Supplier Involvement in New Product Development: a study in the Brazilian footwear industry

Diego de Castro Fettermann
Federal University of Santa Catarina, Florianópolis, SC, Brazil
dcfettermann@gmail.com

Guilherme Luz Tortorella
Federal University of Santa Catarina, Florianópolis, SC, Brazil
gtortorella@bol.com.br

Marcia Elisa Soares Echeveste
Federal University of Rio Grande do Sul, Porto Alegre, RS, Brazil
echeveste@producao.ufrgs.br

Carlos Ernani Fries
Federal University of Santa Catarina, Florianópolis, SC, Brazil
carlos.fries@ufsc.br

Abstract: This study evaluates benefits and success factors of the supplier involvement during the NPD process among three footwear companies in Brazil. The method developed indicates which items must be implemented as common objectives between company and supplier, as well as the most influential points for the success of the partnership.

Keywords: Success Factors, Sinos Valley, Supply Chain Management.

INTRODUCTION

The efficient integration of competences and resources between companies has become a requirement in order to compete in a globalized economy (Bititci et al. 2007). At first, such integration activities were centered in the agility of product delivery, in the quality guarantee during production, in logistics and in cost reduction. However, given the fact that these issues tend to be standardized, the focus shifted on to New Product Development (NPD), mainly to the relations that the company establishes with its suppliers (Hartley et al. 1997). Therefore, according to the reduction in product lifecycles and the competitive pressures caused by technology update also lead the company to integrate both clients and suppliers, especially as a way to add value to its supply chain (Mikkola and Skjoett-Larsen, 2003).

There is still a growing participation of suppliers in the company results, mainly because the purchase of raw materials determines an estimate of 50% of its cost (Hanfield et al. 1999). Moreover, more than 70% of the final cost in the world automotive industry is generated by the suppliers (Quesada et al. 2006). In addition to the pressures for cost reduction made by the manufacturers on their suppliers, which varies from 5 to 8% a year, the continuous improvement of product quality and the reduction in time development demand from the supplier some constant update and a growing influence in the result of the client company (Laseter and Ramdas, 2002).

The supplier involvement in the NPD has become an important contribution to the solution of problems, which causes the process to be faster and more productive (Ro et al. 2008). However, it has not yet made clear how and when it is appropriate to cooperate with the suppliers during

the development process (Pereira et al. 2014), being this issue one of the most important areas to be developed within the scope of NPD (Brown and Eisenhardt, 1995). Recent studies have brought little understanding on how the suppliers should contribute to the process as well as the aspects to ensure the positive results for such relationship (Lau 2011).

Therefore, this study evaluates benefits and success factors of the relationship between company and supplier during the process of NPD. This contribution starts with the identification and measurement of the importance of all benefits as well as the success factors that influence the performance of a cooperative relationship with the supplier during NPD. In order to carry out this study, three companies from the footwear sector in Brazil have been selected along with their most strategic suppliers for the establishment of such partnership.

Brazil is the third largest footwear manufacturer in the world after China and India and sixth among the largest exporter (Guimarães et al. 2014). The Brazilian footwear cluster of the Sinos Valley was chosen because is a showcase for successful integrations into global chains from a developing country (Schmitz and Knoringa, 2000). Therefore, this case is based also on the depth of the cooperation between companies and their suppliers (Guimarães et al. 2014).

Benefits and the Success Factors of the Supplier Involvement during NPD

The benefits and the success factors that match the performance of the supplier involvement have been researched in order to provide a better NPD cooperative performance between companies and their suppliers. Such benefits and factors have been classified according to the subsystems that make up the social-technical system (Schmitz 1999). These authors regarded sociotechnical systems as subdivided into four interrelated subsystems: personnel, technological, work design and external environment. In this study, the social-technical system approach is used to classify the issues related to the work system between the company and its suppliers, more specifically to the cooperative relationship during NPD.

The technological one aims to identify the way in which technology influences the organizations' work system (Hendrik and Kleiner, 2001). The personal subsystem focuses on the influences by which the work system participants' characteristics and qualification determine the result of the project. According to Pasmore (1988), the influences the organization receives from the external environment can be classified within the external environment subsystem as follows: governmental, regulatory, ecological, logistic, commercial, financial, among others. the variables The other three subsystems comprise (technological, personal, and external environment) exert influences upon themselves and upon work structure, considering that the work design subsystem is capable of interacting with the variables in the other subsystems in order for the company to achieve better results (Hendrik and Kleiner, 2001). The benefits (Figure 1) and the success factors (Figure 2) mentioned in the references were used to develop a close-end questionnaire in order to identify the importance of company's perception company and its strategic suppliers in relation to each benefit and success factor. The classification of these questions in the subsystems of the social-technical system allows the comprehensive identification of the subsystems that exert greater impact upon the supplier involvement in NPD performance.

	Benefits of the supplier involvement	Clark and Fujimoto (1991)	Helper (1991)	Womack et al. (1990)	Birou and Fawcet (1994)	Ward et al. (1995)	Dyer (1996)	Liker et al. (1996)	Ragatz et al. (1997)	Wasti and Liker (1997)	Bidault et al. (1998)	Hanfield et al. (1999)	Sobek II et al. (1999)	Wynstra and Ten Pierick (2000)	De Toni and Nassimbeni (2001)	Maffin and Braiden (2001)	Sobrero and Roberts (2001)	Primo and Amundson (2002)	Spina et al. (2002)	Becker and Zirpoli (2003)	Mikkola and Skjoett-Larsen (2003)	Møller et al. (2003)	Chung and Kim (2003)	Liker and Choi (2004)	Perona and Saccani (2004)	Ballé and Ballé (2005)	Fowles and Clark (2005)	Moreira (2005)	Tidd et al. (2005)	Quesada et al. (2006)
B1 (T)	Increase the number of patents																						x							
B2 (T)	Improve product quality	x	x	x	x		x	x	x		x	x	x	x	x			x	x		x			x	x					x
B3 (T)	Develop better manufacturing									x				x																
B4 (T)	Product cost reduction			x				x	x			x	x	x	x				x					x	x	x				x
B5 (T)	Process cost reduction			x				x	x			x	x	x	x				x					x	x	x				x
B6 (P)	Learning opportunities in the cooperation																x													
B7 (P)	Increase the supplier's motivation														x															
B8 (P)	Access to competences and knowledges		x								x	x		x	x	x	x			x		x			x		x	x	x	x
B9 (P)	Innovation source											x					x		x						x		x		x	
B10 (P)	Development time reduction	x		x		x	x	x			x	x	x		x			x	x					x	x	x	x		x	
B11 (E)	Joint investments in R&D		x																						x					
B12 (E)	Comply with environmental and governmental rules											x																		
B13 (E)	Reduction of risk/uncertainty in NPD		x									x		x											x		x			
B14 (W)	Workload decrease in DP	x				x						x																		x
B15 (W)	Flexibility in NPD	x										x																		

(T)-Technology subsystem/(P)-Personal subsystem/(E)-External Enviroment subsystem/(W)-Work Design subsystem

Figure 1 - Benefits of the supplier involvement

	Success factors of the supplier involvement	Clark and Fujimoto (1991)	Helper (1991)	Womack et al. (1990)	Birou and Fawcet (1994)	Ward et al. (1995)	Dyer (1996)	Liker et al. (1996)	Ragatz et al. (1997)	Wasti and Liker (1997)	Bidault et al. (1998)	Hanfield et al. (1999)	Sobek II et al. (1999)	Wynstra & Ten Pierick (2000)	De Toni and Nassimbeni (2001)	Maffin and Braiden (2001)	Sobrero and Roberts (2001)	Nellore (2001)	Primo and Amundson (2002)	Spina et al. (2002)	Twigg (1998)	Becker and Zirpoli (2003)	Mikkola and Skjoett-Larsen (2003)	Møller et al. (2003)	Chung and Kim (2003)	Liker and Choi (2004)	Dyer and Hatch (2004)	Hillebrand & Biemans (2004)	Perona and Saccani (2004)	Ballé and Ballé (2005)	Fowles and Clark (2005)	Moreira (2005)
S1 (T)	Supplier's component costs in the product final value																			x											
S2 (T)	Product greater complexity															x			x				x								
S3 (T)	Use of FMEA and QFD with the supplier												x		x	x															
S4 (T)	Use of DFM and DFA with the supplier														x	x															
S5 (T)	Use of a supplier's *ranking* system	x	x						x					x	x																
S6 (T)	CAD/CAE compatible systems								x					x						x	x										
S7 (P)	Suppliers' knowledge/technology	x										x																			
S8 (P)	Cultural similarity																	x													
S9 (P)	Information/control of the supplier's operations																								x					x	
S10 (P)	Use of guest engineers	x																							x						
S11 (P)	Low Asymmetric Information between Companies																					x		x							
S12 (E)	Low differences between company sizes																			x											
S13 (E)	Low uncertainty of environment		x									x		x								x									
S14 (E)	Type of relationship governance		x														x														
S15 (E)	High integration of the production chain																			x											
S16 (E)	Confidence in the supplier's performance											x		x																	
S17 (E)	Low risk of loss of copyright																													x	
S18 (E)	Low pressure for cost reduction		x	x			x																			x					
S19 (W)	Physical proximity						x													x											
S20 (W)	Relationship with a few suppliers		x	x							x	x					x					x									
S21 (W)	Long-term relationship with the supplier		x	x		x	x			x	x						x							x							x
S22 (W)	High flow of information exchange		x			x		x						x						x			x			x				x	
S23 (W)	Communication with direct contacts						x																							x	
S24 (W)	Informal meeting for the Exchange of information		x																								x				
S25 (W)	Managing the cooperation between client and supplier				x				x																			x			
S26 (W)	Integration of the project team	x	x		x	x		x	x							x				x								x	x		
S27 (W)	Articulate common goals and objectives											x		x																x	
S28 (W)	Moment when the supplier must cooperate in NPD											x																			
S29 (W)	Company's internal integration																											x			
S30 (W)	No use of poor communication						x	x																						x	
S31 (W)	Frequent communication																														
S32 (W)	Use of concurrent engineering							x							x																
S33 (W)	Increase of NPD complexity with suppl. participation							x						x																	
S34 (W)	Possibility of cooperation inefficiency																								x						
S35 (W)	Information dispersion							x														x									

(T)-Technology subsystem/(P)-Personal subsystem/(E)-External Enviroment subsystem/(W)-Work Design subsystem

Figure 2 – Success factors of the supplier involvement

RESEARCH METHOD

The multiple-case study method with a theoretical replication was due to the diversity of shoe companies in Sinos Valley, Brazil and to the lack of similar studies about this sector. Three companies were selected, and their size was used as the criterion for the differentiation between them. For the company case study, interviews with product and supply chain manager were used which also identify the suppliers that already develop any sort of cooperative relationship with the company during its NPD. Subsequently, part of the analysis developed in the company is also replicated in the identified suppliers, which completes the company study.

A close-end questionnaire has been applied in order to measure the importance of benefits and success factors for the supplier involvement during NPD, pointing out each benefit and success factor identified in the referenced literature (Figures 1 and 2). Respondents are then invited to express their opinions on each benefit and success factor through a 15 cm continuous assessment scale, as proposed by Stone et al. (1997). The intensity of each response may vary between 0 and 15 according to the question: (*i*) low importance (0)/ high importance (15) of the benefits or success for the cooperative relationship.

The analysis of the data collected from questionnaire follows three phases: questionnaire reliability, intra-group analysis and performance of subsystems. In the first phase, the analysis of the questionnaire reliability was carried out through Cronbach's alpha (Hair et al. 2006), which aims to evaluate the questionnaire internal reliability.

As a means of identifying the tendency towards the difference or the similarity between the company's and its suppliers' answers, the intra-group analysis, it has been developed a descriptive statistics method made up of three phases: *i*) calculate the mean between each company's suppliers *ii*) for each question compare the difference in module between the suppliers' mean and the company's answers; *iii*) calculate the quartiles for the difference result of the company's answers in module and the suppliers' questions mean. The result is the identification of 25% of the greatest and the smallest differences between the company's answers to each question and the suppliers' mean, that is, the questions where it is possible to identify a greater agreement and disagreement tendency between the company's opinion and its suppliers'.

The third phase, the performance of subsystems (technological, personal, external environment and work design) seeks to identify the subsystems exerting the greater influence upon the performance of the supplier involvement during NPD. In order to identify the significant differences in the importance of the questions inserted in each subsystem, the Analysis of Variance (ANOVA) has been used. In case the tendency towards the influence difference of subsystems in the benefits or success factors is found, the multiple comparison test (LSD) (Hair et al. 2006) is applied in order to identify which subsystems tend to exert greater influence upon the benefits and the success factors.

RESULTS AND DISCUSSION

Both Company A (small size) and Company C (big size) exclusively produce women's shoes, whereas Company B (medium size) mainly produces children's shoes but also women's and sports shoes in smaller quantities. All companies only trade their products using their own brands, and Companies A (small) and C (big) own only one brand. Company B (medium) owns seven different brands, and it happens because this company is a branch of a bigger and older textile group, which has the legal rights. The characterization of these three companies is illustrated in Table 1.

Company A (small size) identified three suppliers as potential partners in order to establish a cooperative relationship during NPD, and these suppliers have maintained a relationship with the company since the start of the activities. Moreover, they are located near the company and have similar number of employees. Company B selected four suppliers to take part in the research, which have also maintained a relationship with the company since the start of the activities. The selected suppliers are located in Sinos Valley and have fewer employees than the company.

Company C (big size) selected three suppliers, which are located in Sinos Valley and have a varied number of employees, being greater that the company in one case.

Table 1 - Characterization of the three companies

	Company A	Company B	Company C
Daily production	1,300 pairs/day	9,500 pairs/day	45,000 pairs/day
Number of employees	40 employees	984 employees	2,500 employees
Start of activities	1998	2000	1955
Main product	Feminine	Children (mainly)	Feminine
Materials most used in the upper	Leather, Polyurethane (PU) and Polyvinyl chloride (PVC)	Polyvinyl chloride (PVC) and cloth	Polyurethane (PU)
Materials most used in the outsole	Polyurethane (PU) and Polyvinyl chloride (PVC)	Polyurethane (PU)	Polyurethane (PU)

Questionnaire Reliability

The answers to the questions in the fourth part of the questionnaire have been submitted to a reliability test, which have been well interpreted by the three companies and by their respective suppliers. This can be verified through a Cronbach alpha greater than 0.6, which according to Hair et al. (2006) represents the acceptable coefficient for exploratory research (Table 2).

Table 2 - Cronbach alpha coefficients for the questionnaire

Benefits of the supplier involvement	Success factors of the supplier involvement
0.932	0.699

Intra-Group Analysis

In the benefits of the supplier involvement, the questions where it can be seen the tendency towards disagreement between company and supplier contribute as to diagnose the company's and its supplier's frame of mind. In questions where a greater tendency to agreement (Q1) can be found as well as a greater qualification than the average score (7.5), it is recommended that these should be used as potential benefits for the company and its suppliers in the establishment of the cooperative relationship during NPD. The tendencies towards the agreement and the disagreement between company and its suppliers in the questions regarding the benefits of the cooperation are presented in Table 3.

Table 1 - Difference between the company's opinion and its suppliers' regarding the benefits of the supplier involvement during NPD

	Companies and their suppliers		
Benefits of the supplier involvement	**Company A**	**Company B**	**Company C**
B1-Increase the number of patents	0.180	2.240	2.931
B2-Improve product quality	3.035	3.685	2.403
B3-Develop better manufacturing	2.257	1.510	0.908
B4-Process cost reduction	6.356	0.626	5.326
B5- Product cost reduction	3.820	1.452	9.199
B6-Learning opportunities in the cooperation	2.057	2.213	2.991
B7-Increase the supplier's motivation	1.481	1.944	2.794
B8-Access to competences and knowledges	6.201	1.269	1.049
B9-Innovation source	3.384	1.100	4.687
B10-Development time reduction	5.280	0.041	2.125
B11-Joint investments in R&D	5.973	2.640	4.120
B12-Comply with environmental and governmental rules	4.502	2.663	4.130
B13-Reduction of risk/uncertainty in NPD	0.416	2.107	8.689
B14-Workload decrease in NPD	5.424	1.426	4.519
B15-Flexibility in NPD	0.453	2.300	2.324

Company and supplier tend to disagree (Q3)
Company and supplier tend to agree (Q1)

Regarding the success factors of the supplier involvement, the questions that show greater disagreement between company and supplier can also be used as a way to diagnose the cooperation with its suppliers, whereas the ones indicating greater tendency to agreement, since all have an average score greater than 7.5, can be used as opportunities of improving the supplier involvement cooperation in NPD. Both the tendencies towards agreement and disagreement regarding the success factors are illustrated in Table 4.

Table 2 - Difference between company and its suppliers regarding the success factors of the supplier involvement during NPD

Success factors of the supplier involvement	Companies and their suppliers		
	Company A	Company B	Company C
S1-Supplier's component costs in the product final value	3.440	3.695	3.335
S2-Product greater complexity	1.911	5.970	0.903
S3-Use of FMEA and QFD with supplier	1.045	3.450	1.220
S4-Use of DFM and DFA with supplier	1.755	0.702	1.467
S5-Use of suppliers' ranking system	1.150	4.734	1.770
S6-CAD/CAE compatible systems	9.520	3.398	0.331
S7-Suppliers' knowledge/technology	1.650	0.537	0.273
S8-Personal relationships	5.024	6.226	7.026
S9-Cultural similarity	2.210	2.998	0.929
S10-Information/control of the supplier's operations	6.266	6.613	1.071
S11-Use of guest engineers	3.947	3.562	0.314
S12-Low asymmetric Information between Companies	0.549	2.620	1.326
S13-Low differences between company size	3.040	1.457	1.815
S14-Low uncertainty of environment	1.786	0.762	1.190
S15-Type of relationship governance	0.546	0.336	2.721
S16-High integration of the production chain	1.985	2.014	0.323
S17-Confidence in the supplier's performance	0.194	0.939	1.149
S18-Low risk of loss of copyright	2.185	9.618	6.707
S19-Low pressure for cost reduction	2.709	9.674	9.836
S20-Physical proximity	1.143	5.825	0.127
S21-Relationship with a few suppliers	5.359	7.363	1.731
S22-Long-term relationship with the supplier	0.224	0.236	0.982
S23-High flow of information exchange	1.014	1.096	1.448
S24-Communication with direct contacts	0.154	1.103	5.104
S25-Informal meeting for the exchange of information	0.823	0.561	8.678
S26-Managing the cooperation between client and supplier	1.414	2.833	7.633
S27-Integration of the project team	1.394	1.361	6.377
S28-Articulate common goals and objectives	3.808	1.877	3.763
S29-Moment when the supplier must cooperate in NPD	1.004	0.762	6.636
S30-Company's internal integration	3.308	0.566	2.697
S31-No use of poor communication	0.540	2.907	2.035
S32-Frequent communication	0.219	0.143	3.774
S33-Use of concurrent engineering	1.432	1.916	0.730
S34-Increase of NPD complexity with supplier participation	1.876	6.962	2.707
S35-Possibility of cooperation inefficiency	4.762	7.105	0.204
S36-Information dispersion	1.531	6.572	4.303

Company and supplier tend to disagree (Q3)
Company and supplier tend to agree (Q1)

Performance of subsystems

In order to carry out this analysis, all respondents' answers to the close-end questionnaire have been included (N=13). The questionnaire is made up of 15 questions related to the benefits and other 35 related to success factors. The ANOVA result shows that there are significant differences between the influence of the subsystems in the relationship both in the benefits (F=7,767; p value<0,000) and in the success factors (F=11,340; p value<0,000). Regarding the benefits of the supplier involvement, the test of multiple comparisons (LSD) shows that the questions comprised in the personal and technological subsystems tend to be more valued by the companies and their suppliers (Table 4).

Table 4 - Test of multiple comparisons (LSD) for the benefits of the supplier involvement

	Average		work design	personal	technological	external
work design subsystem	8,7038	Mean difference	-	-2.9576**	-2.2976**	-1.1246
		Sig.	-	0.000	0.001	0.130
personal subsystem	11,6615	Mean difference	2.9557**	-	0.6600	1.8333**
		Sig.	0.000	-	0.200	0.002
technological subsystem	11,0015	Mean difference	2.2976**	-0.6600	-	1.1733*
		Sig.	0.001	0.200	-	0.049
external environment subsystem	9,8282	Mean difference	1.1246	-1.8333**	-1.1733**	-
		Sig.	0.130	0.002	0.049	-

* *significant at 5%/ **significant at 1%*

In relation to the success factors of the supplier involvement, it was identified a tendency to which the questions comprised in the work design and technological subsystems have greater influence over the result of the cooperative relationship during NPD (Table 5).

Table 5 - Test of multiple comparisons (LSD) for the success factors of the supplier involvement

	Average		work design	personal	technological	external
work design subsystem	10.8700	Mean difference	-	2.2431**	-0.2981	1.2502**
		Sig.	-	0.000	0.536	0.003
personal subsystem	8.6269	Mean difference	-2.2431**	-	-2.5419**	-0.9928
		Sig.	0.000	-	0.000	0.054
technological subsystem	11.1689	Mean difference	0.2981	2.5419**	-	1.5490**
		Sig.	0.536	0.000	-	0.005
external environment subsystem	9.6198	Mean difference	-1.2502**	0.9928	-1.5490**	-
		Sig.	0.003	0.054	0.005	-

* *significant at 5%/ **significant at 1%*

In this sense, it is suggested that in the studied cases, the companies focus more on the questions comprised in these subsystems in order to achieve their objectives during the supplier involvement. The technological subsystem is used in this study to include the questions related to technology and the use of tools in the relationship with the supplier during NPD. The work design subsystem comprises questions directed to the adopted procedures during the performance of activities, in other words, to the work structure. This tendency towards the valuation of the questions comprised in the technological subsystem and work design should not be seen as a means of reducing the importance of the other subsystems. However, they can point to the priority of the questions included in these subsystems.

CONCLUSIONS

The analytical method used was considered effective in order for the companies to identify the possibilities of improving the performance of the supplier involvement during NPD, as well as the setting of common goals during the process. On the one hand, the benefits on which the companies tend to agree are presented as synergy possibilities that should be adopted during the cooperative NPD. On the other hand, the success factors on which the companies agreed tend to indicate the questions that have stronger impact on the result of the supplier involvement during NPD process.

It was found a higher valuation of questions related to communication and NPD by the studied companies and suppliers, which shows that these points should be worked on as to better such companies' cooperative NPD performance. It was also possible to identify a higher valuation of questions comprised in the work project and technological subsystems, the ones towards the procedures included in the development process and in the tools used during the process, respectively.

The application of the questionnaire and the data analysis gave the companies a diagnosis of the relationship they have with their suppliers during the NPD process. This analytical method also offers the companies a way to monitor the main factors that influence the supplier involvement in addition to allowing for the possibility of developing projects that cause the improvement of the performance of the relationships that companies have with their suppliers during NPD.

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