



# The importance of trust and collaboration between companies to mitigate the bullwhip effect in supply chain management

Marly Mizue Kaibara de Almeida<sup>1\*</sup>, Fernando Augusto Silva Marins<sup>1</sup>, Andréia Maria Pedro Salgado<sup>1</sup>, Fernando César Almada Santos<sup>2</sup> and Sérgio Luis da Silva<sup>3</sup>

<sup>1</sup>Departamento de Engenharia de Produção, Universidade Estadual de São Paulo, Av. Dr. Ariberto Pereira da Cunha, 333, 12516-410, Guaratinguetá, São Paulo, Brazil. <sup>2</sup>Departamento de Engenharia de Produção, Universidade de São Paulo, São Carlos, São Paulo, Brazil. <sup>3</sup>Departamento de Ciências da Informação, Universidade Federal de São Carlos, São Carlos, São Paulo, Brazil. \*Author for correspondence. E-mail: [mka Almeida16@yahoo.com.br](mailto:mka Almeida16@yahoo.com.br)

**ABSTRACT.** The aim of the paper is to develop a theoretical construct about the mitigation of the bullwhip effect, considering trust and collaboration in managing the supply chain. The study presents a qualitative research based on the systematic literature review, which is tested through field research, involving companies in the medical and hospital area belonging to the same supply chain. The bullwhip effect has been observed throughout the industry for many years. Several academic studies have assigned to operating causes the reason for its occurrence. Few studies have focused behavioral causes. Through this study, it appears that affective trust (honesty, mutual understanding, credibility, respect and compliance) and trust in the competence (knowledge/technique, commitment in the relationship) are both necessary for keeping the relationship, but without affective trust, the relationship does not develop. Moreover, an organizational culture based on trust and collaboration exchange, and knowledge related to processes and technology among businesses, contributing to the joint planning and collaboration in the information sharing occurs. Thus, aspects of behavior toward partners of supply chain companies can mitigate the operational causes of the bullwhip effect by improving information and knowledge sharing, demand forecasting, replenishment policy, and reducing the risk coordination among the chain participants.

**Keywords:** trust, collaboration, bullwhip effect, supply chain management.

## A importância da confiança e colaboração entre empresas para mitigação do efeito chicote na gestão da cadeia de suprimentos

**RESUMO.** O objetivo do artigo é elaborar um construto teórico de mitigação do efeito chicote considerando a confiança e a colaboração no gerenciamento da cadeia de suprimentos. Este estudo apresenta uma pesquisa qualitativa com base na revisão sistemática da literatura em que o construto é testado por meio de um estudo de caso, envolvendo empresas da área médico-hospitalar pertencentes a uma mesma cadeia de suprimentos. O efeito chicote tem sido observado em toda a indústria, durante muitos anos. Vários trabalhos acadêmicos têm investigado esse tema e atribuído às causas operacionais a razão de sua ocorrência. Poucos trabalhos têm se dedicado às causas comportamentais. Este estudo comprova que a confiança afetiva (honestidade, entendimento mútuo, credibilidade, respeito e *compliance*) e a confiança no conhecimento/técnica e comprometimento no relacionamento são igualmente necessárias para o relacionamento com parceiros, mas se não houver a confiança afetiva, o relacionamento não se desenvolve. Assim, os aspectos do comportamento em relação aos parceiros das empresas de uma cadeia de suprimentos podem mitigar as causas operacionais do efeito chicote, melhorando o compartilhamento de informações e conhecimento, a previsão de demanda, política de reabastecimento e diminuindo o risco de coordenação entre os participantes da cadeia.

**Palavras-chave:** confiança, colaboração, efeito chicote, gestão da cadeia de suprimentos.

### Introduction

The state-of-art of the literature on Supply Chain (SC) shows that trust and collaboration influences the integration of knowledge and processes in a SC (Manu, Ankuah, Chinyio, & Proverbs, 2015; Capaldo & Giannoccaro, 2015; Revilla & Knoppen, 2015; Narayanan, Narasimhan, & Schoenherr, 2015; Schoenherr, Narayanan, &

Narasimhan, 2015; Pomponi, Fratocchi, & Tafuri, 2015); and that trust and collaboration in supply chain management (SCM) is one of the most effective ways to reduce the bullwhip effect (BWE) (Sari, 2015; Nagashima, Wehrle, Kerbach, & Lassagne, 2015; Cao, Baker, & Schniederjans, 2014; Dominguez, Cannella & Framinan, 2014).

The findings of Revilla and Knoppen (2015) support a relationship between knowledge integration and performance, after they have examined the key antecedents that might facilitate knowledge integration: strategic supply management and trust. According to Dong, Huang, Sinha, & Xu (2014), central to Collaborative Planning, Forecasting, and Replenishment (CPFR) is Collaborative Demand Forecasting (CDF) that allows SC partners to share private demand information, and incorporate the jointly derived demand forecast into production planning and product replenishment decisions. A systematic literature review (SLR), by Almeida, Marins, Pedro, Santos and Silva (2015), has only found isolated studies on BWE, trust and collaboration in SC, and strategic SCM, which leads to the need for these concepts to be addressed in an integrated way.

This paper contributes to fill in the gaps observed in the researches by presenting the theoretical construct about the integration between behavioral aspects and strategic SCM in order to reduce the BWE. A single case study is presented using SCM techniques, collaboration in knowledge management, learning and training among the SC companies, and for data collection, it was adopted a qualitative design based on in-depth interviews (Yin, 2009).

### Theoretical framework

The importance of trust and collaboration in SCM to mitigate the BWE has been analyzed based on the theoretical construct (Figure 1), and it was developed based on the SLR elaborated by Almeida et al. (2015). Results show that with the development of trust and collaboration in the SC, such as information sharing, joint decision-making, encoring knowledge management, learning and training, constitute factors that mitigate the BWE.

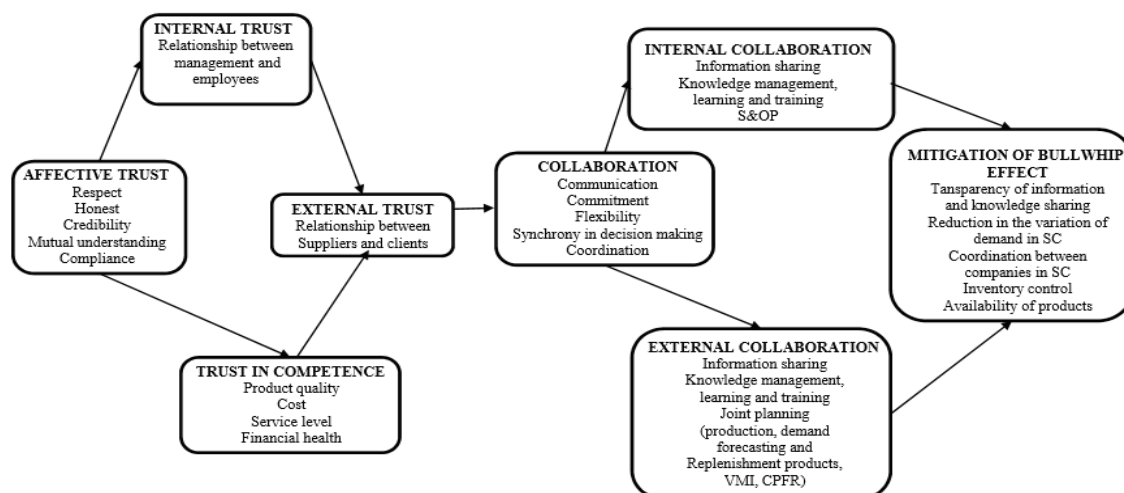
### Trust

In this work, trust involves honesty (Nold III, 2012), credibility (Delbufalo, 2012), respect (Nold III, 2012), and mutual understanding between the suppliers and customers (Nold III, 2012). Figure 2 presents relationships among affective trust, internal trust, trust in competence and external trust.

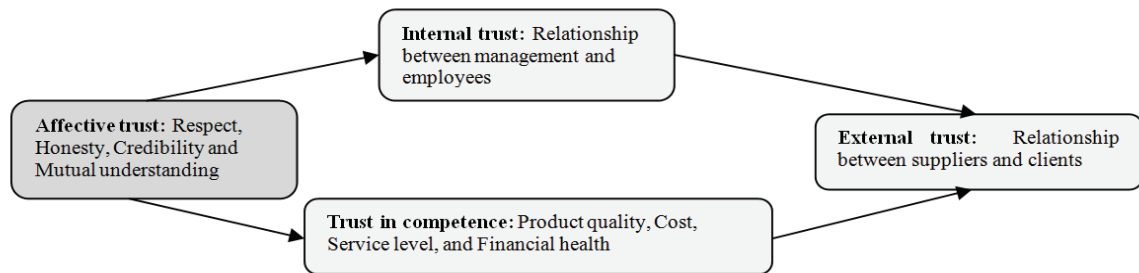
### Collaboration

In this paper, collaboration (Table 1) is a process that promotes inter-organizational cooperation, information sharing, and knowledge, in which two or more independent organizations work together to align the processes of the SC; and it presents the characteristics: communication (Simatupang & Ramaswami, 2005), commitment (Barrat, 2004), flexibility (Zhang, Viswanathan, & Henke, 2011), synchrony in decision-making (Danese, 2007), and coordination (Cadilhon, Fearn, Tam, Moustier, & Poole, 2005). The internal collaboration involves various functions of an organization, and it must be connected with the external collaboration in order to develop the process integration and information sharing between suppliers and customers (Barrat, 2004).

Collaboration in a SC requires practical and defined actions. The most in-depth methods are Collaborative Planning, Forecasting, and Replenishment (CPFR) and Vendor Managed Inventory (VMI). CPFR introduces a sequential approach that defines key actions to be undertaken during the formulation of collaborative initiatives, and VMI was designed to bring partners closer to the SC, however, it does not focus on the information exchange between partners. CPFR captures the operational advantages of VMI and adds collaboration mechanisms to facilitate the exchange of information in different echelons of the SC (Cassivi, 2006).



**Figure 1.** Theoretical construct of trust and collaboration to mitigate the BWE.



**Figure 2.** Relationships between affective, internal, external trust and trust in competence. Source: Almeida et al. (2015).

**Table 1.** Collaboration results in SC.

Results	References
1. Use of initiatives and practices of SCM (CPFR/VMI)	Danese (2007), Kauremaa, Smaros, & Holmström (2009), Danese (2011), Ramanathan & Gunasekaran (2014), Dong et al. (2014)
2. Information sharing	Kim & Lee (2010), Vieira, Yoshizaki, & HO (2009), Ha, Park, & Cho (2011), Revilla & Knoppen (2015), Sari (2015)
3. Joint planning (production, demand forecasts and replenishment products)	Olorunniwo & Li (2010), Danese (2011), Lehoux, D'Amours, Frein, Langevin & Penz (2011), Tsanos, Zografos, & Harrison (2014)
4. Learning and training	Fawcett, Magnan, & Fawcett (2010); Fawcett, Jones, & Fawcett (2012), Croson, Donohue, Katok, & Sterman (2014)

Table 2 presents the key elements to mitigate the BWE.

**Table 2.** Key elements to mitigate the BWE.

Key elements	References
1. Information sharing	Ouyang (2007), Yu, Ting, & Chen (2010), Bhattacharya & Bandyopadhyay (2011), Hussain, Drake, & Lee (2012), Bray & Mendelson (2012), Trapero, Korentzes, & Fildes (2012), Li (2013), Sari (2015), Barkataki & Zeineddine (2015)
2. Improved demand forecasting	Wright & Yuan (2008), Ali, Boylan, & Syntetos (2012), Trapero et al. (2012), Dong et al. (2014), Sari (2015), Xu, Dong, & Xia (2015), Nagashima et al. (2015)
3. Replenishment policy	Lee & Wu (2006), Jaksic & Rusjan (2008), Su & Wong (2008), Kelepouris, Miliotis, & Pramataris (2008), Dong et al. (2014)
4. Lead time reduction	Agrawal, Sengupta, & Shanker (2009), Li & Liu (2013), Nagashima et al. (2015)
5. Behavioral causes	Croson et al. (2014), Xu et al. (2015), Manu et al. (2015), Schoenherr et al. (2015)
6. Coordination	Bhattacharya & Bandyopadhyay (2011), Dong et al. (2014)
7. VMI	Disney & Towill (2003)

### Relationships between trust, collaboration, and BWE

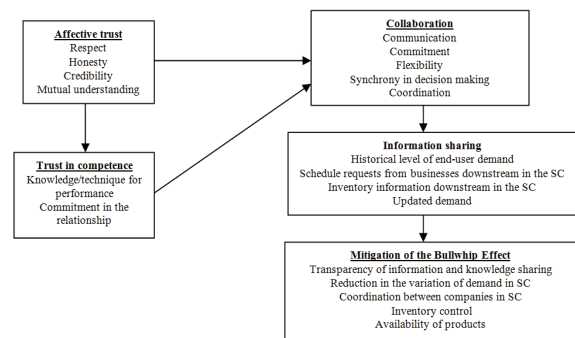
Some studies consider trust as a defining characteristic of the presence of collaboration among members of a SC (Vieira et al., 2009). The relationships between trust, collaboration, and the BWE in SCM are discussed as follows.

### Information sharing

The amplification of demand variation occurs throughout the SC due to distortions, lack of transparency and information sharing. Trust

constitutes an important element for reducing the BWE, because it is related to availability and the information quality in a SC (Chen, Yen, Rajkuman & Tomochko, 2011; Cao et al., 2014).

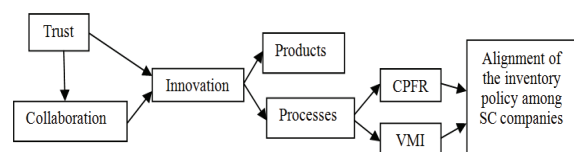
Trust and collaboration positively influence information sharing that is necessary to reduce the BWE in SC, decreasing the incidence of opportunistic attitudes by the presence of respect, honesty, credibility (benevolence), and mutual understanding between the supplier and customers (Figure 3).



**Figure 3.** Trust and collaboration in information sharing for mitigating the BWE. Source: Almeida et al. (2015)

### Innovation

Innovation can be defined as the adoption of an idea or behavior belonging to a system, process, policy, product, or service for a company. It implies the ability to break old habits and try to put forward new ideas. According to Daugherty et al. (2006) and Dong et al. (2014), if each partner trusts the other one in inter-organizational collaboration, initiatives and practices of SCM such as CPFR and VMI will bring benefits for the SC (Figure 4).

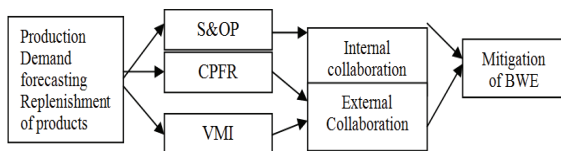


**Figure 4.** Trust and collaboration in the innovation process. Source: Almeida et al. (2015).

### Production, demand forecasting, and replenishment products

The implementation of VMI eliminates from the SC a level of demand forecasting and ordering (Disney & Towill, 2003). With the initiative of VMI, communication and continuous exchange of information between suppliers and customers, according to Disney and Towill (2003), result in a reduction of the BWE in a SC eliminating its main causes. The VMI can be developed only with company in which its partner has trust, based on respect, honesty, credibility, mutual understanding and information sharing. The CPFR focuses on a strong link between business planning, forecasting and replenishment with wide information sharing; and it can solve most of the problems found in the VMI program, but requires that all SC members jointly develop demand forecasts, production planning and purchasing, and inventory replenishment.

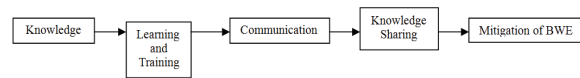
The Sales and Operations Planning (S&OP) is another collaborative practice, which integrates (strategic and operational) business plans in order to balance supply and demand, being an important process to mitigate the BWE. It acts on the internal collaboration of a company and contributes to a more effective demand forecasting. However, it requires the presence of trust and collaboration in the processes, for the members of the SC to achieve better performances (Figure 5).



**Figure 5.** Joint planning and mitigation of the BWE. Source: Almeida et al. (2015)

### Knowledge management, learning, and training

The key to successful collaborative innovation are people (Fawcett et al., 2012), but companies continue to invest in technology, information, and measurement systems. Managers should not ignore training, learning, and the choice of the right people to work and interact with each other. Among the organizational culture elements, trust allows companies to turn knowledge and learning initiatives into tangible performance indicators recognized by the financial markets (Nold III, 2012; Revilla & Knoppen, 2015). The relationship between knowledge management, learning and training, and the BWE is shown in Figure 6.



**Figure 6.** Relationship between knowledge and the mitigation of the BWE. Source: Almeida et al. (2015)

### Material and methods

This paper adopted a qualitative design based on in-depth interviews for data collection (Yin, 2009). As observed by Stake (1995), interviews can provide rich description and explanation of an event, a human affair or a linkage between events or affairs. For data analysis, the two-layer analytic technique (Yin, 2009) was employed as an overall framework of analysis. The general analytic technique (first layer) relied on the SRL, while the specific analytic techniques (second layer) involved cross-interview synthesis.

The single case study method (Yin, 2009) has been adopted and designed in a rational circumstance where the involved companies present high levels of trust among employees, and they use S&OP, VMI, CPFR, collaboration in knowledge management, learning and training.

The research design follows criteria for assured the quality of the qualitative investigation (Yin, 2009): construct validity (identifying correct operational measures for the concepts being studied), internal validity (seeking to establish a causal relationship, whereby certain conditions are believed to lead to other conditions), external validity (defining the domain to which a study's findings can be generalized) and reliability (demonstrating that the operations can be repeated with the same results).

The interview transcripts, word-processed observation notes and documentation from across the three companies of the studied SC were integrated onto a single platform using the qualitative data analysis software QSR NVivo. The three-pronged qualitative data analysis proposed by Miles and Huberman (1994) was adopted for within-case analysis, i.e. data reduction, data display and conclusion drawing or verification. The data reduction process involved sorting, focusing, discarding and organization of large text segments which were assigned to emergent nodes (free nodes). These codes were derived from within the data (*in-vivo* codes), through conceptual sense-making or from literature insights, reflecting the assignment of labels to text based on descriptive or inferential meanings (Miles & Huberman, 1994).

The studied SC belongs to the area of health and includes a focal company from North America, specialized in the production of medical products,

which operates in over 90 countries (the products are sold in more than 175 countries); a supplying company from Germany, specialized in manufacture of chemical products, being its production distributed in 40 countries (with business in more than 170 countries); and a client company that is a hospital, known in Latin America for the quality of care, medical equipment and expertise available to diagnose the main types of pathologies.

According to Johnson (2002), the required number of interviews to investigate a research question depends on the nature of the issue and the type of knowledge that the researcher seeks. So, the approach here was to contact professionals of the studied SC that hold the information necessary on research objectives, in order to answer open questionnaires, including: Focal Company (Four managers - supply chain, procurement, demand, planning and production control manager; planning and logistics supervisor and procurement analyst); Supplying Company (supply chain consultant, supply chain coordinator, planning and production control manager, and producing sequencer); Client Company (planning and logistics manager). The interviews were conducted separately and comprised about 21 hours of recording and the transcription of 170 pages.

## Results and discussion

### Trust

The focal company's principle was that suppliers and distributors must have the opportunity to make a fair profit, and the presence of high quality were required from the manufactured products, where they strove to reduce costs and keep prices reasonable.

#### Internal trust

According SC manager, the focal company is based on relationship and trust and he restates the way it works from the inside towards the outside, i.e. with customers and suppliers. The focal company seeks to maintain a good relationship between management and employees. Employees who contributed to the improvement processes should be acknowledged.

#### External trust

The focal company gets better results considering trust, and not only the technical expertise, as relationships become sustainable over time when trust is established, becoming a long term relationship (Table 3).

**Table 3.** Trust and its relationships with the results of systematic literature review and case study.

Trust	Systematic Literature Review	Case study
Affective	Respect (Min & Mentzer, 2004), honesty (Villena, Revilla, & Choi, 2011), credibility (Min & Mentzer, 2004), mutual understanding (Great Place to Work Institute [GPTW], 2015)	Respect, honesty, credibility, mutual understanding and compliance (not mentioned in the literature review of this research)
	Contributes to the good relationship between administrative authorities and employees (Hofstede, Hofstede, & Minkov, 2010)	The management should be prepared to listen to the employees and act in a fair and ethical manner (principles of focal company)
Competence	Knowledge / technique (Ha et al., 2011)	Technique, material quality and financial health
External	Interpersonal integration, consisting of trust, interdependence, flexibility and reciprocity as the main element for the development of collaboration with partners in the SC (Vieira et al., 2009)	The relationship with SC partners are developed only if they were approved by the qualitative analysis or affective trust, characterized by respect, honesty, credibility, mutual understanding and compliance

However, it also requires the competitiveness of suppliers for cost, technological innovation and quality. The case study demonstrated that companies do not develop relationships with partners that are not approved by the qualitative analysis or affective trust. A quantitative analysis itself is not sufficient to develop the relationship.

### Internal collaboration

The human resources department of the focal company seeks to strengthen an internal integration through meetings, group dynamics, events and disclosures by communication channels. It is developed a work based on the result of this research and once some point of improvement opportunity is identified, action plans are organized. The focal company invests heavily in training its employees. The training of the employees of the client company consists of institutional and external fast training, involving scholarship aid related to master's and doctorate degrees.

The internal collaboration, based on trust, promotes an internal alignment in the company, and problems of conflicts of interest and relationships are solved. In this respect, communication, commitment, flexibility, synchronization in decision-making and coordination are key features in collaboration. According to the focal company's SC manager, one of the S & OP process benefits is visibility and information forecasting; thus mitigating the BWE because lower visibility promotes demand variation in the SC caused by its lack. According to the planning and logistics supervisor of the client company, the S & OP reduces inventory and BWE by improving demand forecasting and collaborative demand.

### External collaboration

Affective trust and trust in technical competence determine the development of partnerships in the SC, but if there is no respect for integrity, honesty and observance with laws (compliance), mainly with regard to antitrust, honest competition, slavery, and child labor among others, the relationship is broken off. This would bring risks to the company itself because it can be accused of co-authorship and interruptions in supply. The focal company and the supplying company used the CPFR and VMI with strategic partners. The client company practices the CPFR, but does not the VMI for not having adequate technological architecture. The VMI used by the focal company is a hybrid form of the traditional VMI, which is characterized by a partnership in which the stock is managed by the supplier and the buyer in order to share responsibility. It is developed with strategic suppliers based on the extent and impact on the production, because not all suppliers have an interest.

Companies in this single study case have not developed the whole CPFR. Customer and supplier participation in demand forecasting occurs only in some cases because it depends on the trading volume basis which would cause a great impact on the company. The demand manager of the focal company added that the more the relationship between customer and supplier is established on trust and collaboration, the more access to customer data and information would facilitate the development of these practices. The results of the relationship of collaboration with the literature review and case study results is presented in Table 4.

**Table 4.** Collaboration and its relationships with the results of systematic literature review and case study.

Collaboration	Systematic Literature Review	Case study
Internal	The internal integration between the various functions of an organization (purchasing, manufacturing, logistics and marketing) must be connected to external collaboration (Barrat, 2004; Fayezi & Zomorodi, 2015)	The focal company presents principles and values based on relationship and trust. It is restated the way they work internally with customers and suppliers (SC manager - focal company)
External	Trust, interdependence, reciprocity and flexibility to develop collaboration with partners in the SC (Vieira et al., 2009; Schoenherr et al., 2015)	The relationship with suppliers and customers is developed from the qualitative analysis (affective trust) of the possible partner.

### Mitigation of the bullwhip effect

Trust in the decisions of the SC partners is necessary, because companies prevent themselves with inventory formation throughout the SC, one of the main features of the BWE. As managers establish

the decisions to be taken and trust in the SC partners to be implemented, the BWE can be mitigated. Trust and collaboration influence the results of the S & OP practice in an internal company level, providing a more accurate demand forecast, because it provides transparency and information sharing between the various company departments, mitigating one of the main features of the BWE, which is the demand increase throughout the SC. Externally, trust and collaboration influence the results of VMI and CPFR practices, providing greater visibility in the chain and contributing to better coordination between companies, sharing and transparency of information with decreased levels of inventory and product availability.

As for the CPFR, planning information, demand forecasting and product replacement communication should be transparent and with commitment of those involved in this practice. With information coming from both ends of the chain, customer and supplier, demand forecast becomes much more efficient. Flexibility, one of the features of collaboration is necessary for a possible problem or error solving in the conduct of the CPFR practice or other processes. The results are synchronization in decision-making and coordination of SC companies. Consequently, the replenishment policy becomes more efficient.

Concerning knowledge management, learning and training, which were identified as being responsible for the lack of coordination of decision makers in the SC, can achieve better results with trust and collaboration. As noted in the case study, it is possible to share knowledge with companies in the SC based on a trust and collaboration relationship, reaching improvements in relation to inventory cost reduction and process improvement. The results of the single case study revealed that the main BWE characteristics observed in the SLR (Almeida et al., 2015) are present in the SC of the studied companies. Table 5 shows the relation of the case study results with the results of the SLR related to BWE. Note that, as aforementioned, it is assumed that solutions are possible with a culture based on affective trust that involves respect, honesty, mutual understanding, credibility and compliance.

Table 6 summarizes the resolution of problems arising from the BWE pointed out by the representatives of the case study companies, and also what was found in the SLR by Almeida et al. (2015).



**Table 5.** Relationships between the SLR and case study related to BWE.

Systematic Literature Review	Case study
Amplification and variation of demand throughout SC (Lee, Padmanabhan, & Whang, 1997)	Demand forecasting is the main challenge for the focal firm (demand manager)
Lack of coordination among SC companies (Bhattacharya & Bandyopadhyay, 2011)	Lack of learning and training (Planning and production control manager - supplier company) Changes in prices (SC coordinator - supplier company)
Lack of transparency in information (Bhattacharya & Bandyopadhyay, 2011)	Deficiencies in information sharing along the SC (Planning and production control manager - focal company)
Formation of excess inventories throughout the SC to protect against variations in demand (Sucky, 2009)	Excessive inventories often occurs in SC companies selected for the study (Planning and production control manager - focal and supplier, planning and logistics manager - client company) The unavailability of products also occurs in the studied companies, but the formation of stock is a more usual problem (Planning and production control manager - focal and supplier, planning and logistics manager - client company)
Unavailability of the product (Sucky, 2009)	

**Table 6.** Results of the SLR and the case study on the mitigation of the BWE.

Processes	Systematic Literature Review	Case study
S & OP	It balances the supply and demand and related strategic and operational plans of the company (Thomé, Scarvada, Fernandez, & Scarvada 2012)	Gathering as much information as possible with the S & OP (Planning and production control manager - focal company)
CPFR	It aligns the complementary capabilities of trading partners in a collaborative external process (Voluntary Interindustry Commerce Standards [VICS], 2013)	The processes favor the visibility and information forecast, contributing to the mitigation of the bullwhip effect (supply chain manager - focal company)
VMI	A positive impact on the reduction of the bullwhip effect in SC (Disney & Towill, 2003)	

Table 7 shows a comparison between what was observed in the case study and SLR, with respect to the difficulties in implementing the S & OP, CPFR and VMI processes. These results are important in mitigating the BWE in SCs and are related to the behavioral causes of this phenomenon which, in turn, can contribute to tackling operational issues regarding the BWE. Integration with suppliers requires information and transparent knowledge exchange that decreases the inefficiencies of the processes and their alignment. This contributes to the introduction of innovations in companies of a SC, related not only to technological advances of products, but also to collaborative processes such as the VMI and CPFR in an external, and to the S & OP in an internal company level.

#### Consolidation of the theoretical construct

Representatives of each studied company were selected to consolidate the theoretical construct.

This choice involved the criteria of knowledge and experience of professionals on the subject of the present research, including managers, supervisors and analysts of the functional areas of the company. It can be observed that it was presented the proposed construct (Figure 1) for them, and they agreed on the consistency and suitability to the theoretical construct.

**Table 7.** Barriers to implementing S & OP, CPFR and VMI processes.

Systematic Literature Review	Study case
- It takes well-structured and operated internal processes (Pires, 2009)	Processes (S & OP, CPFR and VMI) are based on credibility and changes in the culture of the partner companies, developing a culture of collaboration, substantial investment in time and people to prepare the process, predictions are not clearly communicated along the SC and involved companies do not work together to ensure the achievement of consistent performance (Barrat & Oliveira, 2001).
- Difficulty in establishing reliable and efficient information sharing between companies, necessary based on credibility and changes in the culture of the partner companies, developing a culture of collaboration, substantial investment in time and people to prepare the process, predictions are not clearly communicated along the SC and involved companies do not work together to ensure the achievement of consistent performance (Barrat & Oliveira, 2001).	Processes (S & OP, CPFR and VMI) are based on credibility and changes in the culture of the partner companies, developing a culture of collaboration, substantial investment in time and people to prepare the process, predictions are not clearly communicated along the SC and involved companies do not work together to ensure the achievement of consistent performance (Barrat & Oliveira, 2001).

#### Conclusion

The main contribution of this research involved the clarification of the use of SC management practices, such as the S&OP, CPFR, and VMI, and information technology in mitigating the BWE. These SCM practices are possible in contexts where the affective trust and competence are present in the relationship, and in which both partners can enjoy the win-win relationship. This research indicated practical ways related to the process of knowledge that produces value, operational performance and growth for companies, which can be verified by the field research data having identified that the exchange of knowledge processes and technologies improved the operating performance of companies, thus mitigating the BWE in the SCs. Among the future research opportunities are the development of a quantitative study involving the variables defined in this study in order to support the validation of the theoretical construct.

#### Acknowledgements

Higher Education Personnel Training Coordination (Capes), The National Council for Scientific and Technological Development (CNPq).

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Received on October 29, 2015.

Accepted on February 23, 2016.

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