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Bullwhip Effect in the Information Flow of a Supply Chain: A Role of Culture

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***Abstract*—The main goal of our research is to analyze and display causes of a bullwhip effect formation within a supply chain, as well as to provide the appropriate solutions to limit the occurrence of the bullwhip effect by using the proper information flow and partners' cooperation within the supply chain. The bullwhip effect is one of the most important issues in the supply chain management and it is present in many companies. It preserves a character of invisibility because there are lots of causes for its formation and they are usually difficult to discern. The bullwhip effect is a phenomenon of an increase in the order variability within a supply chain. The higher we are within the supply chain, the higher is the order variability. The company encountered with the whip effect can successfully reduce its impact by improving the information flow, as well as improving partners' cooperation within the supply chain. In this way the company can limit its negative repercussions and increase the profit. The article focuses on the overview of the bullwhip effect within a distribution chain, from its causes to suggestions and measures how to ease its negative repercussions on the organisation. Part of the causes could be found in the market demand variability and in the lack of communication about the actual marked demand within the supply chain. The rest of the causes are related to obstacles that emerge among different partners within the supply chain (role of culture). A qualitative analysis is applied on the basis of the selected cognitions from the supply chain management. The quantitative analysis is based on the theoretical research of the effective flow of information among the participants and its contribution to the reduction of the bullwhip impact. The article discusses two research questions: 1) The correct information flow within the supply chain and the improvement of the communication among partners can lead to the bullwhip effect reduction, and 2) A reduction of the bullwhip influence can lead to the increase of cooperation among partners. The results of the analysis can be used for further research.**

***Keywords*—bullwhip effect, information flow, marked demand variability, orders variability, supply chain.**

I. INTRODUCTION

Nowadays in most industries, like food, chemical or production industry, we have been encountering the state of steady final demand at concurrent occurrence of large variances in the amount of orders, current stock and also in the production amounts of the supply chains. Such state in supply chains is denoted as the occurrence of the bullwhip effect [1; 2].

The bullwhip effect represents the occurrence of increased variability of orders, when we move upwards of the supply chain [3; 4; 5]. The higher we go, the greater is the variability of orders. The increased variance of order leads to inefficiency of the whole supply chain. This causes low level services, associated with late deliveries and even non-compliance with orders, excess stock, uneven burdening of production capacities and ineffective transport. All the stated leads to decreased economic result of the organizations that are getting connected into a supply chain and in terms of longevity it leads to deterioration of their competitiveness and visibility [3; 1; 6].

Students of business schools are faced with the everyday occurrence of the bullwhip effect in different courses of logistics and with use of several experimental learning business simulations game, where players are introduced with distribution side dynamics of supply chain and problems that occur in the supply chain [7; 3; 4; 8]. The majority of simulations are based on simple scenarios, where student are put in the role of individual partners of the chain, from the manufacturer to the retailers, who sell to the final customer. During the simulations students have to make decisions, similar to those, made by the supply chain management. The simulation usually takes place according to the predictable scenario, where upwards the supply chain despite of the relatively stable final demand occur incomprehensibly large variances in the amount of orders, current stock and finally at production amounts, which leads to the bullwhip effect. With the described simulation we can picture a basic example of the bullwhip effect in different industries.

The goal of the article is to analyze and present the occurrence of the bullwhip effect in the supply chain with options for its resolving with the use of corporate culture. The introductory part,

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where the occurrence of the bullwhip effect is discussed, is followed by the analysis of its causes. This is divided into two chapters. In the first one we discuss the impact of variability of the final demand and transfer of incomplete information down the supply chain on the bullwhip effect and in the second we study the impact of cooperation among partners in the chain on the bullwhip effect. On the base of causes and the characteristics of bullwhip effect in practice, the article points out possible solutions for the mitigation or elimination of the bullwhip effect. The recommendations are provided in a form of multiple layers – from the view of enabling access to complete information, the operative and organizational view. Companies do not only look for options for improvement in their own processes, but also in cooperation with other partners in the supply chain.

II. LITERATURE REVIEW

A. *Supply chain and corporate culture*

In literature, there are many different definitions of a supply chain. According to Simchi-Levi et al. [8] we can summarize, that a supply chain includes more independent companies and organizations in the relation supplier – customer [see also 9; 6; 2]. The supply chain refers to the flow of material, information, payments and services from suppliers of raw material through factories and warehouses to final consumers. It also includes organizations and processes that manufacture and deliver products, services and information to final consumers and different activities: buying, payment flow, handling material, planning and the control of production, logistics, warehousing, distribution and delivery [10; 8; 11; 12].

As a goal of a supply chain we often set the following simple demand: providing of the right product at the right place at the right time and at the right cost [10; 8; 13; 14; 15]. Example of simple supply chain presents Fig. 1 [adapted from 2, p. 307].

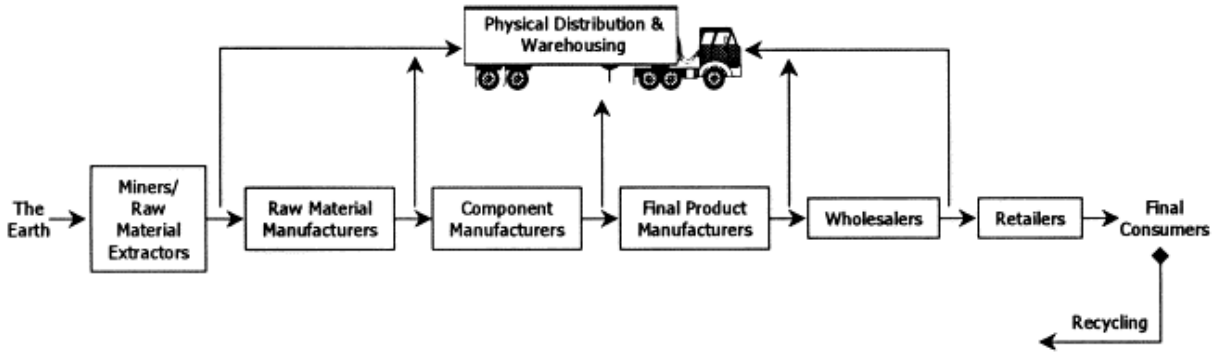

Figure 1: Example of a supply chain

Three types of flows take place within a supply chain. There is the material flow that represents the physical flow of goods from suppliers to consumers and the reverse flow of refunds of products, servicing and recycling. The information flow runs in both sides and represents the transfer of orders, traceability and coordinates the physical flow of goods. The financial flow runs in the reverse way compared to the material flow and includes credit conditions, payment schemes and contracts on the supply and ownership [8; 5; 11; 16].

Companies have supply chains of different structures, which depend on the size of the company and types of production. The reason for the existence of any supply chain is the satisfaction of the consumers' needs and concurrent making profit for the organization [10; 5; 15]. Only satisfied consumers will always come back for more and the successfulness of the supply chain or the entire company mostly depends on them.

We originate our research of culture in work of Schein [17; 18]. Different authors differently define corporate culture, but they certainly all agree that corporate culture is an occurrence in a company, through which the essence and soul of the organization is reflected [19; 20; 7; 21; 22]. The complexity of the concept of corporate culture was well defined by Schein: "Organizational culture is a deeper level of fundamental assumptions and beliefs that are common to members of organization, function on the unconscious level and represent the main self-evident way of perception of ourselves and our environment" [17; 18]. The simplified metaphor of the division of

organizational culture is defined with the visualisation of an iceberg, since it exists of two levels – the visible and the invisible one. The levels of organizational culture present Fig. 2 [adapted from 17, p. 17].

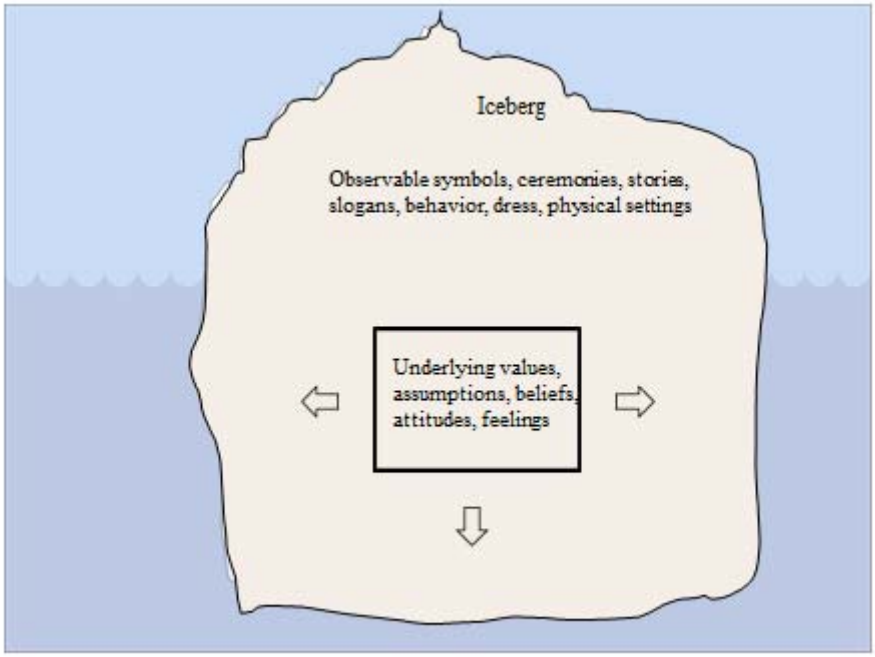

Figure 2: Levels of organizational culture

The invisible part of the iceberg that prevails represents a system of placement and handling of the corporate culture in a company and the visible part of the iceberg represents that part of the organizational culture in the company that is perceived by consumers in the process of meeting with the company and that also significantly impacts user satisfaction. Even better is Schein's model of corporate culture discussion from the view of three levels that differ in visibility and accessibility [23, 9].

Culture as such represents multilayered and dynamic content [19; 20; 21; 22]. When we study it in the context of organization, this even deepens its complexity. This was nicely presented by Schein, who distinguishes three levels of culture regarding to which extent elements are recognizable to the observed. Schein's model of culture presents Fig. 3 Schein's model [adapted from 18, p. 36].

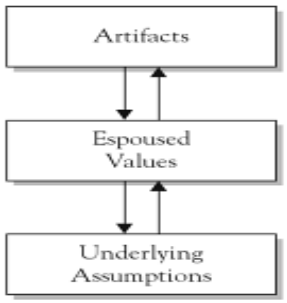

Figure 3: Schein's model of culture

These three levels offer us to find visible manifestation signs, values, norms and basic assumptions [17; 18]:

- Visible artefacts represent the most easily recognizable level of culture, since they are obvious to each individual that enters into a new culture. These include physical environment, language, technology and products, dressing style, addressing rules, myths and stories, rituals.

Among visible artefacts Schein also includes behaviour of the group of individuals and organizational procedures, forming as the consequence of routine behavioural patterns.

- Values according to Schein are "something, that should be, in comparison to that, that is". They reflect in philosophy, strategy and goals of the organization and therefore represent the desired state. The adopted values that are in accordance with fundamental assumptions build a sense of belonging of members of the organization.
- The fundamental assumptions represent the deepest level of organizational culture. Schein places them at the level of pre-consciousness, since they are self-evident, invisible for an individual. The fundamental assumptions combine components the individual is aware of as consequences, but he cannot explain their origin, e.g.: relations with the outside world, nature of reality, time and space, human nature, nature of human activities, nature of human relationships.

B. Occurrence of the bullwhip effect

The occurrence of the bullwhip effect in economy is not new, but researchers from the field of management have been dealing with it for a long time – summary of previous studies were presented Giard and Sali [1] and Simchi-Levi et al. [8]. The first researcher that was in any way interested in the bullwhip effect and described its negative consequences was Forrester [24; 23; 22].

Additionally, Lee et al. [7] have proven with the help of mathematical models that thoroughly describe the activities in the supply chain and optimize the behaviour of chains in it, that the bullwhip effect is actually the consequence of rational behaviour of all the participants in the supply chain. In Lee's model the participants behave rationally and optimize their actions. This theory meant development in the scope of the issue of the bullwhip effect and actually shifted the attention from the subjective decision-making of the participants in the chain towards the structure and functioning of the supply chain [7; 3; 4].

The occurrence of bullwhip effect was noticed on many different markets around the world. The most known are the cases of the companies Procter & Gamble (P & G) and Hewlett-Packard (HP) [5; 11; 15]. In P & G they found out that orders for baby nappies that entered from larger commercial agents vary a lot stronger as actual sales in the store. It also showed that orders to suppliers of raw material for nappies vary even more. It was found that the use of nappies is constant throughout the whole year. Therefore, the highly increased variability of orders in the upper part of the chain was surprising and incomprehensible. The same story happened in the company HP. When they monitored the sales of their printers at one of their main retailers, they discovered that their sale varies. They also discovered that the greatest variability can be monitored at the very beginning of the supply chain, in the case of orders of the printers [14; 12; 16].

Many business schools also use different experimental learning business simulation games like Beer Game [25], for understanding of attribute the increase of variability of orders in the case of players of the game to the irrational behaviour of the player [see also 25; 7; 3; 4; 5].

Many Slovenian companies are encountering the bullwhip effect [6; 4]. As an example we can emphasize the increase of variability of orders in the case of supplying food products to Petrol gas stations by BTC. For the final demand is typical a low coefficient of variability (0,8) that is highly increasing and also reaching the value of 0,22 in the case of Petrol orders by BTC and finally the value of 0,61 in the demand of BTC from suppliers. The occurrence of the bullwhip effect is in the first place attributed to the week-long ordering in bundles and we can emphasize the possibility that increased frequency of ordering decreases the bullwhip effect and consequently decreases the needed stock and costs.

According to certain researches, carried out by many researchers, it soon became clear that not only a few companies have been encountering increased variability of orders – it is a global problem. The variability of orders was eliminated by Dejonckheere et al. [9] with the use of transfer function method. With the method they researched the impact of the use of different systems for the regulation of stock on the side of the bullwhip effect.

Through the functioning of the chains develop new concepts and processes based on knowledge on manifestations of the bullwhip effect and its consequences [7; 1; 26]. One of the origins is: because the bullwhip effect is the consequence of rational decisions in managing the supply chain, we can find tools and methods to mitigate, improve or completely eliminate these effects. The second, more important origin is to ensure cooperation between partners of the supply chain and consequently decrease the bullwhip effect.

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III. RESEARCH

A. *The bullwhip effect in business practice*

The bullwhip effect can be explained as an *occurrence,* where variations in the demand increase with every higher level in the supply chain. It occurs because salesmen respond to variations in sales with larger variations in demand, which cause even greater variations at suppliers' plans. In practice, the bullwhip effect occurs due to incomplete information among partners at different levels of the supply chain. An example of Bullwhip effect presents Fig. 4 [adapted from 13, p. 438].

Figure 4: A simple example of the Bullwhip effect

The main problem, the company encounters, when trying to reduce the effect of the whip, is that there are many causes for its occurrence and that they are mostly not recognisable. The basic assumption is that the case company encounters variable demands for their products or services. One of the most important causes for the increase of variability of orders is that information on actual final demands are no longer available for higher chains. For the chains of the supply chain the demands represent a series of orders that are coming in directly from the lower chain of the supply chain. Incomplete information can tempt a higher chain of the supply chain into excessive reaction to changes in the amount of the orders received, which manifests in excessive increase of own orders to the next chain in the supply chain [26; 14].

It will be necessary to find causes for such actions in the use of methods of forecasting the demand, with the help of which the company should be trying to foresee future changes in the company. The short-term change in demand is recognized as a trend, which will manifest during a longer period of time in the future. It actually can lead to excess reaction to changes in demand.

Increase in the variability of orders in comparison to actual demand, when we move upwards the supply chain presents Fig. 5 [adapted from 6, p. 19].

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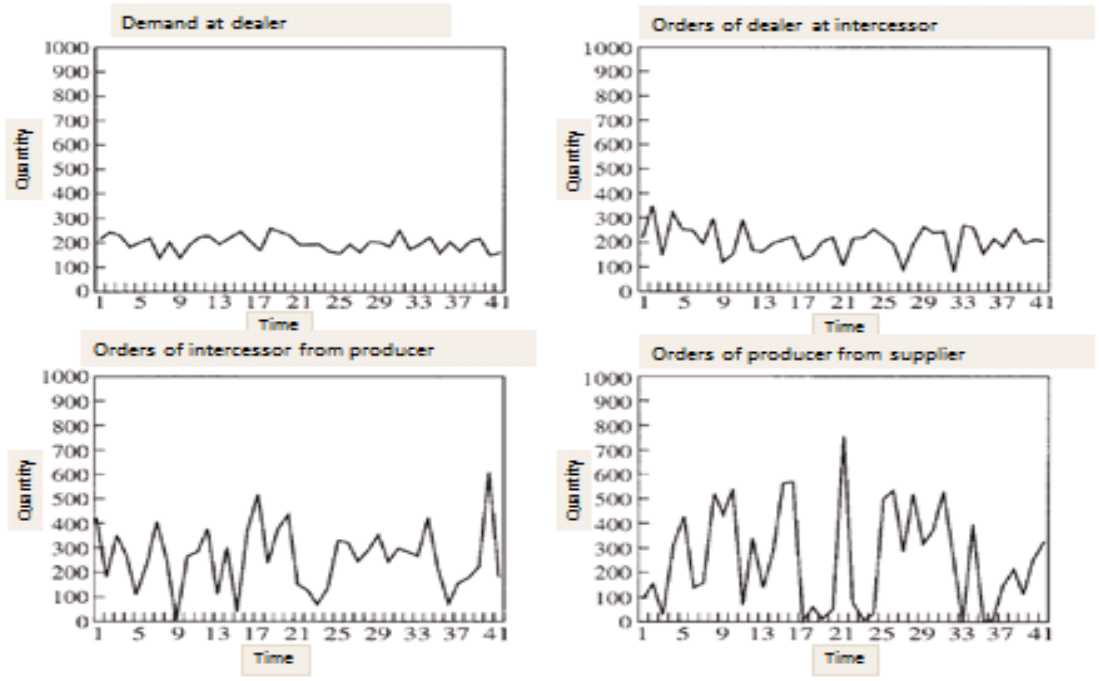

Figure 5: Increase in the variability of orders in comparison to actual demand, when we move upwards the supply chain

Assuming that the next highest chain of the supply chain does not have access to information on the actual demand and builds on its information it comes to further increase of the variability of orders and increased bullwhip effect in the supply chain. As an example we stressed out the case of a salesman, who in a small change of the final demand anticipates the trend of increasing demand and issues an order in the amount corresponding the foreseen upward trend. With a larger order the salesman protects himself against possible exhaustion of the stock, to which it could actually come due to further demands. Similarly, the intermediary recognizes in the order, received from the salesman, a jump in the demand that is higher as the primary jump in the final demand. Because the intermediary has no information about the final demand, the expectations of the intermediary about the trend of increasing demand are even higher then those of the salesman. The consequence of this is that the intermediary passes the manufacturer a larger order than reflecting the increased expectations. Smaller jumps in the final demand cause large variability in orders that increase, the higher we are in the supply chain [6]. Variability of the demand at higher levels of the supply chain will be higher then the variability of the final demand. It comes to the actual occurrence of the bullwhip effect (see Fig. 5 again).

Such increase of variability is also known to certain widely established systems for stock management. Such system is a periodical system of stock management with ordering to the target group, for which we can show that only one generator increases the variability of stock in the supply chain. The reason for this is that the target stock and consequently the amount of the order are set based on the expected demand in the future. The target stock covers the expected demand in the total time of the duration of the period of ordering and supply due and includes a suitable security stock that protects the company from exhaustion of the stock in a period of time. Because we cannot accurately foresee, how the demand will behave in the future, the company assumes that the noticed trend of demand movements will retain in the next periods and correspondingly adapts its stock. How far into the future the demand will reach, largely depends on the delivery time. In the case of longer delivery times the target stock heavily changes from period to period, which consequently influences the changes in the amount of orders. The question arises, whether the selection of such a model is correct, when we know that it leads to the bullwhip effect. Chen et al. [6] discovered that ordering until the target stock is optimal from the view of reducing the stock costs and costs of stock exhaustion for companies, where the bigger part of costs is connected with stock management.

We can also assume that in the situation of heavily variable demand the bullwhip effect leads to an increase in costs, connected with stock management in the supply chain, especially in cases, when the rate of fix costs in key-costs (costs of transport, ordering, preparing of the production etc.)

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is high. In such a situation it is reasonable to decide for a system of stock management, for which a smaller bullwhip effect is typical. The analysis of the connection between the size of the whip and costs showed that the decision for a system of stock management is a compromise between the decreased size of the bullwhip effect and reduction of stock costs [3].

B. Impact of barriers in cooperation in the supply chain on the bullwhip effect

In literature appear more different definitions of causes for the occurrence of the bullwhip effect. In the fundamental work from the field of researches they state four main reasons for the occurrence of the whip: foreseeing the demand in connection with long delivery times, buying in bundles, speculative buying and variable pricing policy [7; 2; 13]. Also important are the barriers, forming during cooperation in the supply chain, better known as: barriers due to different initiative, barriers in data processing, operative barriers, pricing and organizational barriers (See Table 1).

Table 1: Barriers in cooperation/causes of the bullwhip effect

BARRIERS IN COOPERATION	CAUSES OF THE BULLWHIP EFFECT		
Barriers due to different initiatives	Local optimization of functions or partners in the chain	Inconsistent initiative of sales staff	
Barriers in information processing	The demand bases on the orders and not on the actual demand	Denied access to full information	
Operative barriers	Ordering in bundles	Long delivery times	Speculative ordering
Pricing barriers	Quantity discounts tied to the amount of a single order	Short-term pricing promotions	
Organizational barriers	Lack of trust	Bad relations between partners	Lack of learning from mistakes

Barriers that prevent cooperation in the supply chain can cause the occurrence of the bullwhip effect.

Causes for the occurrence of the bullwhip effect cannot only be looked for in the variability of the final demand and in excess reaction to it, since the increase is often a reflection of individual acts of individual chains of the supply chain (manufacturer, distributer, wholesaler, salesman etc.) [9; 1; 13; 16]. These are the consequences of business operations of companies that follow their goals in the supply chain. These often are not in compliance with goals of the chain as a whole and therefore lead to not optimal functioning of the whole supply chain [3; 10; 14]. For example, if we emphasize the problem of transferring an incomplete information on the demand, which was mentioned in the previous chapter, we can explain, how self-initiative acting of an individual chain of the supply chain leads to the bullwhip effect. The intermediary can falsely understand the salesman's intent to increase the amount of the order – because he has assumed a promotion of the product in the period to come – and in the increased order falsely recognize an increase of the actual demand and react to it with excess order from its supplier. The initiative of the salesman to increase the demand with the help of promotion and thus to improve the sales, was not coordinated with the intermediary and other parts of the chain; on the contrary, it misled them into a false assumption of the demand in the future. Or the case, where the salesman based on monitoring of the consumer's demand places orders at the wholesaler. The wholesaler is supplied by a distributer, who orders from a manufacturer. When we look at the wholesaler – he gets the orders from the salesman, but sends his own to the distributer. Because the wholesaler does not have information on the demand of the final consumers, he relies in assuming the needs on the information about the orders of the consumer. But since the variability in the salesman's orders is larger as in the demand of the consumers, the wholesaler needs to have bigger stocks as the

salesman, if he wants to provide the same service as the salesman. If we looked at the distributer and the manufacturer, we would found out, that they need to have even bigger stocks and have consequently higher costs.

Operative barriers occur in the process of stock management [5; 11; 13]. The consequences of local optimization of the stock management process are often increased variability of orders or the occurrence of the bullwhip effect. The main activities that lead to operative barriers and the occurrence of the bullwhip effect are ordering in bundles, long delivery times and speculative ordering.

The company places the order to a higher chain in the supply chain in compliance with the system of stock management in use [7; 2; 16]. The demand, monitored by the company, reduces the stock, but this does not cause an immediate order of new stock, but the company places the order, when the demand is only accumulating. Instead of ordering a new product each time when it sells a piece of the product, the company decides to order in the form of bundles. Companies are forced into such order strategy by fix costs of stock management, ordering and transport. The consequences are extension of the ordering cycle and placing bigger orders [1; 16].

If the demand for a certain product exceeds the supply (excess demand), the manufacturer has to limit the supply of products to consumers [7; 3; 4]. Because consumers are aware that it will come to such a limitation, they order a large amount of products and ensure to take the amount they ordered. The consequence of consumer speculation is that the manufacturer at once records a high demand, which does not reflect the actual demand on the market [9; 26; 16]. But when it comes to limitations of the demand, the given situation ends with reduced orders and cancelations of old orders. In the case, where HP appeared on the market with the laser printer LaserJet III, the demand was so high that they had to limit the supply. The increased demand encouraged additional investing into production capabilities that would ensure a suitable supply. After some time the limitation was withdrawn, which manifested in reduced demand and highly connected stock that the company could not sell.

For pricing barriers the pricing policy of the individual company is mostly to blame, since this causes increased variability of orders and consequently the formation of the bullwhip effect [3; 9; 14]. Changes in prices occur directly because of bulk discounts and more favourable payment terms. For example, in order for the cost of warehousing of additional stock quantities to be lower than the savings from pre-buying at better prices, pre-buying is a reasonable decision. The consequence of this is that consumers order and buy in quantities that do not reflect their actual demand for the product and the stocks are accumulated, therefore the variability of orders is higher than the variability of the demand [9; 5; 26].

Known is also the case of the manufacturer Campbell, who was encountering seasonal demand for products [3; 9; 14]. Its goal was to increase the sales therefore he offered different pricing discounts that would attract potential buyers. The intermediaries took advantages of this benefits and the consequence was a jump in the pattern of the manufacturer's demand. When a manufacturer is encountered with such variability, he needs in certain periods to work with full capacities and in other periods it can come to temporary suspension of the production. Similar burdens occur in accompanying processes of the supply chain, like transport and processing of orders. At the same time the costs of warehousing of excess stocks at intermediaries and salesmen increase.

Organizational barriers are related with the issue of introducing improvements and new concepts in the framework of the supply chain management and construction of cooperation among the participants in the supply chain. These can in comparison with the mentioned barriers lead to the bullwhip effect.

C. Improvement of mutual cooperation in connection with corporate culture

For each company it is essential to be capable to recognize the actual demand, avoid excess reactions to changes in demand and therefore mitigate the effect of the whip [10; 1; 26]. If the company wants to avoid the effect of the whip, it needs to be capable to share the information about the actual demand with other partners in the supply chain. When we return to the case of the company, which places its offers based on the stock management system with ordering until the target stock, we can show that access to information on final demand heavily reduces the effect of the whip in the chain. In the case, that each part of the chain has access to information about the final demand, the increase of the variability is much slower. The manufacturer with the help of the information about the final demand in order of intermediary recognizes, what extent of

the increase in the order represents actual change in the demand. The remaining part of the increase of the order he can assign to assumptions about the movement of the demand of the lower parts of the chain. He can reconcile his reaction with the actual change in the demand and thus avoid the increase of the order to the supplier.

With the increase of the accuracy and accessibility of the information in lots of views he can improve the functioning of the supply chain. But this is not enough to avoid all the barriers in cooperation in the supply chain, the consequence of which can be the bullwhip effect. The measurements to reduce the effect of the whip can be divided into three groups: improvement of accessibility of information about the demand and operative and organizational changes in the supply chain. The accessibility of information is provided with proper transfer of information about the final demand upwards the supply chain. Operative changes are directed towards the reduction of costs of the stock management and reduction of the delivery times. For the introduction of these the introduction of the pricing and transport policy and stock management among participants in the supply chain are necessary [7].

The way to increase the accessibility of information about the final demand is to establish systems for recording the demand or sales at the point of the sale (POS) in relation with the introduction electronic data interchange (EDI). This way the basic conditions are fulfilled so that cooperation between the participants in the supply chain in the process of foreseeing the demand, stock management and production planning can be established. Precisely such cooperation often eliminates the consequences of distortion of information in the chain that misleads the company into ineffective actions.

The provision of information and centralization of the access to information are effective for the company, but in practice it is not always this way, since it shows that companies falsely interpret the information, they receive from their partners. Access to information as such has a positive effect only in a case, when the company properly interprets the information and properly reacts to them. The effects of the cooperation in the supply chain are visible only then, when the partners in the supply chain are connected into a system on information management in the supply chain. One of the main goals of the company should thus be that it does a step from the collector of information towards the information manager. This is possible only when all the organizational barriers are eliminated and the conditions for cooperation between partners in the supply chain are established.

If the company introduces proper operative changes it can reduce the uncertainty and variability of the demand in the supply chain with shorter delivery times and initiatives for the reduction of the need for ordering in bundles. With smaller uncertainty of the demand increases the accuracy of foreseeing the demand as well as stability and efficiency of the stock management in the entire supply chain. The company avoids random accumulation of orders in individual periods and recognizes excess ordering in bundles, particularly with computer supported ordering, reduction of ordering costs and incentives for more uniform ordering. Accordingly the efficiency of stock management rises and the costs of ordering and transport decrease. In combination with access to complete information the company can in the demand on time recognize changes that are not reflecting the changes in the final demand. With such a choice it avoids excess ordering in smaller amounts of bundles and speculations that appear in the expectation of insufficient supply.

When the company has introduced changes it can, with the introduction of direct sales, direct straightforwardly towards the final consumer and therefore reduce the impact of the intermediaries in the supply chain. Similar effect can be achieved with the improvement of cooperation between partners in the supply chain, with the help of mutual coordination and integration of the functions in the process of stock management. Cooperation takes place in the framework of information interchange within the supply chain, joint transports and unified system of stock management in the supply chain. Here the establishment and unification of initiatives are important, being within the pricing or transport policy that encourages cooperation in the supply chain.

In table 2 causes of the bullwhip effect are complemented with possible measures for the improvement of cooperation in the supply chain that lead to the reduction of the bullwhip effect [adapted from 19, p. 25].

Table 2: Measures for the improvement of cooperation and reduction of the bullwhip effect

BARRIERS IN COOPERATION	MEASURES FOR IMPROVEMENT OF COOPERATION AND MITIGATION OF THE BULLWHIP EFFECT

	Information and its accessibility	Operative changes	Organizational changes
Barriers due to different initiatives	- Proper implementation of information	- Sales "bypassing" the salesman	- Coordination of initiatives between partners - Pricing policy, that encourages cooperation
Barriers in information processing	- Proper interpretation of information - Records of sales at the point of sale - Computer interchange of information	- Reduction of uncertainty through shortening of the delivery times - Collaborative Planning, Forecasting and Replenishment in the chain (CPFR)	- Price incentives for information sharing - Direct supply - Vendor-managed inventory (VMI)
Operative barriers	- Computer interchange of information - Computer-assisted ordering - Ordering over the internet	- Reduction of ordering costs - CAO - Incentives for more equal ordering	- External logistics - Joint transports - Supply based on past orders
Pricing barriers		- Price discounts based on the total amount of orders - Permanent discounts / »every day low pricing« (EDLP)	- System of continuous stock management (CRP)
Organizational barriers	- Communication of the information - Trust in information		- Think global - Establishment of cooperation and trust of partners

After all the analysing we can answer the question, why the bullwhip effect is still present in companies all around the world and represents a serious problem. Its reduction demands a huge amount of cooperation between partners in the supply chain. Additional barriers for the cooperation are: the lack of trust between partners in the supply chain and undefined division of possible savings from the view of more effective leading of the entire supply chain. Cooperation is hard to achieve, if in the chain there are no established proper initiatives that would encourage cooperation. Thus we can assume that the key for effective cooperation in the chain is that the supply chain is comprehensive, where individual functions of the company do not run independently, but follow common goals.

IV. DISCUSSION

We discovered that we can now answer the question, why the bullwhip effect is still very present in companies around the world. Its reduction demands a large amount of cooperation among individual partners in the supply chain in the framework of corporate culture. Additional barriers for

cooperation represent the lack of trust among partners in the chain and the undefined division of possible savings from the view of effective leading of the supply chain. Cooperation is difficult to achieve, if within the chain there are no initiatives established, which would encourage such cooperation. The key to effective cooperation in the chain is a complete functioning of the supply chain, where individual functions of the company or the company as a whole do not function independently, but follow common goals.

Despite it all the bullwhip effect maintains the characteristic of avoidance. The number of its causes is increasing and they are often unrecognisable. The causes need to be found in the variability and uncertainty of the demand, but their impact increases the more the individual part of the chain is away from the source of information about the actual demand.

A company or organization that encounters the bullwhip effect can properly reduce its impact with different measures, but it also encounters the acknowledgement that the size of the bullwhip effect heavily depends on the cooperation of partners in a supply chain. Mutual cooperation of partners in a supply chain improves if actions of individual chains in the supply chains are directed towards the increase of profit. Each chain does not only strive towards the increase of its profit, but also takes into account its impact on other chains. If the chains do not cooperate with each other, this can lead to deterioration of the service level and consequently to higher cost and lower profits in the supply chain.

A company that tries to reduce the bullwhip effect and improves the functioning of the entire supply chain needs to think about consequences (while thinking about its actions) that the action could have for the operations of other partners. Often this alone mitigates the occurrence of the bullwhip effect. The findings that were presented through the content of the entire article can be summarized into a hint for successful cooperation between partners in the supply chain.

Corporate culture can have positive and negative effects that heavily impact the successfulness of the organization, which impacts the way of decision-making among partners in the supply chain, the use of human resources and reacting of the organization to the environment. For the company and its competitive advantage it is important that it is aware of its own culture and that it strives for a strong corporate culture between individual partners or chains in the supply chain.

Regarding the deepened knowledge about manifestations of the bullwhip effect and its consequences new processes and concepts of cooperation have been developed in the functioning of the supply chain which will mitigate its negative consequences. But the bullwhip effect will be always present in a certain amount, since it is related with a changing world in which we live.

In the conclusion we can answer the question, we set at the beginning of the article. Proper information flow, its accuracy and accessibility between chains in the supply chains improves its entire functioning and does not mislead the higher part in the chain into excess reaction, which in practice actually mitigates the bullwhip effect. But it is not always this way, since it shows that the company gets a falsely interpreted information form the partner. The access to the information its accuracy and accessibility have a positive effect, when the company properly interprets the information and properly reacts to it (proper information flow).

Proper cooperation between individual parts of the supply chains also leads to a reduction of the bullwhip effect. Its reduction demands a large amount of cooperation between partners in the supply chain. Additional barriers for cooperation in the chain represent the lack of trust among partners and undefined division of the possible savings from the view of efficient leading of the entire supply chain. Cooperation is hard to achieve, if there are no proper initiatives established in the chain that would encourage cooperation. So we can assume that the key for effective cooperation in the chain is that the supply chain functions comprehensively, where individual functions of the company do not run independently, but follow certain common goals.

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