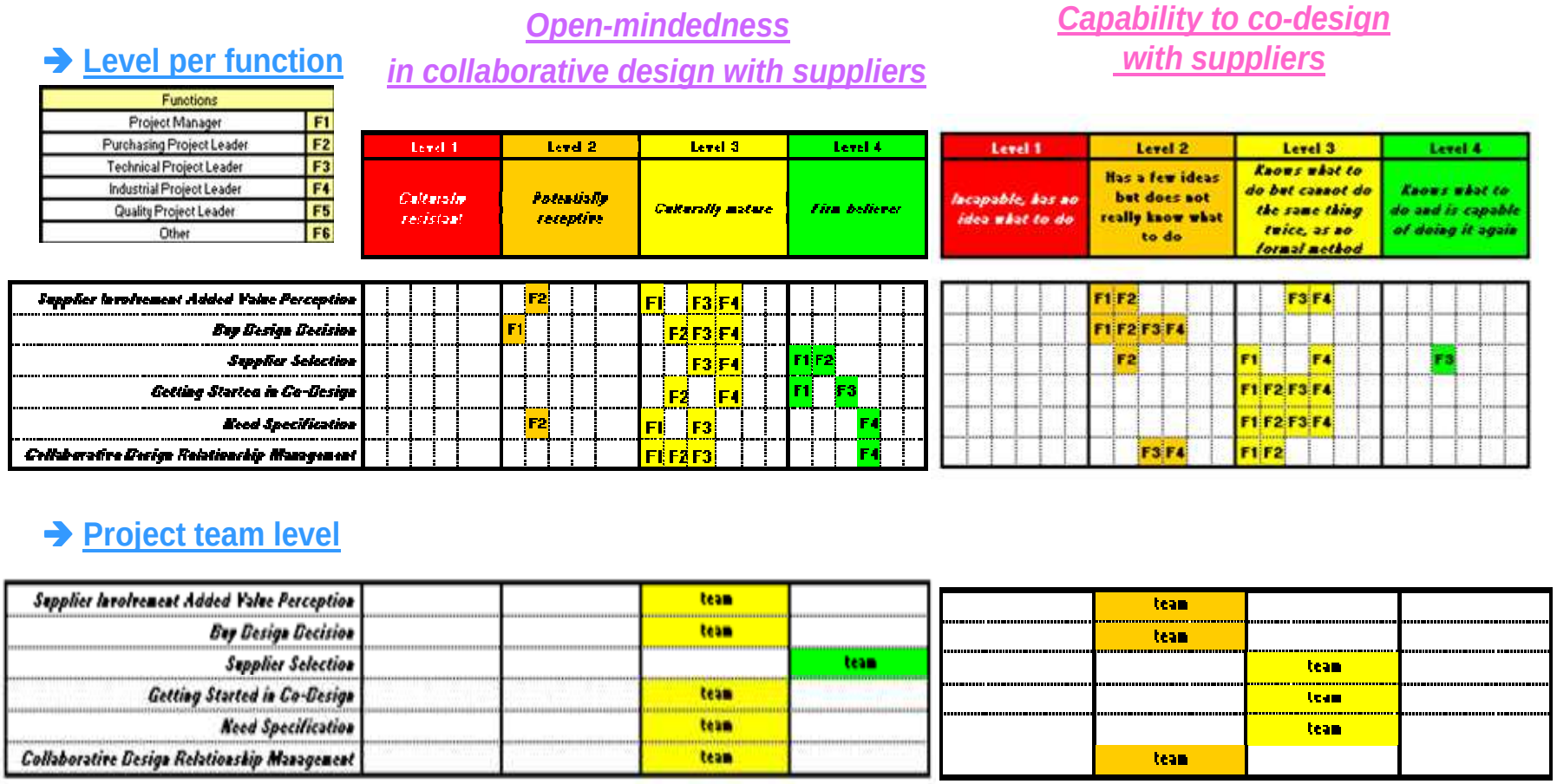

Figure 6: Project team's ability to co-design with supplier – Summary grid

In this non-real example, we can diagnose a global lake of capability for the team, mainly in the upstream phases of the co-design process. The response should be training and coaching in order to secure the concerned activities of the process and so decreased the risk of the collaboration.

5. Audit tool Validation

The self-assessment audit tool was applied in one industrial setting as outlined in the methodology section. A researcher was present and carried out the workshop session in the following way: after an introduction to clarify the aims of this workshop, each participant filled in the self-assessment audit tool and the questionnaire exploring the *usability*, the *completeness* and the *usefulness* of the tool (Probert et al., 2000, Neely et al., 1996, Fraser et al., 2003, Moultrie et al., 2007). Finally, the result of individual responses was presented to open the discussion and to understand the remarks. Modifications were made in response to feedback. The questionnaire feedback is provided in Figure 6 for the Bosch Rexroth Fluidtech case.

Bosch Rexroth Fluidtech (one of our PRAXIS partners) is part of the Robert BOSCH GmbH and is specialized in the Development and the Production of Industrial Pneumatics and Hydraulics. Bosch Rexroth Fluidtech in Bonneville (France) is the worldwide competence centre for pneumatic valves and the lead plant in southern Europe for pneumatic cylinders and customized products and the lead plant for hydraulic cylinders with tie rods.

The audit workshop was carried out involving four people: a project manager and respectively a technical, a purchasing, and a quality project leader. The cross-functional team feedback was generally positive with favorable comments on usability, completeness and usefulness. The summary of the audit results proposed in the tool (Figure 6) provides a quick overview capturing both the individual and the collective positions. This overview generated discussion between the different stakeholders and facilitated the identification of the improvement actions. In addition, the summary results point out a difference of levels between both dimensions: the *capability* level is lower than the *open-mindedness* level. This finding was confirmed by the project team and explained their commitment in the PRAXIS project to acquire methods and tools for improving their supplier involvement in the NPD process.

Moreover, the project team was divided concerning two items of the questionnaire as illustrated in Figure 7: Completeness of the *Need Specification* process area and the usefulness of the tool as a *guide to plan improvement*. A discussion was launched on these two items.

According to the completeness of the *Need Specification* process area, they judged as sufficient the questions about the capability dimension but as incomplete the question about the open-mindedness dimension to gain an overall insight into this topic (Figure 7, completeness – *Need Specification*). Each member of the project team considered the need specification as a crucial activity within the supplier involvement process in NPD but they acknowledged some difficulties in carrying out this activity. These difficulties are primarily due to the lack of expertise regarding some specific delegated technologies but also because they are used to specify solutions rather than requirements.

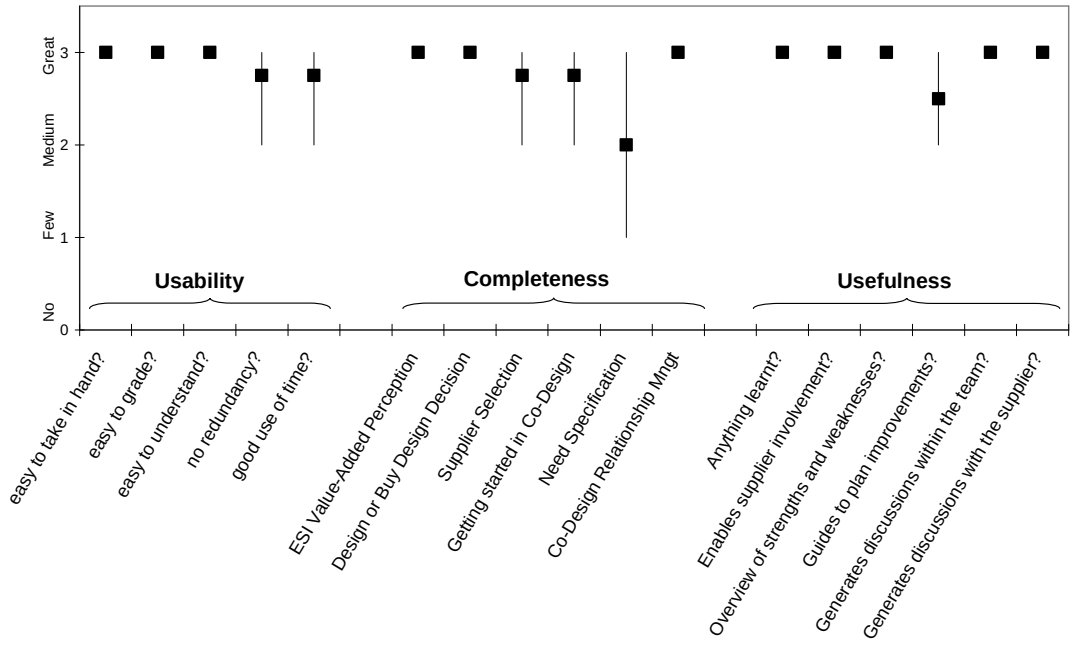

Figure 7: Feedback from the Bosch Rexroth Fluidtech case

In order to reach to a good need specification, the project team proposed adding the following two points to the existing ones: (1) clearly specify all their requirements regarding the supplier's product (functional requirements, industrial requirements, supply chain, schedule, acceptance criteria, environmental standards, etc.) and (2) ensure that the supplier clearly understands all the specifications expected by the customer, after which the supplier could propose the best adapted solution without unproductive additional costs.

According to the usefulness of the tool as a *guide to plan improvement*, the participants pointed out that the audit tool successfully raised awareness of efficient supplier involvement issues and encouraged the participants to take tangible action. They highlighted that for improvement actions depending directly on their own operation perimeters (for example, define a need rather than a solution, identify tangible supplier selection criteria, making decisions in a collective way…), their definition and their implementation were possible. Furthermore, for actions without their project perimeters (Design or Buy Design strategy, training…), they thought that their implementation would not be easier. Indeed, such actions don't flow from the "project" level but mainly from the strategic level.

6. Limitations

The research results have been primarily generated from one longitudinal case study – the Tango project at Schneider Electric. This approach was considered appropriate because a direct integration within a project team was required for two reasons: (1) to identify the key process areas and the associated issues and (2) to test the tools in a real-life setting and to obtain feedback for its improvement when trying to investigate an issue.

The results should nevertheless be carefully interpreted in light of the following limitations.

Firstly, it would be possible to criticize, on the one hand, the choice of only six key process areas to cover the build up and the management of a collaborative design relationship and the other hand, the selection of the process areas and their associated key points.

For the moment, the second limitation of our study is the lack of an application case. Moreover, we are presently carrying out phase 3 (Generic Tool Validation) of our methodology. Some applications of the tool are in progress in real-life settings with project teams of each PRAXIS partner. Ultimately, the audit tool will be applied in six cases, which will be sufficient to validate the framework of the tool and to demonstrate its usefulness.

7. Conclusions and implications

The objective of the PRAXIS project is to contribute to both an academic understanding and an improvement of industrial practices of joint design and development activities involving customer and suppliers. The main contribution of this research is to provide a framework which enables a 'tangible' evaluation of the prerequisites necessary to build up collaboration and to manage the relationship performance throughout the project.

In this paper, an audit tool has been described for self-assessing and further improving the customer firms' organization capabilities regarding relationship management in an extended NPD project. Using an exploratory approach, which included in-depth interviews, academic evidence, and feedback loops, six key process areas, covering the full scope of co-design process were identified. Subsequently, for each process, two dimensions were assessed, respectively *open-mindedness* and *capability*, in order to measure the team's ability to co-design with suppliers.

The implications of this research are twofold. Firstly, from a theoretical standpoint, we contribute to an extension of the message induced by the Resource-Based View[8] (RBV) of the firm (Barney, 1992; Wernerfelt, 1984) in accordance with the new *relational view* advocated by Dyer and Singh (1998). For us, to generate inter-organizational competitive advantage through supplier involvement in NPD projects requires the customer firm to build up and maintain appropriate routines and processes and to work with suppliers possessing complementary competencies in NPD projects. Secondly, the empirical evidence tends to support that in collaborative design the suitable unit of analysis is the relationship rather than the supplier as advocated by the RAP model (Lamming et al., 1996). We provide an operational contribution to this model in the context of extended NPD projects.

From a practical perspective, this tool will serve as a basis for defining the continuous improvement strategy needed to guarantee the success of the collaboration. The findings of this study have implications for both customers and suppliers. The use of this tool should lead a customer firm to evolve from a situation where success is due to a few heroic individuals to a situation where success is widely acknowledged as a core competence of the whole organization. In addition, for the customer project manager, the results of this audit provide a risk assessment for analyzing the set up of such co-design collaborations. If this risk is too critical then the design or buy design decision within the NPD project should be challenged. From the supplier's point of view, the willingness of

the customer to assess his ability to co-design should be considered as a visible sign of *goodwill trust* (Sako, 1992) allowing an investment within the collaboration.

8. Acknowledgements

The authors wish to thank all the partners of the PRAXIS project and more particularly Schneider-Electric for their close cooperation in this work.

9. References

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10. Endnotes

[1]This project is supported by the Business & Innovation Centre of Haute-Savoie (Thésame). It gathers researchers in Engineering Design (G-SCOP – Scientific Manager of the project) and in Management Science (CERAG and OEP Prism), a professional syndicate (Udimec) and 6 French industrial partners (Biomérieux, Bosch RexRoth Fluidtech, Salomon, Schneider Electric, SNR Roulement and Somfy). This project began in January 2006 for 4 years.

[2] Schneider-Electric is the word leader for electricity and automation management.

[3] A *Key supplier* is a globally performing supplier to be actively grown by all Schneider Electric entities. This supplier is a technology leader with favourable performance track record in the group. A *Challenger* is an attractive existing supplier with development potential to become, within 2 years, a future *Key supplier* if proving itself.

[4] *According* to Avenier (2007), this is the process by which generic knowledge is constructed. "*Generic knowledge consists of decontextualized knowledge, which can take on the form of meta-models, principles of action, interpretative typologies… They are not to be considered as rules which apply universally and mechanically. They are to be considered as heuristic guides that need to be contextualized so as to take proper account of the idiosyncratic circumstances of each organisation*".

[5] *CMMI (Capability Maturity Model Integration)* is a process improvement maturity model for the development of products and services. CMMI® for Development, Version 1.2_CMMI-DEV, V1.2, Improving processes for better products, 561 pages, 2006.

[6] The project team is generally composed by upstream purchasing, design, industrialization, quality leaders and project manager.

[7] I.e. not *«too early »* in respect of the supplier's ability to perform the design, but also not *«too late »*, i.e. when there's no more degree of freedom in design definition.

[8] In this initial message of the RBV theory, the differences of firm performances are fundamentally due to heterogeneity on resources and capabilities that are owned in house.