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DEVELOPMENT OF A TOOL FOR SELF-ASSESSING THE PROJECT TEAM'S ABILITY TO CO-DESIGN WITH SUPPLIERS IN NEW PRODUCT DEVELOPMENT

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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 Relationship Assessment Programme (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 at shaping the outline of customer's *ability* to co-design with suppliers in New Product Development (NPD). We introduce two dimensions to specify this *ability*: *Open-mindedness* and *Capability*. We propose a self assessment audit tool based on a maturity grid approach to assess through both these dimensions the *ability* of a project team to successfully set up and manage the co-development process with the suppliers. Our proposition was built up with the collaboration of six French industrial manufacturers, partners of the PRAXIS research project (Performance in Relationships Adapted to eXtended Innovation with Suppliers).

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. Indeed, when a customer would 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; Shiele, 2006). Similarly, it seems relevant to measure the capacity of the customer's project team to build and manage a collaborative relationship with suppliers.

This paper aims to present a self-assessment audit tool enabling a project team to self-evaluate its ability to co-design with suppliers involved in a New Product Development (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, in which this research took place. Then, the research methodology is described underlining the genesis of the pilot tool. The framework of the audit tool is 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. Then, we explain both proposed dimensions - *open-mindedness* and *capability* - to specify the project team's ability to co-design with suppliers. Subsequently, the maturity levels are defined to characterize improvement relative to the set of six process areas. Then, we present the assessment tool and its potential use by a project team. The feedback providing of an application case of the tool is next described in detail. Finally, the limitations and the implications for theory and practice are discussed.

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 influence of the customer's project team competency on the performance of suppliers involvement in NPD projects. Furthermore, this stance fits perfectly in the theory of the 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, the sole evaluation of the supplier is not sufficient. The RAP model departed from the vast majority of vendor assessment models in focusing on the relationship as unit of analysis rather than the sole supplier firm side (Johnsen et al., 2008). Thus, assessing the contribution of both parties in the exchange becomes necessary 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*"ⁱⁱ. Within this project, methods and associated tools are developed on the 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.

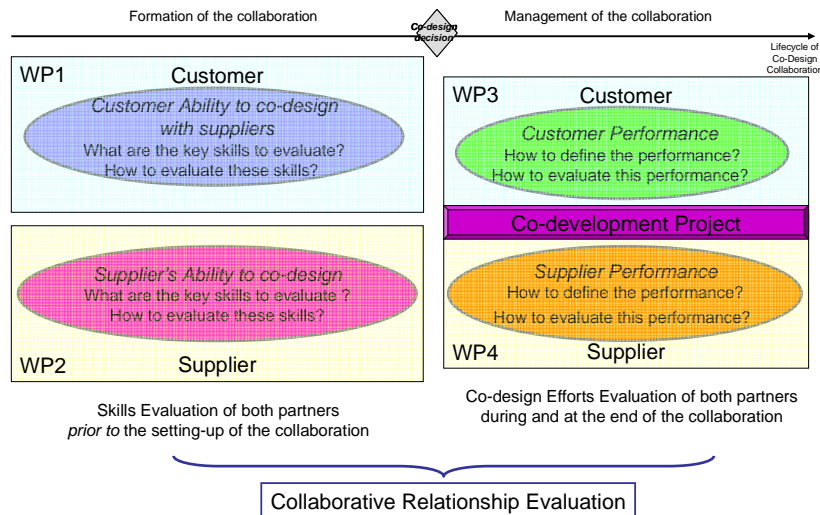


Figure 1: Objectives of the PRAXIS research project

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 focusing on co design practices. The industrial partners of the project are mostly firms which, until now, integrated all the design activity of their NPD project. 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

RESEARCH METHODOLOGY

In January 2006, Schneider Electric Companyⁱⁱ 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 joined the Tango project team full time to handle in particular the development of the methods and associated tools concerning the four WP presented in Figure 1. In addition, 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*.

Presentation of the Tango Project of Schneider Electric

As a *local actionable knowledge* (Avenier, 2007), with Schneider-Electric Tango team, we co-constructed, , 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.

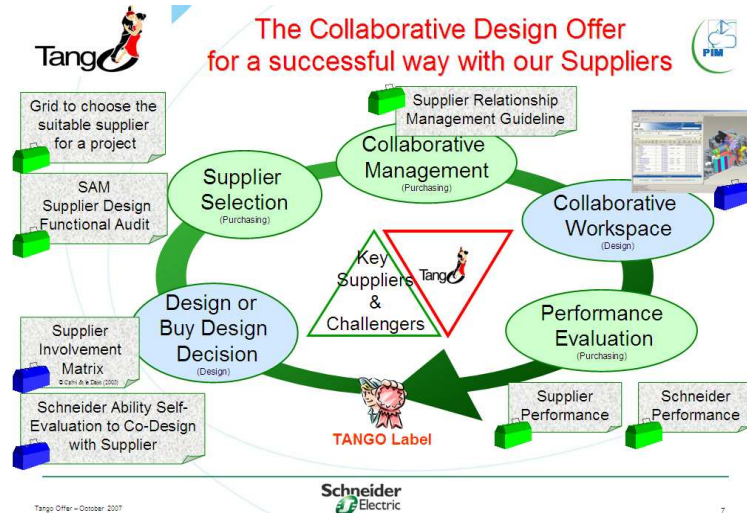


Figure 2: The Tango Offer of Schneider Electric in Collaborative Design with Suppliers

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

- *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 contracted out of 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 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. Hence, the determination 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 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 in order to lead effectively the collaboration process.

- *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 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.

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

“*Genericization^{iv}*” Process in PRAXIS Project

The self-assessment audit tool presented in this paper was primarily build with the collaboration of Schneider Electric and then discussed in workshops with the other PRAXIS industrial partners as explaining below. The research was conducted over three phases described below:

▪ Phase 1: Prototype Tool Creation

We carried out numerous interviews with project purchasing, technical, quality and industrialisation leaders and also 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* of Schneider Electric. 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 provide feedback on the usability, completeness and usefulness of the self-assessment audit tool. These three 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). A questionnaire exploring these three criteria was completed by each participant. A researcher will be present at each workshop to incorporate the feedback as one goes along 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) for the customer's ability assessment tool. A first feedback obtained following an application of the tool with a project team of Bosch Rexroth Fluidtech (phase 3) is then presented.

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 tool for the 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 but also from the process capability and maturity models of CMMI^v applied in Schneider Electric's Development Centres. When developing a maturity grid, two items have been specified: the key activities or "process areas" with the key points examined for 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:

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 their associated key points have been identified from literature and then considered by the practitioners of Schneider Electric as relevant to a successful Early Supplier Involvement in 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. Thus, we 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 define the key points used to build up the audit tool.

Preparation phase

(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 around 80 percents 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*”^{vii} suppliers during these 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 about their perception of the supplier involvement value-added 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 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*. As Petroni and Panciroli (2002, p147) highlighted in their empirical study: that this decision is critical because “*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*”

This decision has to be a systematic cross-functional decision making (Echtelt, 2004) based on (a) the executive core competency vision, (b) the skill’s availability in house, (c) the degree of responsibility that the customer wish granted to 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 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.

Formation phase

(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 literature (Wynstra et al., 2003, Bidault et al., 1998, Goffin et al., 2006; Emden et al., 2006). Schiele (p 928, 2006) 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) 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: (a) 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, (b) 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). 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 to establish between both partners the ground rules to implement 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 to both project teams, and (b) 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. 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... 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 latter 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: (a) customer's willingness to specify a "need" rather than "a solution" in order to fully benefit from the supplier's expertise in design, and (b) customer willingness to take into account into the upstream phases of a NPD project the relevant supplier's suggestions and more particularly the suggestions which induce an evolution of the customer specifications in order to more closely meet the necessary need.

Day to day management, evolution and conclusion phases

(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 ability for (a) developing an atmosphere of trust and mutual learning to improve “*collaborative capabilities*” (Fraser et al., 2003). This atmosphere is based on 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) an easiness to create between both organisations a cross-functional relationship at all levels. The second specific competency concerns the customer 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 past experience and setting-up the improvement programme for the benefit of future projects (Echtel, 2004).

Ability level to co-design with suppliers

As earlier mentioned, the nature of interface with the supplier in collaborative design is an “*interactive*” one (Araujo et al., 1999). For these 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 method. 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 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 and coaching for the application of best practices.

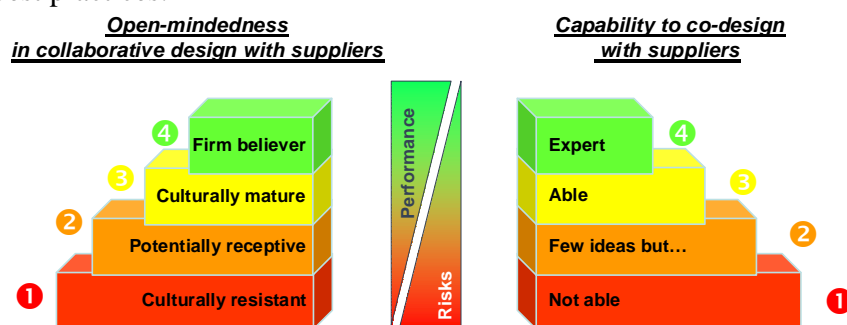


Figure 3: The Open-mindedness and Capability maturity levels of a project team in collaborative design with suppliers

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) as crucial when the supplier has a great input into the customer's design (p149). 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).

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.

To meet the required objectives of this audit tool as previously stated, the choose 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 organisation 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 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 <i>Open-mindedness</i> level of the project team		
<i>Do you agree with the following statements?</i>		
Issues	<p>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</p>	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 <i>Capability</i> level of the project team		
<i>Is the project team capable of performing the following tasks?</i>		
Issues	<p>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</p>	Score (1-4)
Suggestions from supplier	Take into account any relevant suggestions from the. 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. This summary overview allows the visualisation 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 and weaknesses and the areas to improve.

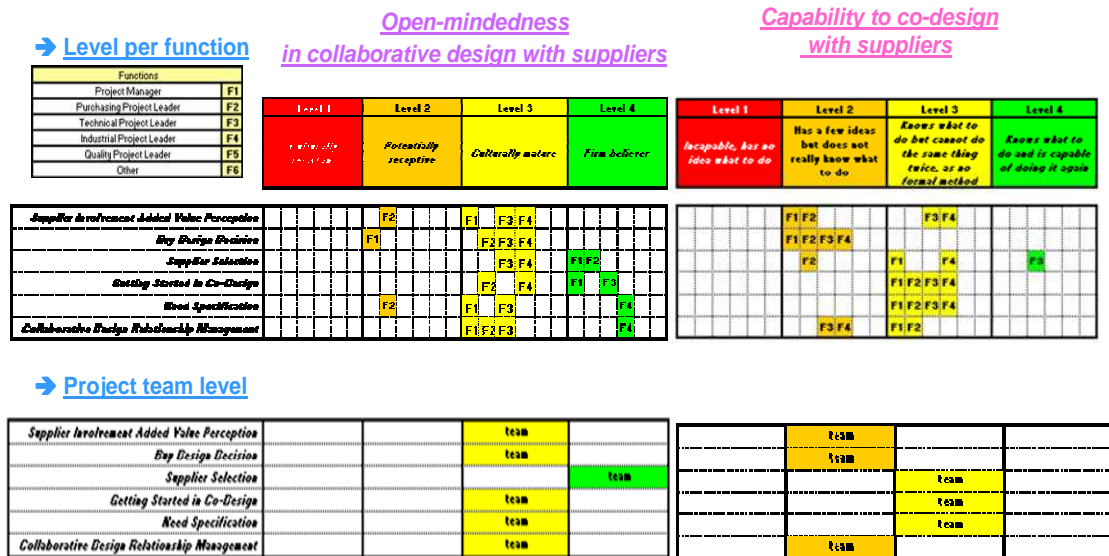


Figure 5: Project team's ability to co-design with supplier – Summary grid

AUDIT TOOL APPLICATION

The self-assessment audit tool was applied in one industrial setting as outlined in the methodology section. A researcher was present in each case and carried out the workshop session in 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. Finally, the result of individual responses was presented to open the discussion and understand their remarks. Modifications were made in response to their feedback. The questionnaire feedback is provided in Figure 6 for 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 Pneumatic and Hydraulic. In this holding, Bosch Rexroth Fluidtech is the worldwide competence centre for pneumatic valves, the Lead plant South of 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 favourable comments on usability, completeness and usefulness. The summary of the audit results proposed in the tool (Figure 5) provides a quick overview capturing of both positioning, the individual and the collective one. This overview generates discussion between the different stakeholders and facilitates 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 down than the *open-mindedness* level. This finding is confirmed by the project team and explains their commitment in the PRAXIS project to acquire methods and tools for improving their supplier involvement in NPD process.

Moreover, project team was divided about two items of the questionnaire as illustrated on Figure 6: Completeness of the *Need Specification* process and the usefulness of the tool to *guide to plan improvements*. A discussion is launch on these two items.

On the last, the participants point out that the audit tool successfully raised awareness of efficient supplier involvement issues and encouraged the participants to take tangible action. They highlight that for improvement actions depending directly on their own operation perimeter (for example, define a need rather than a solution, identify tangible supplier selection criteria, making decision in a collective way...), their definition and their implementation are possible. Furthermore, for actions without their project perimeter (Design or Buy Design strategy, training...), they think that their implementation will not be easier. . Indeed, such actions don't depend on the "project" level but mainly on the strategic level.

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 open-mindedness dimension to gain an overall insight into this topic (Figure 6, completeness – *Need Specification*). Each member of the project team considers the need specification as a crucial activity within the supplier involvement process in NPD but they acknowledge some difficulties to carry out this activity. These difficulties are primarily due to the lack of expertise regarding to some specific delegated technologies but also because they are used to specify solutions rather than requirements.

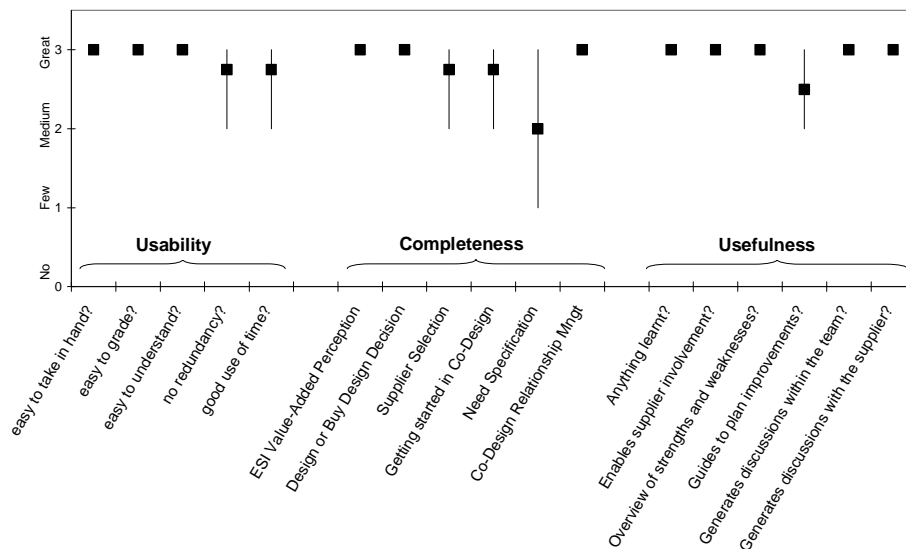


Figure 6: Feedback from Bosch Rexroth Fluidtech case

In order to reach to a good need specification, the project team proposes to add the two following 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 and then the supplier could propose the best adapted solution without unproductive additional costs.

LIMITATIONS

The research results have been primarily generated from one longitudinal case study – Tango project of Schneider Electric. This approach was considered appropriate because a direct integration within a project team was required for two reasons: (1) identifying the key process areas and the associated issues, (2) testing the tools in a real-life setting and to obtain feedback for its improvement when we try 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 design collaborative 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 application case. Moreover, we are carrying out at present the 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 was sufficient to validate the framework of the tool and demonstrate its usefulness.

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 the collaboration and manage the relationship performance throughout the project.

In this paper, an audit tool had been described for self-assessing and further improving the organization’s capabilities of the customer’s firm regarding the relationship management in 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 are 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. From a theoretical standpoint, firstly we contribute to an extension of the message induced by the Resource-Based View^{viii} (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 go up 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 organisation. In addition, for the customer project manager, the results of this audit provide a risk assessment to set up such co-design collaboration. 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 visible sign of *goodwill trust* (Sako, 1992) allowing an investment within the collaboration.

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ENDNOTES

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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.

^{viii} 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.