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Early Supplier Involvement in Product Development: How to Assess the Project Team's Ability to Co-Design with Suppliers?

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Abstract

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 the successful product development, particularly through the RAP model (Lamming et al., 1996), as an interaction process between a customer firm and a supplier. We adopt this point of view in our paper aiming to shape the outline of customer's *ability* to co-design with suppliers in New Product Development. We introduce two dimensions to specify this *ability*: *open-mindedness* and *capability*. We propose a tool to assess through both these dimensions the *ability* of a project team to successfully manage the co-development process with the suppliers. Our proposition was built with the collaboration of six French industrial manufacturers, partners of the PRAXIS research project (Performance in Relationships Adapted to eXtended Innovation with Suppliers)

Keywords: New Product Development, Early Supplier Involvement, Maturity grid approach,

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 identified the benefits of ESI in the product development (Bidault et al., 1998, Clark et al., 1991, Handfield et al., 1999). However, such partnerships present 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). We argue that this specific competency must take into account the capacity of both the supplier and the customer to collaborate successfully.

This paper aims to present an audit tool to enable a project team to self-evaluate its ability to co-design with suppliers involved in a New Product Development Project (NPDP). Firstly, we discuss the issue of performance evaluation in the specific context of collaborative design in NPDP. Then the research methodology is described and the Schneider Electric TANGO

project, in which this research took place, is presented. Section 4 describes the framework of the proposed audit tool. 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. Then, we explain both proposed dimensions - *open-mindedness* and *capability* - to specify the project team's ability to co-design with suppliers. Subsequently, the levels for each dimension are given to characterize improvement relative to the set of six process areas. Finally, we present the assessment tool and its potential use by a project team.

2. From supplier evaluation to collaborative relationship evaluation

Several works in literature addressed the issues of how to manage Early Supplier Involvement (Bidault et al., 1998, Handfield et al., 1999, Wynstra et al., 2001) in order to better identify and understand the relevant processes and the enabler factors for the success of such involvement. As Araujo et al. argue (1999), that kind of relationships requires building an "interactive" interface which is always *"an outcome of decisions made on both sides of a dyad"* (p 506). Yet, little amount of researches are focused on the collaborative maturity level (Fraser et al., 2003) and the competency of customer's project team in charge of the formation and the management of the relation with the suppliers involved in NPDP. Furthermore, this notion fits perfectly in the theory of the evaluation of the relation as presented by (Lamming et al., 1996) in their RAP model. For these authors when customer and supplier work together in a collaborative way, the sole evaluation of the supplier is not enough. So it's necessary to assess the contribution of both parties in the exchange to improve the performance of the relationship, This is the starting point of the PRAXIS research project (Figure 1) performed within the French Cluster "*Arve Industries Haute-Savoie Mont Blanc*"[i]. Within this project, methods and associated tools are developed on one hand to assess the ability of both partners – customer and supplier – to co-design (Working Package (WP) 1 and 2 on Figure 1) and on the other hand to evaluate the performance of both partners throughout a product development project (WP2 and 3 on Figure 1). The co-design ability evaluations of both partners are performed prior to the setting-up of the collaboration, and the performance evaluations are performed during and after the collaboration in order to measure the real co-design effort of both partners in a specific project.

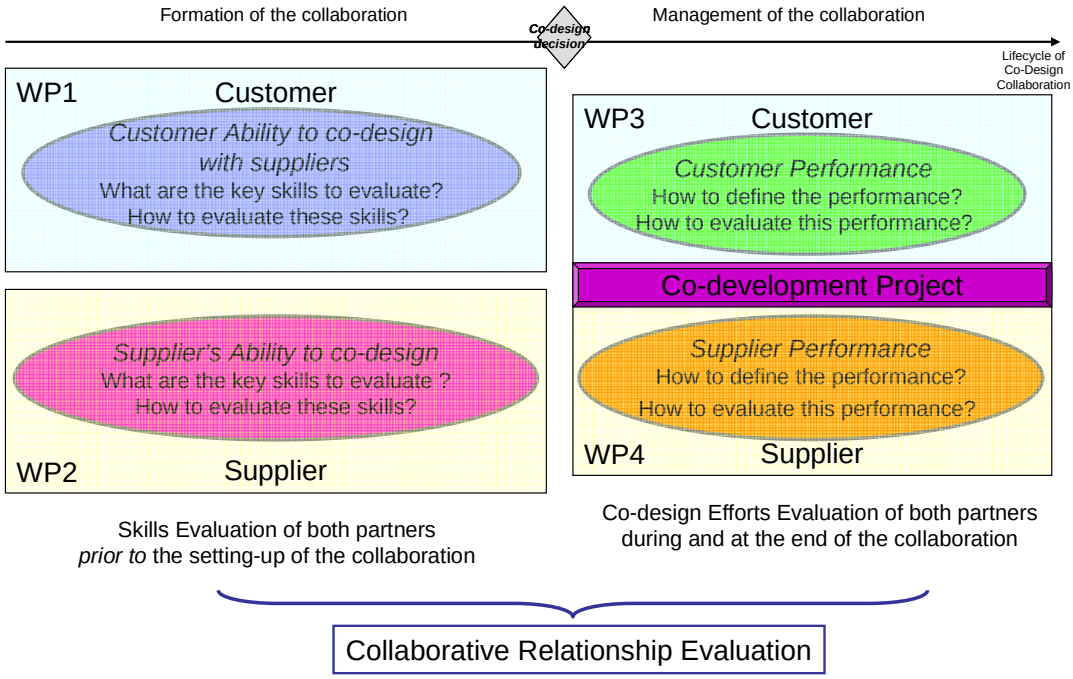

Figure 1: Objectives of the PRAXIS research project

This question is all the more important since our centre of interest in PRAXIS project is not the relationships between OEM and First Tiers suppliers contrary to the most part of researches focus on co design practices. The industrial partners of the project are mostly firms which, until now, integrated all the design activity of their NPDP. Their supply networks are composed of SMEs with poor experience and/or limited resource in 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 a part of this wide research program and it is focused on the foundation of the WP1 of the PRAXIS project. The main findings presented here are outcomes of an action research conducted within Schneider Electric group which is one partner of the PRAXIS project.

3. Research methodology

In January 2006, Schneider Electric[ii] launched a project – the Tango project – for the worldwide unification of methods and tools to facilitate and improve the *key* and *challenger*[iii] suppliers' involvement in product development. Last year, a senior researcher was full time involved into the Tango project team to handle this engineering work. A *mirror group* including the corporate representative skills brought into a NPDP (Purchasing, Electro mechanic Design, Electronic Design, Soft Design, Industrialisation, Project Quality, and Project Management) was allocated to the Tango project.

In this engineering work, our purpose was to build *generic actionable knowledge*, i.e. knowledge taking on 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 concrete setting and for researchers it can be recognised as legitimate academic knowledge (Argyris, 1993). To meet this objective, we adopted an action research approach based on great interactions between researchers and practitioners for the co-construction of local knowledge which can finally serve to build up *generic actionable knowledge*.

3.1. Presentation of the Tango Project of Schneider Electric

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

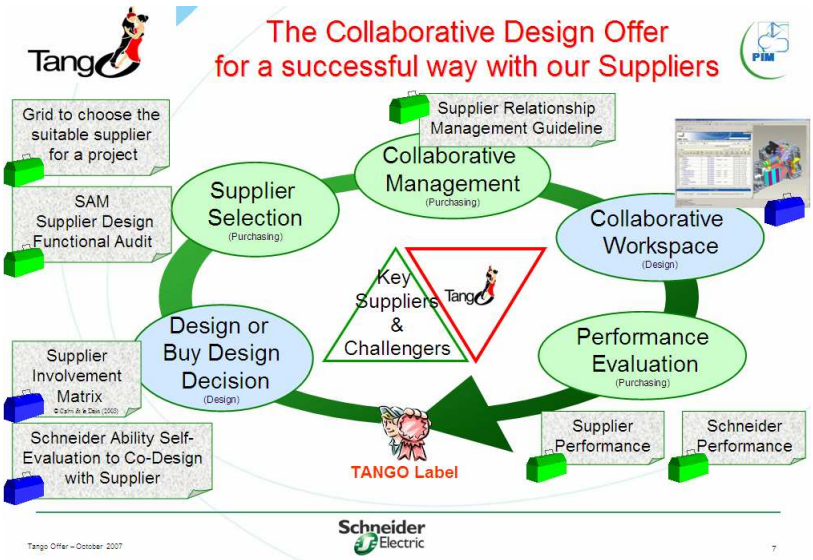

Figure 2: The Tango Offer of Schneider Electric in Collaborative Design with Suppliers

In this road map, we identified five key processes and for each of them we proposed some methods and associated tools:

- ***Design or Buy Design Decision (DoBD)***

The project team must make decision about the transfer to suppliers for the responsibility of the concept design and/or the engineering activities of the products that it wishes to contract out within the project (component, sub-assembly, part ...). Two tools are proposed to help the project team in this DoBD decision process:

- *The Supplier Involvement Matrix* (Calvi and Le Dain, 2003) enables the identification of type of collaboration needed for each of outsourced products and, hence, the determination whether such collaboration would be feasible in view of the supplier market and the skills available in-house.
- *Schneider-Electric Self-Evaluation of its ability to co-design with supplier* enables the identification of the project team's strengths and weaknesses in collaborative design and then the definition of the improvement measures to implement for the success of the collaboration.

- ***Supplier Selection:***

The supplier selection process within a collaborative design project covers the phase of potential suppliers' 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 the 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 result of this audit, the supplier will belong or not to 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 to compare pre-selected suppliers through their response to the Request for Quotations and their through their ability to meet specific project needs.

- ***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***

The performance of the relationship within collaborative design project is defined from the results of both the following evaluations:

- The supplier performance evaluation performed by the project team throughout the project,
- The Schneider Electric evaluation performed by the supplier throughout the project

These evaluations serve as a basis for defining the continuous improvement strategy needed within these two organizations - both the supplier and Schneider-Electric - to guarantee the success of any future collaboration.

3.2. "Genericization[iv]" process in PRAXIS project

The audit tool presented in this paper was primarily build with the collaboration of Schneider Electric (it is one of tools of the *Design or Buy Design* Decision process) and then

discussed in workshop with the other PRAXIS industrial partners as explaining below. The research was conducted over three phases. Each phase is described in greater detail following:

– Phase 1: Prototype Tool Creation

We carried out numerous interviews with project purchasing, technical, quality and industrialisation leaders and project managers from Schneider Electric in order to analyse Schneider Electric practices and to understand their needs and their difficulties in terms of collaborative design 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* including Schneider Electric representative stakeholders. At the same time, workshop meetings with our other PRAXIS industrial partners were conducted. Modifications were made in response to their feedback. Finally, an application of the revised tool was performed with the Schneider Electric *mirror group* to establish its usability and usefulness and to review the using guide. These two criteria are usually used in similar managerial action research (Probert et al., 2000, Neely et al., 1996, Fraser et al., 2003, Moultrie et al., 2007). Their remarks were taken into account for the elaboration of a pilot tool presented in this paper.

– Phase 3: Generic Tool Validation

The tool must be applied in a real-life setting within numerous project teams from each PRAXIS industrial partners to improve its usability and verify its usefulness. A researcher will be present at each workshop to incorporate the feedback into the final version which can be considered as a *generic actionable knowledge i.e.* a meta model which is (1) co construct 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) we carried out to build the customer's ability assessment tool.

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 strengths and weaknesses in collaborative design and then, defining the improvement measures to implement. The results of this evaluation are crucial for the project purchasing leader. Indeed, as he is in charge of the design chain relationships, he has to ensure the quality and reliability of the interactions between both parties throughout the lifecycle of the partnership.

Our proposition is based on maturity grid approach. More particularly, we draw inspiration from the application performed by Fraser et al. (2003) to audit the *collaborative maturity* in NPDP but also from the process capability and maturity models of CMMI^{v} applied in Schneider Electric's Development Centres. In developing maturity grid, two items have been specified: the key activities or "process areas" with the "subheadings" associated to each of these key activities and the maturity levels. The key process areas chosen in our audit tool, the definition given to the notion of *ability to co-design with suppliers* with its associated maturity scale, and a presentation of the assessment tool are described in greater details following:

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

Maturity models focus on improving key process areas in an organisation by evaluating the level to which these processes are mastered. The studied organization is the project team in interface with the supplier[vi]. The proposed process areas and associated subheadings are first identified in literature and after considered by the practitioners of PRAXIS as relevant to a successful Early Supplier Involvement in NPDP. We chose these key process areas according to the collaboration lifecycle 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. Thus, we defined six key process areas that take place in the following way within these five phases of the collaborative design relationship:

<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 the total product development costs, both these activities lock in 80 percent of the total product cost. 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"*[vii] 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 (1) the interest and associated risks of an early integration and (2) its impact on the project's objectives. Thus, the project team members are audited about their perception of the supplier involvement value-added through both these 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 also is expanded to concept and/or product design and/or industrialisation activities of the outsourced product. We label this decision as *Design or Buy Design Decision*.

This decision has to be a systematic cross-functional decision making (Van Echtelt, 2004) based on (1) the executive core competency vision, (2) the skill's availability in house, (3) the degree of responsibility that the customer wish granted to the supplier for the outsourced-product development (Wynstra and Ten Pierick, 2000), (4) the related collaborative development risk (Wynstra and Ten Pierick, 2000, Calvi and Le Dain, 2003), (5) the product architecture vision enabling well-defined module with clear and simple interfaces (Fraser et al., 2003), and finally (6) 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 (Wynstra et al., 2003, Bidault et al., 1998, Goffin et al., 2006). Petroni and Panciroli (2002, pp147) highlighted in their empirical study: "by choosing inappropriate levels of responsibility for suppliers, a customer may waste resources, urge suppliers to design highly customised 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". In addition, Wynstra and Van Stekelenborg (1996) and 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 three following practices concerning the supplier selection : (1) the different members of the customer project team (designers, purchasing, project quality, industrialisation, ...) 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 customer and 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, (2) suppliers should be selected on the basis of a broad assessment including their technical skills, their organisational skills (project management, knowledge management and learning training, ...), and their strategic orientation (development of an innovation's strategy with their targeted customers, motivation and goal congruence) in product development area (Ellram, 1990, Emden et al., 2006, Petroni and Panciroli, 2002) (3) a risk assessment must be carried out in order to identify and manage the technical and commercial risks (Fraser et al., 2003).

(4) *Getting started in Co-Design*

Once the supplier has been chosen, it is necessary to establish between both partners the ground rules to implement within the collaboration (Calvi and Le Dain, 2003, Fraser et al., 2003), i.e. (1) a clear definition of the goals, roles, responsibilities and accountability of each partner (customer and supplier) with an effective communication to both project teams (2) a joint identification and negotiation about the issues to be including in the contract (confidentiality agreement, deliverables expected from both the supplier and the customer, intellectual property and patents policy, 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 (3) 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,… The customer's project team must be convinced by the importance of the setting-up of such "interactive" interface (Araujo et al., 1999) at the start of the project due to its strong impact on the performance of the relationship.

(5) *Need Specification*

The choice of this need specification activity reflects more a synthesis of issues from case study evidence more than literature evidence. In the context of co design which involves significant design input from a supplier, the later can "contribute to the design process by helping customer 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 about developing specifications: (1) customer's willingness to specify a "need" rather than "a solution" in order to fully benefit from the supplier's expertise in design, and (2) customer willingness to ensure that the supplier clearly understands the customer specifications in order that the solution proposed by the supplier enables the "lean" definition of the 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, i.e. (1) developing an atmosphere of trust and mutual learning to improve "*collaborative capabilities*" (Fraser et al., 2003). This atmosphere is based on four following items : (1.a) a

mutual respect of the confidentiality of the provided information, (1.b) a prompt response to all questions and/or requests for further information from the supplier, (1c) an ability to capture any relevant suggestions from the supplier and systematically explain the reasons to the supplier for each suggestion not taken into account, (1d) an easiness to create between both organisations a cross-functional relationship at all levels. (2) jointly evaluating the development performance of each party (the supplier and customer) throughout the project (Lamming et al., 1996, De Toni and Nassimbeni, 2001, Le Dain et al., 2007), and (3) capitalising past experience and setting-up the improvement programme for the benefit of future projects (Bechtel, 2004).

4.2. The two dimensions of ability to co-design with suppliers and the associated maturity scales

As earlier mentioned, the nature of interface with the supplier in collaborative design is an "interactive" one (Araujo et al., 1999). For the authors, this "interactive" interface allows to open-ended dialogue based on how the customer and supplier can combine their knowledge of user and producer in order to develop the specifications together. Bearing this consideration in mind, the project team of the customer must at once be convinced by the potential interest of this kind of collaboration for the project and able to lead the supplier involvement process with professionalism and success. 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: 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 used two dimensions - open-mindedness and capability - to define co-design ability, as the measures needed to improve each of these two dimensions are not the same. Indeed,

- A lack of open-mindedness will mainly require management and communication measures.
- A lack of capability will mainly require training.

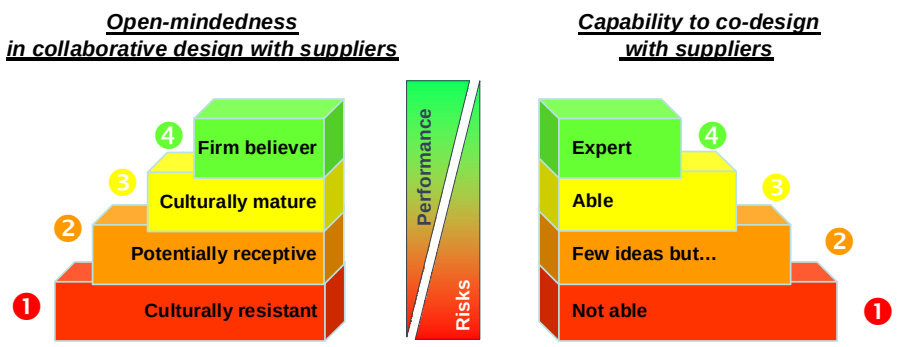

Figure 3: The Open-mindedness and Capability maturity levels of a project team in collaborative design with suppliers

So 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's necessary to improve both the open-mindedness level and the capability level of the project team.

Both these dimensions refer respectively to *goodwill trust* and *competence trust* identified by Sako (1992). We argue that the behaviour (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 considered as a key factors in collaborative design with suppliers (Bidault et al., 1998)

4.3. The self-assessment tool

The proposed tool is a self-assessment tool covering the six key process areas and containing 21 questions to quantify (scale from 1 to 4) both the levels of *open-mindedness* and *capability*. Figure 4 illustrates how the open-mindedness and capability level 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)**
Suggestions from supplier	Customer's project team must not be afflicted by the syndrome NIH consisting in rejecting all externally-invented products.	
Inter-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)**
Suggestions from supplier	Take into account any relevant suggestions from the supplier including suggestions to change customer's specifications in order to more closely meet necessary needs. Should the supplier's suggestions not be taken into account, systematically explain the reasons to the supplier.	
Inter-functional relationship	Go beyond the bounds of intra-functional relationships (technico- technical, purchasing-sales, etc.)	
….	….	

Figure 4: 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 by the figure 5. The objective of this summary sheet is to support a structured review of the project team, to share knowledge and to identify the strengths and weaknesses and the areas to improve.

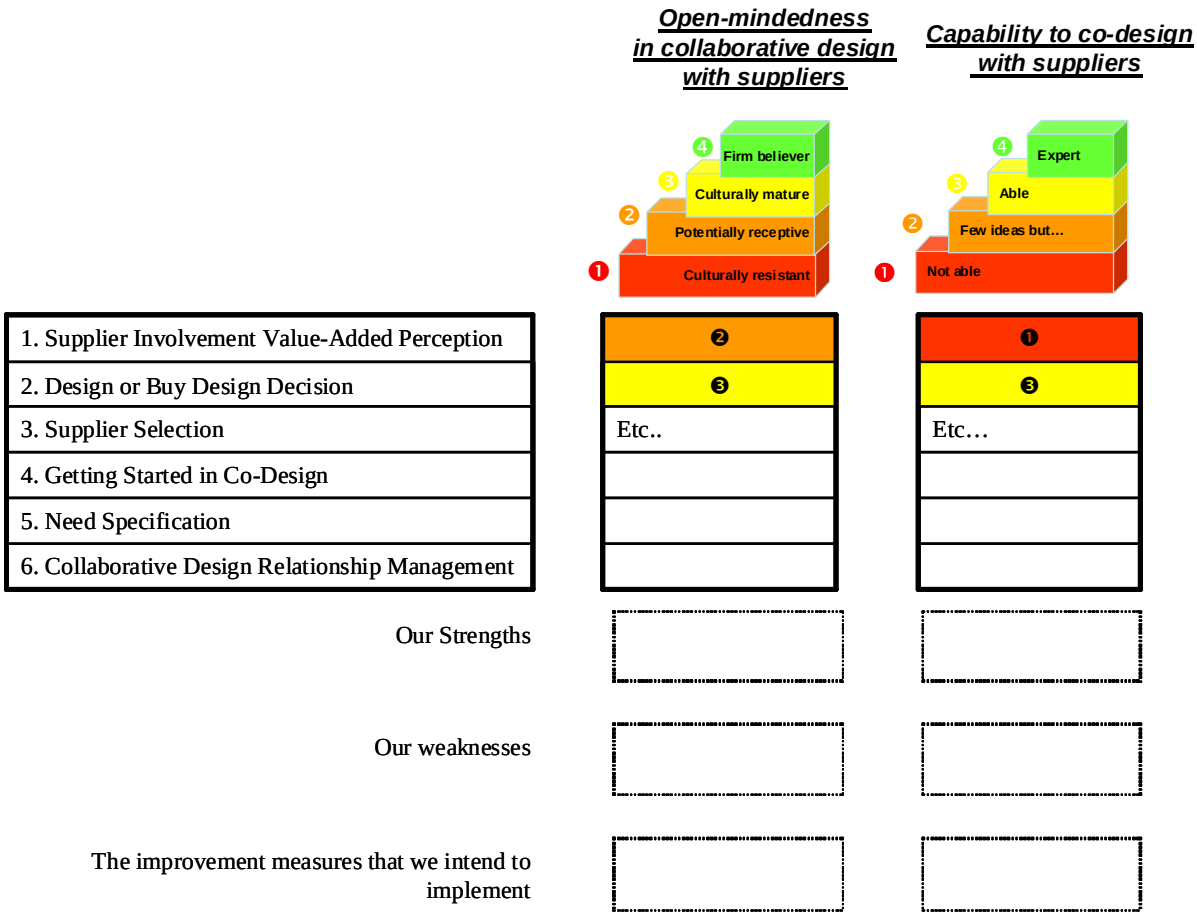

Figure 5: Project team's ability to co-design with supplier grid

5. Conclusion and managerial implication

The objective of the PRAXIS project is to contribute to both an academic improvement understanding and to an improvement of industrial practices of joint design and development activities involving customer and several of its suppliers. This main implication of this research is to provide a framework enables a 'tangible' evaluation of the prerequisite necessary to build up the collaboration and of the relationship performance thoughout the project.

In this paper, the objective was to develop a tool for assessing and further improving the organization's capabilities of the buyer's firm regarding relationship management. Using an interpretative 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 are assessed, respectively *open-mindedness* and *capability*, in order to measure the team's ability to co-design with suppliers. The related maturity tool can have at least two impacts for the client firm: (1) this assessment of the current organization's position regarding to the relationship management is a valuable basis for managers to further advance and improvement.(2) it's also an efficient way to capture the potential know-how of the suppliers because if the project's team ability to co-design is high the latter can presuppose a good promotion of its propositions.

In this way, we hope we have moved from the concepts of co-design to the managerial realities of relationship management in co-design situation.

The research results have been generated by a case study research. This methodological instrument was considered appropriate for the investigation objectives. It was relevant to have interviews with those persons who were directly involved into the co-development projects. A limitation of our study can be found in the single organization approach. Now, the tool must be tested in a real-setting by the project teams of our six other industrial partners of PRAXIS in order to obtain feedback for its improvement of its usability.

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Endnotes

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[i] 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.

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

[iii] 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.

[iv] *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"*.

[v] *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.

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

[vii] 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.