HOW TO APPRAISE THE BENEFITS OF COLLABORATIVE DESIGN WITH SUPPLIERS? A "GLITCH-BASED" APPROACH

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Abstract

It is now acknowledged that Early Supplier Involvement (ESI) in product development confers a competitive advantage. Thus, ESI benefits on new product performance have been investigated by numerous authors through both in-depth qualitative and large-scale quantitative research methods. However, quantitative measurement of the ESI benefits has been less considered whereas such elements would encourage customer companies and its suppliers to adopt collaborative design. This paper seeks to provide an approach to appraise the ESI value to both the customer and the supplier. The approach proposed is based on the "glitch" concept introduced by (Hoopes and Postrel, 1999). Those authors used this concept to measure the importance of sharing knowledge on product development performance from the opposite direction i.e. by identifying what happens when it is absent. In this respect, identifying "glitch" and its cost is an interesting track to appraise the ESI benefits. In this paper, we propose a "glitch" categorisation according to the lifecycle of the collaboration. This categorisation has been built from the analysis of an in-depth case study relating an unsuccessful collaborative development with a supplier. It may help to identify critical pitfalls that would prevent from reaping the benefits of supplier involvement and to define preventive actions to avoid them.

Keywords: New Product Development (NPD), Early Supplier Involvement (ESI), Collaborative Design, Glitch concept

1. Introduction

Firms in many industries are facing increased competitive pressures and are compelled to consider new strategies. The aim is to compress time between each stage of the value chain (Batchelor, 1997) and to obtain more frequent innovation and higher quality. A means that many companies are adopting to gain competitive advantage is to involve suppliers earlier in the design phases. A large body of research confirmed the positive influence of ESI on performance measured by shorter time to market, improved product quality, and reduced development and product costs (Bidault et al., 1998; Ragatz et al., 1997; Van Echtelt et al., 2008). Nevertheless, when companies are dealing with projects characterised by a high technological uncertainty, contradictory results concerning ESI influence have been published (Johnsen, 2009). In previous researches, the ESI benefits have been mainly analysed as a key explanatory factor of superior or inferior new product performance. The lack of clear monetary advantage of the collaborative design activity with suppliers seems to be a real hindrance for the development of that kind of practices. Indeed, for a lot of industrial actors it is difficult to invest resources in collaborative design with suppliers when real expected benefits are unknown. In addition, gaining experience from these collaborations is important for both the customer and the supplier companies, in order to improve their practices. This way, a lack of measure in the ESI literature is deplored both by industrial and academic actors in order to legitimate ESI practices. From a theoretical point of view, the supplier involvement in the early phases of new product development projects refers to a typical situation of a high ambiguity in the evaluation of the performance. Consistent to the (Ouchi, 1980)'s theory, we can expect that *trust* between partners was the main governance mechanism for that kind of situation. However with the increase of both inter-organisational collaborations and product complexity due to an integration of various technologies during the product's development phases, trust is not enough (Sako, 1992). Furthermore trust has to be acquired and is more intuitive with historical suppliers whereas with non-historical suppliers trust

may not be a sufficient element. Thus, some tangible evidences are necessary to encourage collaborative design effort with suppliers.

The purpose of this paper is to propose an appraisal of ESI benefits in order to reduce the performance measurement ambiguity and aiming at bringing down the resistance to the co-development practices. This proposal leads to wondering how to measure the impact of a *good* inter-organisational collaboration in NPD? In our work, we draw inspiration from the approach adopted by (Hoopes and Postrel; 1999) to measure the importance of shared knowledge on product development performance. Those authors considered that if shared knowledge is important for product development, then we ought to be able to identify what happens when it is absent. Instead of trying to see how the resource contributes positively to performance, they examined how lack of the resource detracts from performance (p845). To operationalize this approach of the problem from an opposite direction, they introduced the concept of *glitch* i.e. "*a costly mistake that could have been avoided if some of the parties involved had understood things that were known by other participants* (p838)". The objectives of the approach adopted to appraise the ESI benefits are twofold: (1) identify various types of dysfunctions (*glitches*) in customer-supplier collaboration for a new product development and, (2) find quantitative elements as regards the cost of those dysfunctions in order to approach the benefits of collaborative design with suppliers.

This article is organised as follows: firstly a literature review focused on ESI is presented. Then, the *glitch* concept used in the proposed approach to appraise the benefits of ESI is introduced. Subsequently, the research method adopted in this paper is described. Then *glitches* encountered during our in-depth study, the associated causes and their costs are exposed. Thereafter, the categorisation of these *glitches* is proposed and discussed with respect to the insights from literature. Finally, conclusions are drawn by discussing its limitations and potential future avenues.

2. State of art on Early Supplier Involvement (ESI) benefits

A substantial body of research focuses on the impact of ESI outcome. In order to know what kind of studies has been carried out concerning ESI, we drew a review of the literature since the beginning of the 90's that focuses on the benefits of ESI on product development. For each paper a work of identification of ESI benefits on product development has been made. Thus, findings related to ESI impact on time, quality, cost, innovation or other points concerning new product development are mentioned. In order to structure our literature review, four categories were distinguished inspired of (Carter et al., 2003). The first category concerns *hypothesis testing* papers which are articles that introduce and then test research hypotheses or propositions (Carter et al., 2003). The second category contains *exploratory studies* that are researches making observations of ESI benefits for the purposes of developing theories but leave the testing of the theories for other studies (Carter et al., 2003; Mentzer and Kahn, 1995). The third category groups *normative studies* and concerns studies where literature might be cited but the point of the inclusion of this literature is to support the opinion/assertions of the author (Carter et al., 2003). The fourth category concerns *comparative studies*. In this category, we have considered studies that compare results coming from various industrial sectors and various geographical areas or comparing relationships with or without collaboration with suppliers. Table 1 presents an overview of this literature review.

			Positive impact of ESI on performance				
Approach	**Number of papers**	**Authors**	**Time**	**Quality**	**Cost**	**Innovation**	**Other positive impact**
Hypothesis testing	11	Hartley et al. (1997)	X				
		Langerak et al. (1997)	X		X		New markets, financial risks sharing
		Takeishi (2001)		X			
		Primo and Amundson (2002)	X	X	X		
		Ragatz et al. (2002)	X	X	X		
		Petroni and Panciroli (2002)	X	X	X	X	Better specifications
		Chung and Kim (2003)	X	X	X		Improvement of market adaptability. Suplier side considered
		Petersen et al. (2005)			X		
		Hoegl and Wagner (2005)	X	X	X		
		Koufteros et al. (2007)		X		X	
		Song and Benedetto (2008)					Gross margin, sales growth
Normative studies	6	Ragatz et al. (1997)	X	X	X	X	
		De Toni and Nassimbeni (2001)	X	X	X	X	Improvement of the supplier motivation
		Zsidisin and Smith (2005)	X	X	X		Supplier technological expertise utilisation
		Fliess and Becker (2006)			X	X	
		Van Echtelt et al. (2008)	X	X	X	X	Strategies alignment, collaborations more efficient and effective
		Johnsen (2009)	X	X	X	X	
Explorative studies	12	Bonaccorsi and Lipparini (1994)	X	X	X		Technical strategies alignment
		Bozdogan et al. (1998)	X	X	X	X	Organisational innovation and risks reduction
		Wynstra (1998)	X	X	X	X	Technical strategies alignment
		Handfield et al. (1999)		X	X	X	
		Veloso and Fixson (2001)				X	
		Von Corswant and Tunälv (2002)	X	X	X	X	Risks sharing, access to ressources and new technologies
		Goffin et al. (2006)		X	X		
		Wagner and Hoegl (2006)	X	X	X		New skills, risk sharing, new market
		Handfield and Lawson (2007)		X	X		
		Lyu and Chang (2007)	X		X		
		Sushandoyo et al. (2010)					Competitive positions and competences improvement
		Weber and Camuffo (2010)	X	X	X	X	
Comparative study	4	Clark and Fujimoto (1991)	X	X	X		
		Monczka et al. (1997)	X	X	X	X	
		Garel (1999), quantitative elements	X	X	X	X	Supplier side considered
		Dyer (2000), quantitative elements	X		X		

Table 1: ESI benefits studies (literature review)

From this analysis of literature on ESI benefits studies (Table 1), the following points can be deduced:

- The most mentioned ESI benefits are development time reduction, development costs reduction, quality improvement and innovation improvement. Some authors considered other benefits such as technical strategies alignment (Bonaccorsi and Lipparini, 1994; Wynstra, 1998), market and risks sharing (Langerak et al., 1997), accessibility to new skills (Wagner and Hoegl, 2006) or improvement of the supplier motivation (De Toni and Nassimbeni, 2001).
- In the hypothesis testing, normative studies and explorative studies categories, there are no studies that propose quantitative elements concerning ESI benefits. Only comparative studies provide some clues to this topic.
- Few comparative studies have been observed. Among those studies, only two mentioned quantitative elements. The first one is the Garel's (1999) study. This study compares two projects of an automotive maker, one with supplier collaboration and another without, and measure the economy induced, at different stages of the project, by this collaboration considering both the customer side and the supplier side. Such comparative analysis of two development projects and with some quantitative elements concerning benefits both for the customer and the supplier seems to be unusual. Dyer's study compares Chrysler's projects with or without supplier involvement. Those studies are comparative studies hard to set up, linked to a specific project and characterized by specific field conditions. Thus results may be hard to generalise. Clark et al. (1991) and Monczka et al. (1997)'s studies compare different countries results.

- Benefits or impact for suppliers is scarcely considered. (Chung and Kim; 2003) take into account supplier's benefits with for instance a market risk reduction. Garel (1999) also considers this aspect.
- Moreover, literature contains contradictory results (Hoegl and Wagner, 2005). Some studies show a positive impact of supplier involvement on project performance such as for instance concerning development time reduction, quality improvement, costs reduction, innovation improvement (Bidault et al., 1998; Ragatz et al., 1997; Van Echtelt et al., 2008) or product value improvement (Wynstra, 1998), other no relationship and still others a negative impact (Eisenhardt and Tabrizi, 1995, Wynstra, 1998). Literature also shows some possible risks caused by ESI such as a decrease of the customer's influence on the supplier or know-how diffusion. Therefore, despite of the obvious benefits of supplier involvement in new product development, research remains fragmented (Johnsen, 2009).

This literature review shows the need to have a quantitative measure and necessary actions to implement in order to legitimate and to reach those benefits. The aim is to convince actors of the necessity of this practice.

3. Glitch-based approach

(Hoopes and Postrel, 1999) introduced the *glitch* notion. *Glitches* are defined as "*an unsatisfactory result on a multi-agent project that is directly caused or allowed by a lack of inter-functional or inter-specialty knowledge about problem constraint*" (p843). Three requirements have to be verified for a *glitch* to be declared on a project: (1) more than one functional or product group was involved; (2) multiple interviewees suggested that the result of the project, or some aspect of it, had been unsatisfactory; (3) the unsatisfactory result could have been avoided using the knowledge of one of the participating group.

As explained at the beginning of this paper, (Hoopes and Postrel, 1999) used this concept in order to approach the influence of sharing knowledge on product development because this notion was hard to quantify. A two years study near 250 people of a firm that develops and sends cutting-edge scientific modeling and simulation software was carried out in an intra-organisational context. As (Hoopes and Postrel, 1999) encountered the difficulty to control and know what the common knowledge is shared and that some knowledge models are hard to quantify, they chose to approach the issue from the opposite direction. Therefore instead of trying to see how resources contribute to the performance, the authors decided to examine how the lack of those resources detracts from performance. Nevertheless, they noticed that each *glitch* depends on a sharing knowledge problem but all differences in sharing knowledge are not a *glitch* cause. To summarize, their idea is to consider that if shared knowledge is important for product development, then we ought to be able to identify what happens when it is absent. Identifying a *glitch* and its costs enables to evaluate the marginal benefit of knowledge integration mechanisms (actions that may have prevented a *glitch*). In their research work, (Hoopes and Postrel, 1999) specify that their aim is not identifying *glitches* but determining how much they are important quantitatively. They speak about making an estimation of the *glitch* cost. An important indicator is lost work-months (unused or additional work). In addition there are customer complaints and problems or release delays. Thus one can attach a value to a mistake: the cost in terms of wasted work or over-runs (Hoopes, 2001).

Our research subject aims at appraising the benefits of customer-supplier

collaboration in product development. Similarly to the quantification of sharing knowledge importance of (Hoopes and Postrel, 1999), the quantification of the supplier involvement importance in new product development is tricky to tackle. Thus, we have chosen to adopt their approach by trying to quantify how much *glitches* in the customer-supplier relation studied cost.

4. Research methodology: in-depth case study

This paper explores an unsuccessful collaborative development between a customer and a supplier. Yin (1994) stated that when investigating events that may have little or no theoretical background, the researcher may select an exemplary case that provides the best example of a phenomenon. The case study selected in this paper meets this criterion. The customer was willing to charge suppliers with more responsibilities in the design on technologies that are not in its core competencies (not included into internal resources). But the first experience of collaborative design with a supplier was judged as unsuccessful by both partners. Thus the customer expressed the need of understanding the reasons of this failure. This analysis aimed at preventing from a deadlock concerning internal actors (R&D engineers, technical and purchasing actors) and suppliers in the implementation of this practice due to this bad past experience. This research is designed to enable a longitudinal case study which provides a single setting with a large observation over an extended period of time (Yin, 1994). The unfolding events play an important role in building explanations (Pettigrew, 1973). Furthermore, case studies are appropriate for analysing complex mechanisms (Yin, 1994; Huberman et al., 2002). Therefore, case study research was regarded as an adequate method to gain information and to identify relevant problems in collaborative development. The unit of analysis adopted in this research is the co-development project carried out between a customer and a supplier. The customer is a French company considered as a global market leader for roller shutter motorisation. This company has a strong tradition of external growth with multiple acquisitions and considers innovation and new product introduction as a major issue in order to maintain its market position. Its main activities are designing and assembling suppliers' parts. Supplier involvement is mostly used for production delegation but less for design delegation. The supplier is the world leader for cable manufacturer industry (for high voltage, energy cables...) and it is an historical supplier for the customer. The collaboration concerned occurred during a new roller shutter motorisation development project. This is a new product developed to compete with Asian market. An *ex post* analysis of this relationship considered as unsuccessful both by the customer and the supplier was carried out. For this project, the customer chose to delegate the development of the external connector. This connector is a specific sub-system that must handle the power supply of the roller shutter motorisation. This sub-system includes the development of a cable and a plug. It is considered as a critical component because it has a considerable impact on the performance. This case acted as "learning history" and was used to stimulate thinking and encourage learning in the project teams (Kleiner et al., 1997). A sequence of events of the studied relationship was built. Through the help of this sequence, a diagnosis has been made in order to better understand this unsuccessful collaboration. The *glitch* concept introduced by Hoopes and Postrel (1999) was used to identify what makes unsuccessfully ESI efforts in this inter-organisational design collaboration. This approach enabled us to list the *glitches* related to the collaboration observed and to categorise them. Numerous interviews were carried out with project purchasing, technical, quality and

industrialisation members and project managers of this project. Each interview lasted about one to two hours. Fifteen interviews were carried out. The case study was conducted at the customer's R&D centre during a seven months in-depth observation. Notwithstanding the supplier's point of view was gathered and its opinion was taken into account.

5. Collaborative glitches observed

At the beginning of the considered project, the customer needed design expertise and intuitively the project team consulted the historical supplier for this technology. Some negative signals were observed before the definitive choice but with the past experience and the amount of trust toward this supplier, the project team minimized them. Nonetheless, as collaboration progressed, those negative signals become more and more harmful. In order to understand what happened concerning the collaborative relationship and to learn from this experience, we built ex post, the sequence of events encountered throughout the lifecycle of the collaboration. From this chronological reconstruction, a diagnosis has been made to identify the costly mistakes due to a failure in the collaborative design, i.e. glitches. Table 2 presents the ten types of glitches observed during our in-depth study.

Glitch	Reasons/causes	Customer / supplier responsibility	Glitch costs
Selected supplier non adapted to the project expectations	Purchasing project manager vs commodity manager vision concerning supplier selection Panel's issues prevailed Lack of internal collaboration Negative signals neglected	Customer	One year of rework
Confusing determination of roles expected by the supplier	Wrong understanding of acceptability criteria New tool of customer long to be used Lack of sharing of determination of roles	Customer	3 months lost
No alignment in expectations	Lack of sharing of mutual expectations, lack of communication and initial meetings	Customer & Supplier	Less innovation than expected
Contractual arrangement hard to build up	Initial contract sent with delay (2 months) Lack of expectation matching No collaborative behaviours Ending of the relationship	Customer	One year of rework
Wrong understanding of needs	Supplier's difficulties as regards English language New way of working between the customer and this supplier	Customer & Supplier	Time necessary for a mutual understanding
Problems for sharing of quality requirements	Breaking off in quality requirements Difficulties of adaptation of the supplier Difficulties of implementation of the customer	Customer & Supplier	Delay in FMEA realisation, issues in qualification plan construction
No joint definition of specifications	Lack of communication between customer and supplier	Customer & Supplier	A delay of 2 months in prototype realisation
Unstable specifications	Customer's change Evolution of expectation	Customer	Rework on specifications changed
Privileged interlocutor hard to identify	Lack of initial determination of communication matrix	Customer & Supplier	First meetings unsuccessful
Verification plan hard to obtain	Lack of communication Problems not communicated by the supplier	Supplier	A delay of 3 months

Table 2: Collaborative Glitches observed during our case study

The ten *glitches* observed, their causes and their costs are described below:

- *Selected supplier non-adapted to the project expectations*: The purchasing project manager vision was not in accordance with the commodity manager vision concerning the supplier selection. As the cable is the most important part in the overall cost, a choice of a cable supplier was privileged. The selected supplier was already in the supplier base for this commodity and it was an historical and trustworthy supplier. The commodity manager has influenced this choice because a development project concerning a manufacturing plant in a low cost country was in course with this supplier. The

project team had carried out an audit to evaluate the ability of the supplier to co-design. The results of this audit pointed out an uncertainty related to the ability to the supplier to bring in the necessary R&D resources within a new product development project. On the whole everybody agreed with this supplier choice but specified that it was more a compromise than an appropriate answer to project needs. Finally, the historical relationship with this supplier and its manufacturing abilities prevailed upon its co-design abilities. During the pre-study stage, the supplier was not able to mobilise R&D resources. After several demands of improvement on this point without results, the customer team decided to change the supplier. One year of work was lost. This *glitch* is first of all linked to a failure in internal collaboration. It seems that when a customer wants to promote collaborative relationships with its supplier, collaboration must be a notion firstly mastered in intra-organisational relationships.

- *Confusing determination of roles expected by the supplier*: Each partner had its idea of what was expected but this vision was not totally shared. At the beginning of the relationship, an appendix of the contract specified responsibilities of each partner in the project. However, it was not signed and therefore was subject to contestation. In addition, a project management tool was developed by the customer in order to control and manage the product quality within the collaboration. This tool is an EAQP (Electronic Advanced Quality Planner) and could have been helpful but as a new tool it was long to be used by the team members. Particularly, this tool enables both partners to clearly define the acceptability criteria concerning the connector. This new tool was introduced after the beginning of the collaboration and thus discovered too late by the supplier. The customer noted that the supplier had not understood those criteria and that it was unable to satisfy them. This *glitch* shows a lack of initial determination of roles and regular face to face meetings. As it was difficult to know who was in charge of what, time was lost (about 3 months) and product innovation affected.
- *No alignment in expectations*: At first the customer wanted to delegate the study and then a part of mass production if all suited whereas the supplier was more interested with the mass production. Thus, both project teams did not have the same alignment in expectations. Previously, the relationship between the customer and the supplier was mostly based on a manufacturing activity. The supplier underestimated the importance of the design activity. None of each part tried to tackle the misunderstanding. Therefore, product innovation and quality were affected. The proposed solution did not present real innovation or optimisation. The level of propositions made by the supplier concerning the solution was judged below what was expected.
- *Contractual arrangement hard to build up*: The initial contract for study was sent to the supplier two months after the choice of this supplier. The supplier disagreed with this contract which did not consider the production aspects. This led to a blocking of the situation for 5 months because the teams did not collaborate anymore as their expectations did not match. The project contract taking into

account the design stage and then the production stage was finally sent and the customer stopped the relation three months later (3 months lost). The withdrawal from this supplier leads to about one year of rework. Indeed studies carried out in this collaborative work are specific to this supplier and it is not possible to reuse them totally with a new supplier.

- *Wrong understanding of needs*: This issue is mostly due to the difficulties encountered by the supplier to work in the language adopted within the project. As a matter of fact, English was the language chosen for this project and especially for the specification sheet redaction because the design chain involved non French speakers. For instance, there was a German speaker supplier with who the supplier concerned had to collaborate. In addition, the supplier's lack of habit of functioning this way with the customer led to time lost. The supplier team continued working in the same way that during previous years that is to say by studying the need and producing in high quantity. Thus, time was necessary to get a common understanding of what was expected and the beginning of the relationship was non-productive.
- *Problems for sharing quality requirements*: The project's quality requirements were a breaking off compared to previous ones. As the supplier is an old one, he knew difficulties to understand and to reach this new level of exigencies. Important issues were encountered as regards the EAQP tool. Consequences were a delay in FMEA (Failure Mode and Effects Analysis) realisation and issues in the verification plan construction.
- *No joint definition of specifications*: Points were not considered by the supplier and this issue was raised late leading to a delay of two months for obtaining a prototype. The prototype obtained was not optimal which caused unproductive additional costs. For instance a wrong choice of material due to a non-consideration of a test demanded in the specification sheet led to an important delay and to the choice of a new material. Furthermore, new tests were carried out in order to qualify this new material.
- *Unstable specifications*: The customer is blamed of often modifying specifications which was highly disturbing for the supplier development activity. The norms to be assured by the connector were modified two times in of two months. Dimensions constraints were also modified several times. Similarly, the contract was subjected to several modifications. Those modifications were not discussed between the actors. There was also some rework due to specifications changed and to a non-adapted response to the need expressed.
- *Privileged interlocutor hard to identify*: This remark was mentioned both by the supplier and by the customer. When an issue is raised, it is difficult to know who is accountable. This point leads to time lost and confusion. At the beginning of the relationship there were unsuccessful meetings. As regards customer's expectations, a late mutual arrangement was observed.
- *Verification plan hard to obtain*: The supplier is responsible of the design and the development of its connector. For this reason, the customer considered that the supplier was in charge of building and completing the verification plan of its sub-part. Owing to the

supplier's lack of habit with those practices, especially with this customer, the supplier declared not to be able to understand what the customer's expectations were. So, a 3 months delay was observed to get the verification plan by the supplier.

6. *Glitch* categorisation and discussion

Among those ten *glitches* observed, a major part is linked to a lack of knowledge sharing or to a failure in collaborative behaviour both across intra-organisational boundaries of each company (customer and supplier) and across inter-organisational boundaries. For instance we have observed failures concerning the need expression, quality requirements and acceptability criteria. Furthermore, as we considered *glitches* in both intra-organisational and inter-organisational relationships it enabled us to take into account more points than if we had limited our consideration to inter-organisational relationships. As *glitches* are costly mistakes harmful for project performance, our aim is to tackle those unproductive phenomena in order to be more efficient in future collaborative developments with suppliers. In this respect, we had to classify *glitches* in order to set up appropriate actions. A categorisation according to the relationship lifecycle was chosen. Figure 1 represents this temporal repartition of the ten *glitches* encountered during our case study. Two stages are indentified in this representation:

- The relationship design. This stage takes into account the supplier selection and the construction of the relationship framework (contracting, determination of roles and resources, need specification).

- The day to day interaction. This stage embodies the interface between the supplier and the customer during the collaborative work. This is the daily work.

This action view will enable each partner to identify the actions they have to carry out for the success of the relationship design and its management. Impact was also considered. An evaluation is proposed Figure 1. A small impact corresponds to a *glitch* that impacts the delay, the development costs, the product quality or the product innovation but with no irreparable consequences. Medium impacts means more consequences and an important impact *glitch* can be responsible of prejudicial consequences hard to master.

In terms of impact, the relationship design stage is obviously more critical than the day to day interaction stage. Tan et al. (2007) said that in order to involve suppliers in new product development projects, a good global internal collaboration in the customer firm is a prerequisite. Thus, if the internal collaboration raises issues and is not correctly carried out, the collaboration with a supplier probably will not be efficient. Figure 1 and Table 2 show that, in our case study, internal issues of the customer team impacted the collaboration with the supplier. Problems encountered during the relationship design at the beginning of the project highly impacted the next events. The customer team encountered difficulties to make a common supplier choice, to express its need, for the contract redaction, for the definition of quality exigencies and thus to agree internally. This confusion prevented them from succeeding in their relationship with the supplier. It is interesting to notice that on Table 2, the *glitches* responsibility often comes from the customer. Furthermore, *glitches* costs engendered are important and the major part of those *glitches* occurred during the early phases of the relationship design. Thus, the supplier change lead to almost 12 work-months lost. This embodies some rework with the new supplier. This is why Hillebrand et al. (2004) said that early involvement of purchasers internally is associated with a good early inclusion of suppliers. As a matter of fact, collaborative behaviour must begin internally before to be implemented externally.

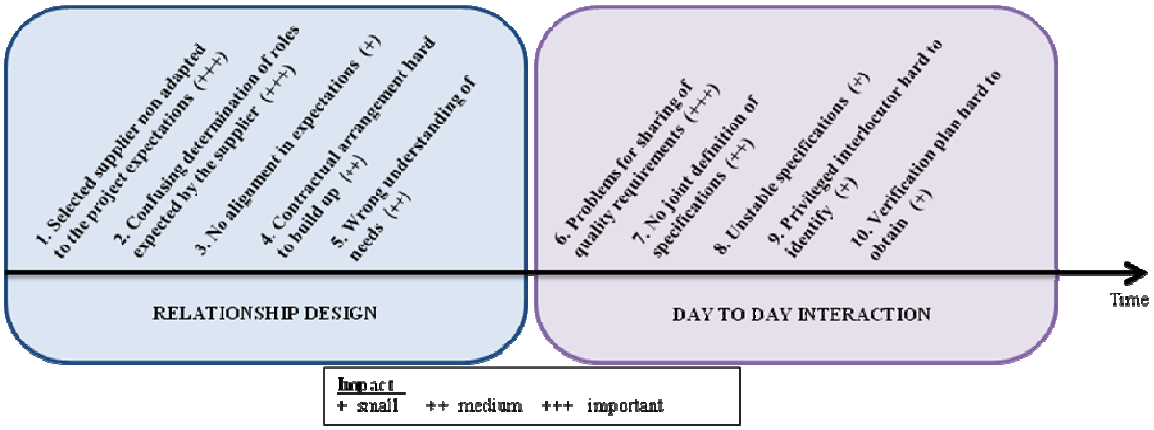

Figure 1: Glitch categorisation proposal

As we said at the beginning of this paper, trust between partners can intuitively be the main governance mechanism for our kind of situation (Ouchi, 1980) but is more natural with historical suppliers. For (Mc Cutcheon et al., 1997), the history with the supplier is a likelihood factor for the buyer collaborating with the supplier. The relationship mentioned in this paper proves that it is not always verified. The supplier was an historical one, with whom the customer had successfully worked for several years but it was not enough to prevent from *glitches* observed. As a matter of fact, the awarded supplier developed the external connector for the previous motor but since this development was mobilised for mass production. Therefore, its R&D capacities were not used enough to be sure of their good level. For the studied product development, the customer tried to change the supplier from a manufacturer supplier to a designer supplier and thus over-estimated them. This point raised the issue of suddenly changing habits of working with a supplier. Even if the supplier works in the expected way with another customer, it is difficult to set up a new mode of collaboration. Time is necessary. Despite of the fact that the supplier is known and demonstrated positive behaviours on the past, it is necessary to be vigilant. Furthermore, capacity used and potential capacity of the supplier should be distinguished. Finally, the right supplier must be allocated to the right need because over-estimate or under-estimate one supplier is counterproductive.

7. Conclusion and implications

The objective of our research work is to obtain an assessment of collaborative design between customer and supplier impact on project performance. The aim is to contribute to both academic research and industrial need of tangible elements as regards ESI benefits. In this paper, the objective was to obtain a first appraisal of those benefits. Using an explorative approach, which included in-depth interviews and academic evidences, field elements of a case study was obtained. (Hoopes and Postrel, 1999)'s glitch was used and we choose an extended vision with both intra-organisational and inter-organisational relationships. Thus, an adapted definition can be proposed for what we call a *collaborative glitch*. It embodies a costly mistake on a multi-agent project in inter or intra-organisational situation that could have been avoided with more sharing knowledge and collaboration between involved agents. By appraising the *glitch* cost, we can approach the benefit that can be expected from a collaborative development. The idea is to show that by making mistakes, many losses are observed and those losses may be seen as gains in case of a successful and pacific collaboration between a customer and its supplier. The link with collaborative development is to consider that by setting up appropriate collaborative design, losses

are not present and thus we "earn" this "loss" in a certain way.

The research results have been generated by a case study research. This methodology was considered as suitable for our explorative objectives. It was relevant to carry out interviews with people directly involved into the project considered. Thanks to our observation of a collaborative relationship, we have been able to notice some collaborative glitches and associated costs. Thus it enabled us to find possible benefits in case of successful collaboration.

One limitation of our study is that only one case study was carried out. Now, this approach must be applied with other organisations, other projects and other persons in order to obtain a generalisation of our glitch typology and to set up preventive actions to avoid collaborative glitches and thus generate benefits.

8. Thanks

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9. References

Batchelor, C., 1997. Moves in the right direction. Financial Times:Survey Logistics 97, 7 October, p.1.

Bidault, F., Despres, C. and Butler C., 1998. *Leveraged Innovation: Unlocking the Innovation Potential of Strategic Supply*. MacMillan Press, London.

Bonaccorsi, A. And Lipparini, A., 1994. Strategic partnerships in new product development: An Italian case study. Journal of Product Innovationn Management 11(2), 134-145.

Bozdogan, K., Deyst, J. et al., 1998. Architectural innovation in product development trough early supplier integration. R&D Management 28(3), 163-173.

Carter, C.R. and Ellram, L.M., 2003. Thirty-Five Years of The Journal of Supply Chain Management: Where Have We Been and Where are We Going? The Journal of Supply Chain Management 38 (2), 27-39.

Chung, S.A. and Kim, G.M., 2003. Performance effects of partnership between manufacturers and suppliers for new product development: the supplier's standpoint. Research Policy 32, 587-603.

Clark, K.B. and Fujimoto, T., 1991. Product Development Performance: Strategy, Organization and Management in the Word Auto Industry (Boston, Harvard University Press).

De Toni, A. And Nassimbeni, G., 2001. A method for the evaluation of the supplier's co-design effort. International Journal of Production Economics 72(2), 169-180.

Dyer, J.H., 2000. Collaborative advantage: winning through extended enterprise supplier networks. New York, Oxford University Press.

Eisenhardt, K.M., Tabrizi, B.N., 1995. Accelerating adaptive processes: product innovation in the global computer industry. Administrative Science Quaterly 40, 84-110.

Fliess, S., Becker, U., 2006. Supplier Integration – Controlling of co-development processes. Industrial Marketing Management 35 (1), 28-44.

Garel,G.,1999. Analyse d'une performance de co-développement.Revue française de gestion,123,5-18.

Goffin, K, Lemke, F. et al., 2006. An exploratory study of 'close' supplier-manufacturer relationships. Journal of Operations Management 24(2), 189-209.

Handfield, R.B., Ragatz, G.L., Petersen, K.J. and Monczka, R.M, 1999. Involving Suppliers in New Product Development. California Management Review 42(1), 59-81.

Handfield, R.B., Lawson, B., 2007. Integrating Suppliers into New Product Development. Research Technology Management 50(5), 44-51.

Hartley, J.L., Zirger, B.J. et al., 1997. Managing the buyer-supplier interface for on-time performance in new product development. Journal of Operations Management 15(1), 57-70.

Hillebrand, B. and Biemans, W.G., 2004. Links between Internal and External Cooperation in Product Innovation Management 21, 110-122.

Hoegl, M. and Wagner, S.M., 2005. Buyer-Supplier Collaboration in Product Development Projects. Journal of Management 31, 530-548.

Hoopes, D.G. and Postrel, S., 1999. Shared knowledge, “glitches”, and product development performance. Strategic Management Journal 20, 837-865.

Hoopes, D.G., 2001. Why are there glitches in product development? R&D Management 31 (4), 381-389.

Huberman, A.M. and Miles, M., 2002. The qualitative researcher’s companion: classic and contemporary readings (London, Sage).

Johnsen, T.E., 2009. Supplier involvement in new product development and innovation: Taking stock and looking to the future. Journal of purchasing & Supply Management 15, 187-197.

Kleiner, A., Roth, G., 1997. How to make experience your company’s best teacher? Harvard Business Review 75 (5), 172-177.

Koufteros, X., Chen, E.T. et al, 2007. Black Box and gray box supplier integration in product development: antecedents, consequences and the moderating role of firm size. Journal of Operations Management 25(1), 847-870.

Langerak, F., Peelen, E. And Comandeur, H., 1997. Organizing for Effective New Product Development An Exploratory Study of Dutch and Belgian Industrial Firms. Industrial Marketing Management 26, 281-289.

Lyu, J. And Chang, L.Y., 2007. Early involvement in the design chain-a case study from the computer industry. Production Planning & Control 18(3), 172-179.

McCutcheon, D.M., Grant, R.A., Hartley, J., 1997. Determinants of new product designers’ satisfaction with suppliers’ contributions. Journal of Engineering and Technology Management 14, 273-290.

Mentzer, J.T. and Kahn, K.B., 1995. A Framework of Logistics Research. Journal of Business Logistics 16(1), 231-150.

Monczka, R.M. and Trent, R, 1997. Purchasing and Sourcing 1997: trends and implications, Greenwich CT: Center for Advance Purchasing Studies (CAPS).

Ouchi, W., 1980. Markets, Bureaucracies and Clans. Administrative Science Quaterly 25 (3), 129-141.

Petersen, K.J., Handfield, R.B., Ragatz, G.L., 2005. Supplier integration into new product development: coordinating product, process and supply chain design. Journal of Operations Management 23, 371-388.

Petroni, A. and Panciroli, B., 2002. Innovation as a determinant of suppliers’roles and performances: an empirical study in the food machinery industry. European Journal of Purchasing & Supply Management 8(3), 135-149.

Pettigrew, A.M, 1973. On studying organizational cultures. Administrative Science Quarterly 25, 570-581.

Primo, M.A.M. and Amundson, S.D., 2002. An exploratory study of the effects of supplier relationships on new product development outcomes. Journal of Operations Management 20, 33-52.

Ragatz, G.L., Handfield, R.B. and Scannell, T.V., 1997. Success Factors for Integrating Suppliers into New Product Development. Journal of Product Innovation Management 14, 190-202.

Ragatz, G.L., Handfield, R.B., et al., 2002. Benefits associated with supplier integration in NPD under conditions of technology uncertainty. Journal of Business Research 55, 389-400.

Sako, M., 1992. Prices, quality and trust. Inter-firm relations in Britain and Japan. Cambridge University Press.

Song, M. and Di Benedetto, C.A., 2008. Supplier’s involvement and success of radical new product development in new ventures. Journal of Operations Management 26, 1-22.

Sushandoyo, D., Magnusson, T., Berggren, C., 2010. New forms of vehicle maker-supplier interdependence? The case of electric machine development for heavy hybrid vehicles. Gerpisa 2010.

Takeishi, A., 2001. Bridging Inter- and Intra-Firm Boundaries: Management of Supplier Involvement in Automobile Product Development. Strategic Management Journal 22 (5), 403-433.

Tan, C.L. and Tracey, M., 2007. Collaborative New Product Development Environments: Implications for Supply Chain Management. The Journal of Supply Chain Management Summer 2007.

Van Echtelt, F., Wynstra, F. and Van Weele, A.J., Duysters, G., 2008. Managing Supplier Involvement in New Product Development: a Multiple-Case Study. Journal of Product Innovation Management 25 (2), 180-201.

Veloso, F. And Fixson, S., 2001. Make-Buy Decisions in the Auto Industry: New Perspectives on the Role of the Supplier as

an Innovator. Technological Forecasting and Social Change 67, 239-257.

Von Corswant, F. and Tunälv, C., 2002. Coordinating customers and proactive suppliers. A case study of supplier collaboration in product development. Journal of Engineering and Technology Management 19(3-4), 249-261.

Wagner, S.M. and Hoegl, M., 2006. Involving suppliers in product development: Insights from R&D directors and projects managers. Industrial Marketing Management 35, 936-943.

Walter, A., Ritter, T. And Gemünden, H.G., 2001. Value Creation in Buyer-Seller Relationships'. Industrial Marketing Management 30, 365-377.

Weber, Camuffo, 2010. Mapping the Determinant of Time-to-Market in Automotive New Product Development: a multiple case study analysis. Gerpisa 2010.

Wynstra, F., 1998. Purchasing Involvement in Product Development. Doctoral Thesis, Eindhoven University of Technology.

Yin, R.K., 1994. Case study research: design and methods, 2nd edition (Thousand Oaks: Sage Publications).

Zsidisin, G.A. and Smith, M.E., 2005. Managing Supply Risk with Early Supplier Involvement: A Case Study and Research Propositions. The Journal of Supply Chain Management, Fall 2005, 44-57.