Bullwhip Effect in Supply Chain

Subjects: Instruments & Instrumentation

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The bullwhip effect results from inefficiencies in the supply chain; in perishable products, the inefficiencies are quality in the supply chain and product waste. Update the demand, the level of deterioration of the product, and the number of intermediaries is the causes of the bullwhip effect most investigated.

bullwhip effect perishable supply chain quality waste

1. Introduction

When reviewing the bullwhip effect in perishable products, [1] indicates that research does not look at the level of waste, interaction with similar products, and impact over multiple periods. This process [2] states that it is better to focus on improving forecasting methods than clearly defining safety inventory.

Feeding more than seven billion people becomes an essential factor in guaranteeing food security; it is imperative to design operating models to reduce food waste [3].

This increase in the number of people in the world directs the gaze towards the loss and waste of food, directly affecting people's nutrition [4]. This population increase can reach 1.7% per year, making it necessary to guarantee food availability and improve the supply chain's effectiveness [5].Ref.[6] shows us the interest of researchers in knowing the quality of the supply chain's performance and the technological and logistical tools to identify these factors.

The research has three objectives: (1) to identify the variables that are causing the bullwhip effect in supply chains; (2) establish the factors that affect the quality of the perishables supply chain and (3) articulate those quality factors of the perishables supply chain, which may be impacting the bullwhip effect. Paper seeks to identify the variables of the bullwhip effect by researchers, the type of solution they have proposed for the perishables supply chain, and the variables and factors not investigated yet, which will serve as future framework research.

2. Bullwhip Effect

Researchers like [7][8][9][10][11][12] indicate that demand management is a relevant factor when measuring the impact of the bullwhip effect. The seasonality of demand can cause sales promotions in periods of low demand; the variation in prices to boost sales can be another critical factor that increases the bullwhip effect.Refs.[13][14][8][15]

indicate that price fluctuation amplifies orders upstream of the chain, in that order of ideas[16] indicates that the price variation is the most crucial cause of the bullwhip effect.

Regarding inventory and restocking policy, refs.[2][14][17] indicate that its control may become relevant to reduce the bullwhip effect.Refs.[18][16]they establish the lack of synchronization between the actors in the chain and the failure to share information as operational causes of the bullwhip effect, and ref.[19] ensures that information sharing reduces the influence of bullwhip effect [20] added more categories to the operational causes and found that the pressures caused by the commercial part of the company to meet sales goals and the number of actors in the supply chain and damage to production machines are additional factors that increase the whip effect.

The bullwhip effect review references [21] and his postulate on the causes of the bullwhip effect.This classification complete with the characterization of the bullwhip effect proposed by [22], which involves behavioral and operational reasons.Ref.[20] makes contributions such as the breakdown of machinery and the number of intermediaries as other operational causes.[23] proposes a new cause such as the level of deterioration of the product, found in “other causes”—the structure of the bullwhip effect’s causes shown in **Figure 2**.

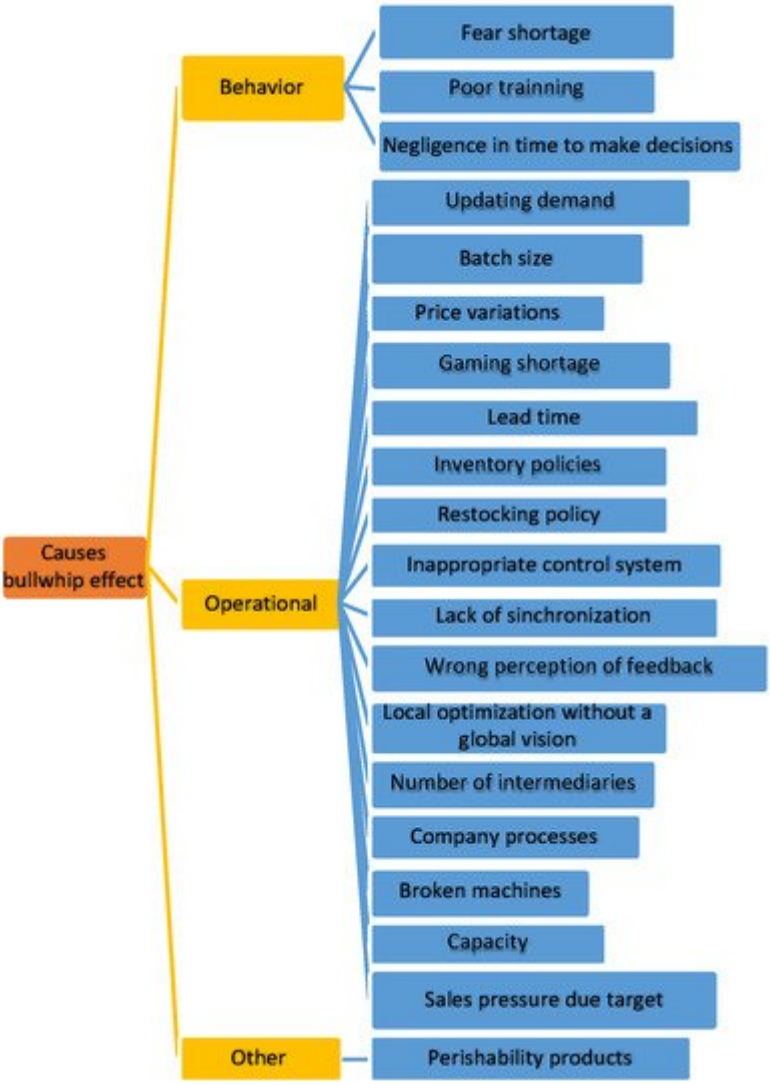

Figure 2. Causes of bullwhip effect. Reference: Authors.

Table 1. Causes bullwhip effect classification.

Classification	Description	Authors	ID
Behavior	Fear shortage	[3][15][17][20]	B-1
	Poor training	[3][15][16][20]	B-2
	Negligence in time to make decisions	[3][16]	B-3
Operational	Updating demand	[2][5][19][20][21][22][23][24]	O-1
	Batch size	[2][3][21][25]	O-2
	Price variations	[2][3][4][19][22][26][27]	O-3
	Gaming shortages	[2][3][21][28]	O-4
	Lead time	[4][5][21][25]	O-5
	Inventory policies	[3][9]	O-6
	Restocking policies	[19][20]	O-7
	Inappropriate control system	[3][18]	O-8
	Lack of synchronization	[6][22][29]	O-9
	Wrong perception of feedback	[3]	O-10
	Local optimization without a global vision	[3]	O-11
	Number of intermediaries	[22][27]	O-12
	Company processes	[3][14]	O-13
	Broken machines	[27]	O-14
	Capacity	[3]	O-15
	Sales pressure due target	[26][27]	O-16
Other	Perishability products	[7]	N-1

Table 1shows the identification assigned to each cause of the bullwhip effect in the supply chain, as well as the research that support the cause of the bullwhip effect.

Reference: Authors.

3. Bullwhip Effect in Perishable Supply Chain

Table 6 also shows that most of the research is related to agricultural products; this may mean an interest in researchers related to the increase in world population [5].

Table 6. Type of perishable products analyzed.

Type of Perishable Product	DATA	
	Real Case	Case Study
Perishable	[30][31]	[32][33][34][35][36][37]
Obsolete/Out date	[38]	
Deteriorate/Decay:		
Non-eatables		
Eatables:		
Animal/Birds and their produce	[39]	
Agricultural produce:	[40][41]	[42]
Long shelf life	[43]	
Processed produce	[10][44][45][46][47][48][49]	
Fresh produce	[50][51]	[52][53]

The information available in the supply chain can limit the investigation of the supply chain of perishable products. On the other hand, there is a strong tendency to investigate agricultural products within the perishables family, where one of the factors that drive this interest is the increase in the world population [3].

Solutions models.

* ILP: Linear programming Mixed-integer/integer linear programming; NLP: Non-linear programming; MOLP: Multi-objective linear programming; SM: Simulation models; DP: Dynamic programming; HEU: Heuristics algorithms and metaheurıstics; STAT: Statistics analysis; ML: Machine Learning.

4. Conclusions

Research on the causes of the bullwhip effect is a journey that began with [26] when first identifying this phenomenon. Today there are human and operational classifications for the causes of the bullwhip effect, to the point that it is possible to go more in detail and find sub-classifications that show new elements such as machinery maintenance plans and changes in the methods to process information such as causes of the bullwhip effect in the supply chain [20]. According to the review carried out, we can conclude: The causes of the bullwhip effect most investigated in the supply chain of perishable products are demand update processes, the level of deterioration of the product, the inventory policy, and the number of intermediaries. The quality factors of the supply chain of

perishable products most investigated to reduce the bullwhip effect in the supply chain are the safety of the product and the quality of the information and its information technologies.

Future research should review how the bullwhip effect affects human behavior in perishable product supply chains, and no research articulates these two variables. Similarly, there is no research on the causes of the bullwhip effect in perishable products: rational game of shortages, wrong perception of feedback, local optimization without a global vision, machinery breakdown, limited capacity, and pressure to meet production goals. Similarly, the quality factors of the supply chain of perishable products not investigated yet as variables of the bullwhip effect are quality assurance, quality of human resources, and sustainability.

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