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Buffer positioning optimization in Demand-Driven DRP: model development and case study

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Abstract: The physical flow in distribution networks is highly susceptible to fluctuations caused by demand uncertainty. These fluctuations contribute to variability amplification across supply chain stages, known as the Bullwhip Effect. This paper investigates the conceptualization, modeling, and optimization of Demand-Driven Distribution Resource Planning (DDDRP) as a strategic management tool to mitigate this issue. We begin with a systematic literature review, covering (1) the causes, consequences, and solutions for the Bullwhip Effect and (2) conventional flow management methods, including lean distribution and the theory of constraints. Next, we present the theoretical foundation of the DDDRP model, outlining its core principles and stages. We then propose an optimization strategy of the first stage (i.e., Buffer positioning) through mathematical modeling to enhance system performance. This model can be applied by practitioners to improve decision-making. We validate its effectiveness through a real-world case study, demonstrating significant improvements in flow stability and supply chain performance. As an emerging flow management approach, DDDRP offers a robust alternative to traditional forecast-driven methods by aligning supply with actual market demand. Its growing adoption reflects its potential to enhance agility, reduce variability, and build more resilient distribution networks.

1 Introduction

The concept of supply chain management (SCM) is perceived as the organization of a set of networks that manage physical, information, and financial flows. These networks involve relationships between the different links in the supply chain (SC) that provide a product or a service to satisfy the end customer (Christopher, 1992). However, SCM is currently facing many challenges in a dynamic, fuzzy, and increasingly competitive market. One of the main challenges is reducing the gap between planned and shipped sales (i.e., variability), which may amplify while we pass from retailer to factory (i.e., the bullwhip effect). Managing this issue involves the consideration of the following question: How efficiently does the distribution flow manage variability amplification in multi-echelon distribution networks?" In fact, many authors highlight the importance of flow efficiency, mentioning that an organized and well-managed flow helps to adapt distribution to unpredictable variations in the process and customer demand. On the other hand, inefficient flow management can lead to several undesirable consequences, causing an amplification of demand and process variability through distribution networks [1]. This amplification has been recognized in many markets, such as Procter & Gamble and Walmart, the pasta industry, the automotive industry, and retail [2-5]. In literature, the causes of this phenomenon are widely studied, as are its effects [6]. The authors affirm that the most impactful causes are demand forecasting imprecision and inventory policy inadequacy, which negatively affect lead times and consequently the service level. In this context, the DDDRP model has been proposed recently to mitigate the bullwhip effect. It brings the concept of demand-driven distribution and takes advantage of push-flow approaches like DRP and pull-flow ones like lean distribution and the Theory of Constraints [7]. The model phases are:

- Buffer positioning at strategic points of the network in order to protect flow from variability amplifications.
- Buffer sizing, taking into consideration demand covering, safety stock, and replenishment frequency.
- Dynamic adjustment of the buffer according to market fluctuations.
- Demand-driven planning to determine when replenishment orders should be triggered.
- Execution of planned orders by priority, not due dates.

This work gives a contextualization, description, and evaluation of the DDDRP model. It is structured as follows: In the first section, a systematic literature review exhaustively illuminates the bullwhip effect in distribution networks. It also analyzes conventional approaches to flow management, such as DRP, lean distribution, and the theory of constraints. Secondly, a section is devoted to dissecting DDDRP phases, presenting its algorithms as well as the theoretical elements. Finally, an approach for Buffer position optimization is detailed in this work, presenting a mathematical model as well as its resolution.

2 Systematic literature review

2.1 Bullwhip effect in distribution networks

The bullwhip effect (Figure 1) is a supply chain phenomenon describing how small fluctuations in demand at the retail level can cause progressively larger fluctuations in demand at the wholesale, distributor, and manufacturer levels.

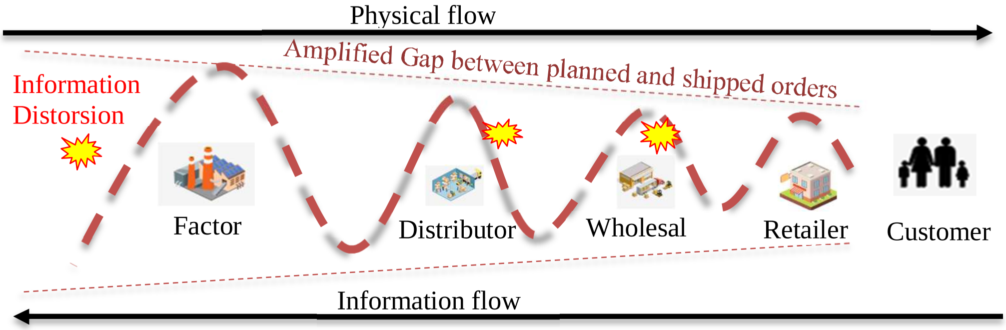

Figure 1 Illustration of the bullwhip effect

The phenomenon is recognized in many structures, especially those with large-scale distribution networks. Figure 2 shows four cases related to the auto parts industry, computer sales, washing powders, and fresh orange juice.

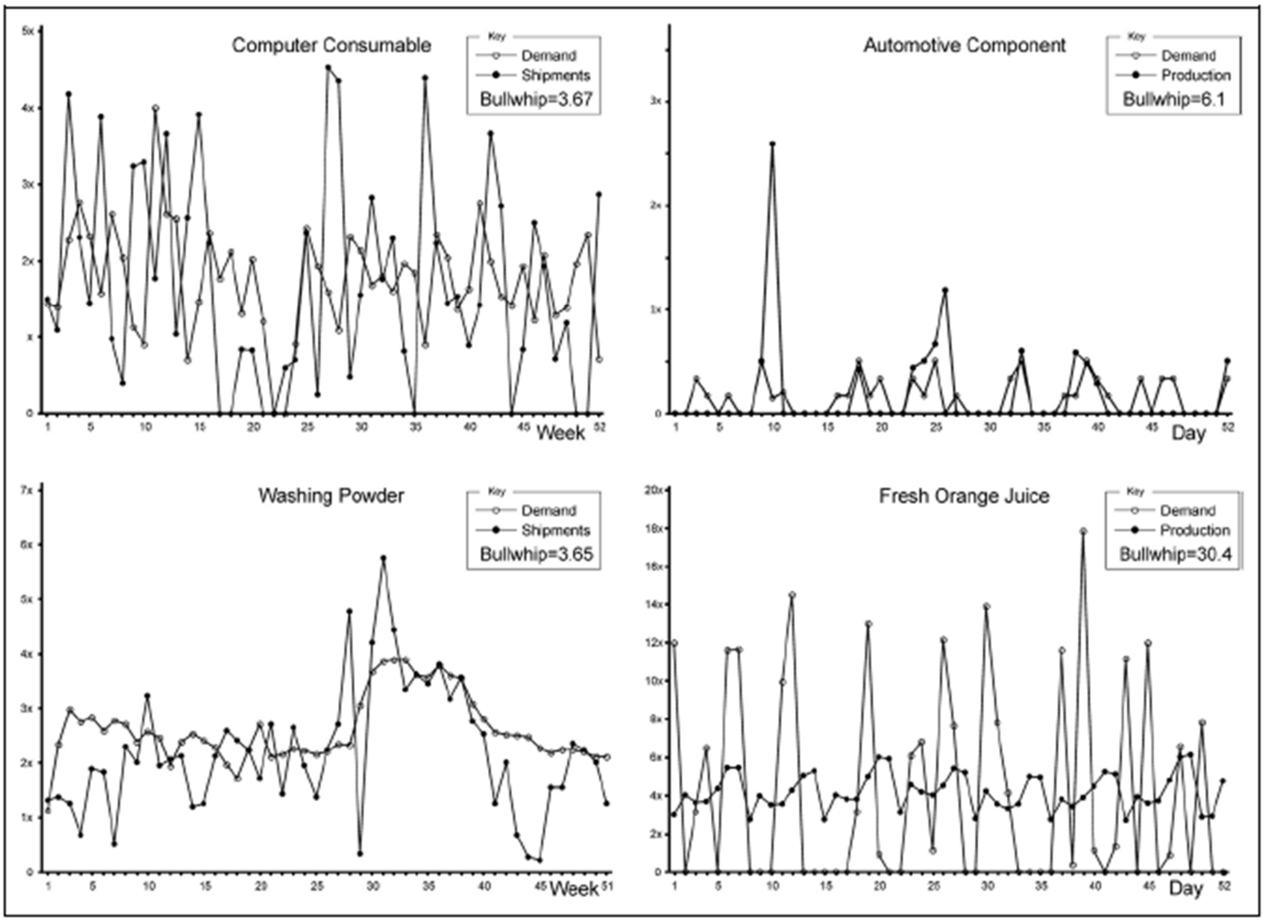

Figure 2 Real cases of the bullwhip effect [8]

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The illustration above indicates the gap between customer demand and shipped/produced orders for different industry sectors. Many works of literature address the direct and indirect causes of this phenomenon. Table 1 summarizes the different causes reported in literature.

Table 1 Causes of the bullwhip effect [2]

N°	Cause	N°	Cause
1	Demand Forecast	9	Multiplier effect
2	Batch Order	10	Inadequate control system
3	Price fluctuation	11	Lack of synchronisation
4	Lack of transparency	12	Timeframe for implementation
5	Storage policy	13	Poor perception of feedback
6	Business process	14	Fear of empty stock
7	Capacity limits	15	Lack of learning and/or training
8	Replenishement policy	16	Number of echelons

To summarize, the bullwhip effect amplifies demand fluctuations across supply chain echelons, leading to inefficiencies. The key causes include inaccurate demand forecasting, inadequate inventory policies, and poor information flow. Understanding these factors is crucial for mitigating variability in distribution networks.

2.2 Flow management policies in distribution

This literature review focuses on two main topics, which are lean distribution and the theory of constants, and illuminates their importance to improving conventional DRP. In fact, they have been used in the construction of the demand-driven MRP model [9], where a fundamental rethinking of MRP logic incorporates ideas from lean principles and the theory of constraints. This review allows us to call into question some tenets of DRP, leading to the substitution of dynamic buffers for static safety stock as well as demand-driven distribution for forecast-driven management.

2.2.1 Lean distribution

In general, lean principles have been integrated to minimize waste and increase productivity [10]. In a distribution context, it is defined as a pull-flow approach that replaces conventional methods in terms of forecasts, inventory [11], and replenishment in order to cope with fluctuating customer demand (Table 2). The main concept is to place the right product in the right place while minimizing waste in the downstream supply chain [12].

Lean distribution mitigates the Bullwhip Effect by isolating variations and using demand-driven replenishment instead of forecast-based systems. This improves inventory accuracy and reduces waste. Table 3 shows some quantitative benefits, based on a case study in a Serbian company, of implementing lean concepts in distribution units [7].

Table 2 Comparison of lean distribution and traditional management

Distribution elements	Traditional distribution management	Lean distribution
Systems variations	Variations cause continuous resetting of plans.	Isolation of variations and taking them into consideration in all lean practices
Forecasts	The constraint of being more accurate	Used only for long-term and aggregate planning
Inventory	The inventory should not be close to customer orders.	The inventory should be close to the source and redirected according to replenishment needs.
Transportations	It is forecast-driven.	It is demand-driven and takes into consideration delivery conditions.

Table 3 Quantitative benefits of lean distribution

Area of improvement	Improvement quantity	
	Before	**After**
Inventory accuracy	9.29%	5.97%
Reducing lost-time accidents	15-20 days	7-10 days
Reducing picking error	0.17%	0.01%
Inventory levels	Decrease of 76%	
Required storage space	Decrease of 51%	
Warehouse productivity	Improvement of 9.43%	

2.2.2 Theory of constraints

The theory of constraints (TOC), which was originally conceived as a continuous improvement philosophy, has now developed and broadened its methodological foundation. In its original form, TOC was created by Dr. Eliyahu Goldratt and included a systematic method for resolving organizational issues [13]. Its "5 focusing steps" allow for the identification of the constraints that prevent an organization from achieving its objectives as well as the "breaking" of those constraints and subsequent iterations of improvement.

The TOC technique presently consists of two major components, which can be categorized as logistics paradigms and thinking process (TP) tools.

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Table 4 Categorized tools and general description of TOC components

TOC Component	Description		Tools	Role
Logistics paradigms	It is managed using time buffers (T-Bs) and the drum-buffer-rope (DBR) approach.		Drum	The system schedule or the pace at which the constraint works
			Buffer	Inventory to protect the output from system variations.
			Rope	It provides communications between critical control points to ensure their synchronization.
Thinking Process	a general strategy for examining and resolving complex situations through:	Decide What to change	Current Reality Tree (CRT)	It identifies actual problems and negative impacts in order to determine their "root causes".
		Decide What to change to	Evaporating Cloud (EC)	It focuses attention on problems with the CRT that have not been resolved and takes steps to resolve them.
			Future Reality Tree (FRT)	It studies the effects of the identified solution.
		Decide how to change	Prerequisite Tree (PRT)	It focuses attention on the problems and challenges that may arise when shifting from CRT to FRT.
			Transition Tree (TT)	It assists in determining which actions are necessary to accomplish the intended goals and which are secondary.

By focusing research on the TOC literature, we can conclude that it offers the solution of pull-flow management. The central point of this axis is the notion of capacity constraint resource (CCR). It stipulates the need to promote protection at points with capacity constraints (high system variation), which has negatively affected flow performance. In addition, the DBR concept inspires the setting up of protection buffers at strategic points, more specifically those with high demand or process variability.

2.3 Synthises

From the axes discussed previously, several facilitators are to be considered in the new model to allow a systematic assessment (Figure 3). These axes serve an effective mechanism for conventional DRP improvement.

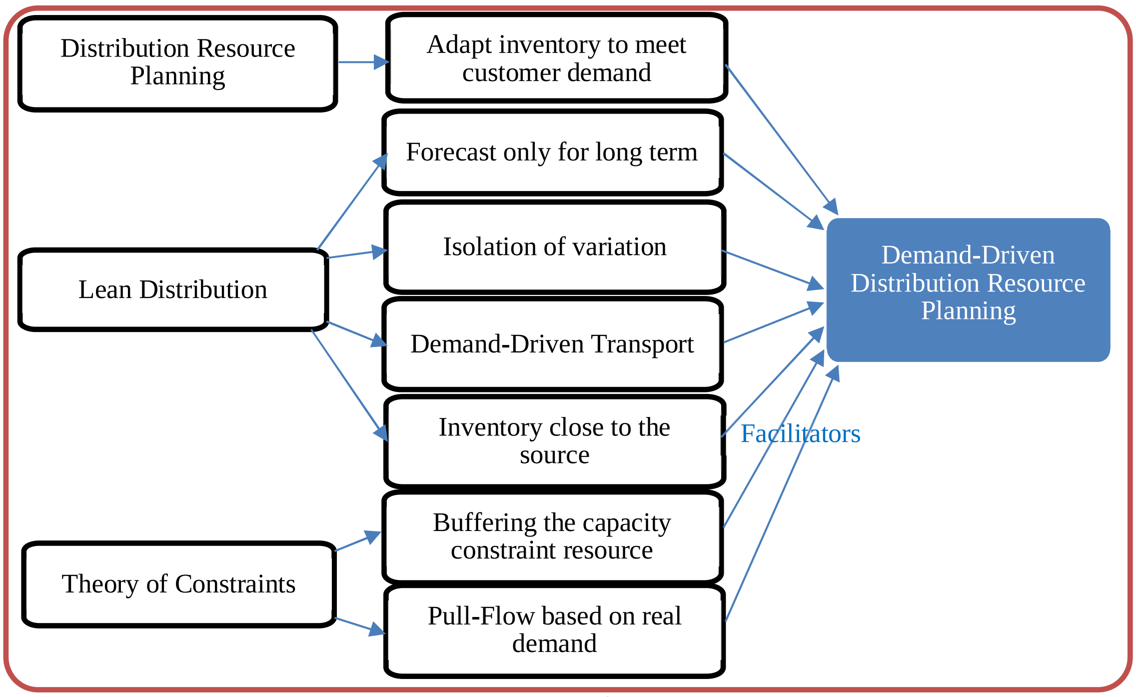

Figure 3 Facilitators of DDDRP model

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Figure 3 illustrates how Demand-Driven Distribution Resource Planning (DDDRP) draws upon foundational concepts from traditional DRP, Lean Distribution, and the Theory of Constraints. These paradigms contribute key operational principles—such as variation isolation, decoupling, and pull-based logic—that act as facilitators in building a demand-driven, responsive distribution system. This synthesis highlights the theoretical coherence of the DDDRP model and supports its relevance as a modern flow management approach.

3 Demand-Driven DRP (DDDRP) steps and theoretical elements

The demand-driven DRP has been proposed as a multi-echelon planning and execution solution for optimal flow management, and then was subject to an empirical comparison with the conventional DRP [7]. In fact, the model exploits DRP, lean distribution, and theory of constraints concepts. It allows for reducing the amplification of variabilities that spread through distribution networks. Figure 4 describes the essential phases of the DDDRP model.

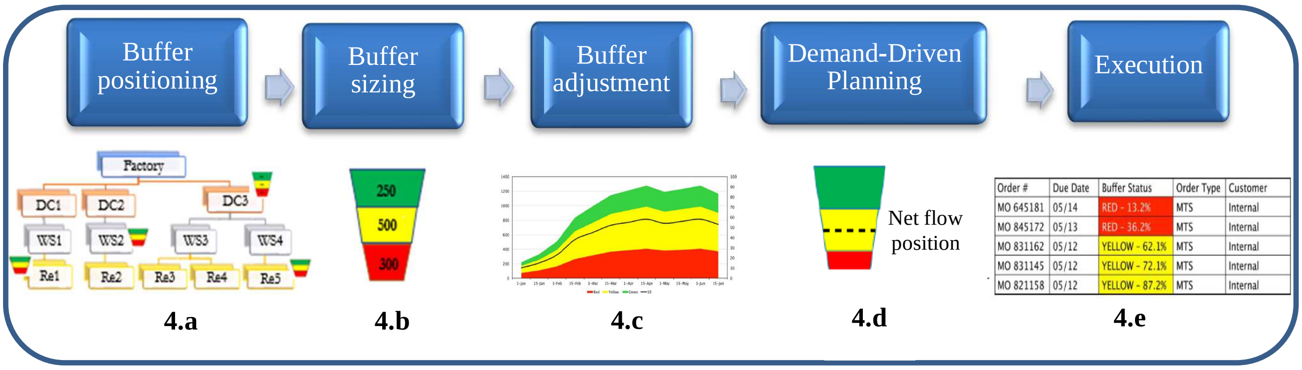

Figure 4 DDDRP essential phases

Phase I: Buffer positioning (figure 4.a)

The DDDRP model uses the concept of positioning “Buffers” at strategic points of the distribution networks. It allows us to stop the amplification of variability while we pass from upstream to downstream in the supply chain. In addition, buffering is a way to decouple lead times and reduce distribution delays. Numerous configurations are possible for buffer positioning in distribution networks, among them the hub-and-spoke, make-and-ship, or hybrid configurations [14]. Otherwise, an optimization approach was illustrated to buffer positioning in a manufacturing context based on the minimization of the total inventory cost [15]. They propose a non-linear mathematical model and study its complexity as well as its linearization, which permits them to determine the optimal positions for Buffer.

Phase II: Buffer sizing (figure 4.b)

Buffer profile and sizes refer to various mathematical formulas (1), (2), (3), (4), (5), that specify the dimensions related to the three buffer zones.

Red part: responsible for safety stock.

Yellow part: responsible for demand coverage.

Green part: responsible for frequency and number of orders.

$$Red\ Base = ADU * DLT * LT\_factor \quad (1)$$
$$Red\ Safety = Red\ base * Var\_factor \quad (2)$$
$$Total\ red\ zone = Red\ Base + Red\ Safety \quad (3)$$
$$Yellow\ Zone = ADU * DLT \quad (4)$$
$$Green\ Zone = ADU * DLT * LT\_factor \quad (5)$$

The equations above use a variety of distribution parameters, where:

- LT (Lead Time): distribution delay between a supply center and a receiver center. It involves time to load, transport, unload, prepare an order, launch, and stock the product.

- DLT (Decoupling Lead Time): It is the longest cumulative nonbuffered sequence for each buffered point in the network.

- ADU (Average Daily Usage): Historical or forecasted amount of an item utilized on an average day.

- LT_factor: It reflects the height of delays in the network.

- Var_factor: It reflects the variability of customer demand.

Phase III: Buffer adjustment (figure 4.c)

Demand-driven DRP considers market changes as well as fluctuations in operating factors such as ADU to adjust buffers continually. It ensures a dynamic adjustment for the buffer, in which the level of protection flexes up and down depending on the condition of those parameters, implying that the buffer situation is constantly updated.

Phase IV: Demand-Driven Planning (figure 4.d)

This stage involves generating supply orders. The notion of “Net Flow Position” (NFP) in the buffer is central; it is calculated to decide whether to launch a supply order or not. It includes the quantity of inventory on hand, the quantity of open supplies, and qualified sales rather than forecasted sales (6). The Net Flow Position (NFP) determines when to trigger a supply order. It is calculated as:

$$NFP = OnHand\ Inventory + Open\ Supply - Qualified\ Sales \quad (6)$$

If NFP is high: The inventory level is sufficient, and no order is needed.

If NFP drops below TOY (Top of Yellow Zone): A supply order is triggered.

This ensures that replenishment occurs only when necessary, reducing excess stock while preventing shortages."

Phase V: Visible and collaborative Execution (figure 4.e)

The last phase considers the execution of the previously planned orders. The decision is based on the priority of execution for each article, which has an indicator called "Buffer Status". Articles with low status form an execution emergency among the other articles.

$$Buffer\_Status = \left(\frac{On\_Hand}{Top\_Of\_Red}\right) * 100 \quad (7)$$

4 Optimisation of Buffer Positions

Buffer positioning is considered a stock location issue. The purpose of addressing this issue is to determine where buffers should be placed in the distribution network to best meet client demand. The study concerns a three-echelon distribution network belonging to a Moroccan food company. The manufactured products at the factory are delivered to hypermarkets through one of the seven distribution centers (DC) (Figure 5). The exploited data in this study concerns:

- Historical sales data for the last five years.
- Lead time for distribution.
- All distribution and inventory costs.

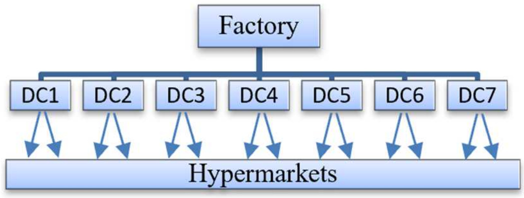

Figure 5 Case study distribution network

4.1 Buffer positioning model

To address this model, it is necessary to formulate an objective function that reduces the total cost of storage. We consider the customer delay as a constraint, and we elaborate on decision variables corresponding to the buffer locations. Each node in the network has a single supplier considered the parent node, and all delays are deterministic.

A general distribution network with N echelons is modelled by a matrix with L rows and C columns. The network points are located at i ϵ L and j ϵ C. The coordinates where there are no nodes have null values when reading the tree structure from the top left to the top right. The following notations are used in the formulation of the positioning problem (Table 5).

Table 5 Positioning problem notations

$LT_{i,j}$	Lead time in the node (*i,j*)
$DLT_{i,j}$	Decoupling lead time at the node (*i,j*)
$Supp_{i,j}$	As every node in the distribution network has a single supplier, it indicates the column position of the supplier located at the node (*i,j*)
$Client_{i,j,k}$	It indicates the column position of the k^th client
TS	Tolerated service by the final customer
$ADUi,j$	Average daily usage in the Node (*i,j*)
SCi,j	Storing cost in the Node (*i,j*)
TC	Total storage cost in distribution network
BAI*i,j*	Buffer Average Inventory at the node (*i,j*)
UP*i,j*	Unit price at the node (*i,j*)
AIH*i,j*	Average inventory holding rate at the node (*i,j*)
LT_Faci,j	Lead time factor at the node (*i,j*)
Var_Faci,j	Variability factor at the node (*i,j*).

Decision variable consideration precedes the development of the objective function to be minimized. They are linked to the decision whether or not to position the buffers in the nodes (i, j) (8), (9).

$$\{x_{i,j}\ i \in L, j \in C\} \quad (8)$$

$$x_{i,j} = \begin{Bmatrix} 1 \middle| Buffer\ in\ the\ node\ (i,j) \\ 0 \middle| else \end{Bmatrix} \quad (9)$$

The overall cost of storage in the distribution network will be (10):

$$TC = \sum_{i \in L} \sum_{j \in C} SC_{i,j} * x_{i,j} \quad (10)$$

If the node has no supplier (factory in our study), the decoupling lead-time $\boldsymbol{DLT_{i,j}}$ is equal to the lead time $\boldsymbol{LT_{i,j}}$.

Otherwise, $\boldsymbol{DLT_{i,j}}$ expression must integrate the situation of the direct supplier (located at $(i + 1, Supp(i, j))$). The final expression of $\boldsymbol{DLT_{i,j}}$ is (11):

$$DLT_{i,j} = \begin{cases} LT_{i,j} & Node\ (i,j)\ has\ no\ supplier \\ LT_{i,j} + [(1 - x_{i+1,Supp(i,j)})DLT_{i+1,Supp(i,j)}] & else \end{cases} \quad (11)$$

The profile levels are expressed using the following expression, exploiting equations from 1 to 5 (12).

$$\begin{aligned} Red\_Zone_{i,j} &= (1 + Var\_Fac_{i,j}) * LT\_Fac_{i,j} * ADU_{i,j} * LT_{i,j} \\ Yellow\_Zone_{i,j} &= ADU_{i,j} * LT_{i,j} \\ Green\_Zone_{i,j} &= LT\_Fac_{i,j} * ADU_{i,j} * LT_{i,j} \end{aligned} \quad (12)$$

The buffer average inventory is defined for a demand-driven model at a decoupled point by the following formula (13):

$$BAI_{i,j} = Red\_Zone_{i,j} + \frac{1}{2} Green\_Zone_{i,j} \quad (13)$$

Given that the possession rate is the proportion of the storage cost $\boldsymbol{SC_{i,j}}$ to the value of the average stock $\boldsymbol{AIH_{i,j}} * \boldsymbol{BAI_{i,j}}$, the storage cost $\boldsymbol{SC_{i,j}}$ in a Buffered node *(i,j)* is written (14):

$$SC_{i,j} = UP_{i,j} * AIH_{i,j} * BAI_{i,j} \quad (14)$$

With the previous notations and equations, the mathematical formulation of the objective function of buffer positioning problem is as follows (15):

$$TC = \sum_{i \in L} \sum_{j \in C} UP_{i,j} * AIH_{i,j} * (1.5 + Var\_Fac_{i,j}) * LT\_Fac_{i,j} * ADU_{i,j} * LT_{i,j} * x_{i,j} \quad (15)$$

With

$$\forall\, j \in C \;\; DLT_{1,j} \leq TS$$

The last constraint indicates that the total decoupling lead time $\boldsymbol{DLT1,j}$ must be lower than the tolerated customer delay $\boldsymbol{TS}$. These times concern the first line nodes in the first Echelon, as they represent the final distribution points to deliver the product to customers.

4.2 Optimization results

Since the network includes eight nodes (excluding Hypermarket Echelon), the objective function value is calculated for all the possible combinations. Then, the minimal function value that respects the constraints is retained as an optimal configuration of the buffer positioning. The optimization results indicate that buffer placement at DC5 leads to the lowest total storage cost. Three key findings emerge:

- Buffering at DC5 minimizes costs while keeping service levels high.
- Configurations with multiple buffers (e.g., DC2 + DC6) provide stability but increase costs.
- Lead time constraints influence optimal positions, requiring dynamic adjustments.

The following table (Table 6) presents the top-performing configurations.

Table 6 Inputs Data for optimisation

Node	UP (DH)	AIH (%)	LT_Fac (%)	Var_Fac (%)	ADU	DLT (days)
Factory	**0.2**	**0.5**	**0.5**	**0.5**	**706**	**1**
DC1	**0.2**	**0.5**	**0.5**	**0.5**	**58**	**2**
DC2	**0.2**	**0.5**	**0.5**	**0.5**	**29**	**2**
DC3	**0.2**	**0.5**	**0.5**	**0.5**	**72**	**2**
DC4	**0.2**	**0.5**	**0.5**	**0.5**	**100**	**2**
DC5	**0.2**	**0.5**	**0.5**	**0.5**	**10**	**2**
DC6	**0.2**	**0.5**	**0.5**	**0.5**	**58**	**2**
DC7	**0.2**	**0.5**	**0.5**	**0.5**	**379**	**2**

The number of combinations is equal to 28. Thus, 256 results are obtained, and the minimal value is retained. The 256 values are calculated (Table 7), and Table 8 gives an extract of the results related to all possible values of the objective function.

Table 7 Extract from possible objective function values

Configuration number	Decision variable								Objective function value
	$X_{2,1}$	$X_{1,1}$	$X_{1,2}$	$X_{1,3}$	$X_{1,4}$	$X_{1,5}$	$X_{1,6}$	$X_{1,}$	
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**75.8**
2	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**11.6**
4	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**4.4**
5	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**80.2**
10	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**95.8**
52	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**108**
100	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**105**
202	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**179**
256	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**215**

The minimum value corresponds to the 4th configuration, where a buffer must be placed at the distribution center 5 ($X_{1,5}$=1). For this configuration, the delay values respect the constraint 15 given in the mathematical model presented previously.

Table 8 Constraints value for the optimal position

	Factory	DC1	DC2	DC3	DC4	DC5	DC6	DC7
$X_{i,j}$	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
DLT	**1**	**3**	**3**	**3**	**3**	**2**	**3**	**3**

Table 8 shows that all delays are less than the service tolerance. For the illustrated week in the tables, the optimal configuration consists of a buffer in CD5. However, it is possible to obtain different configurations from one week to another due to the weekly updated ADU.

Moreover, costs as well as factor values play an important role in determining the optimal positioning configuration. In our case, the unit price (PU) and average inventory holding rate (AIH) are considered equal for all distribution units. On the other hand, the time and variability factors are set at an estimated value of 0.5.

4.3 Discussion

In assessing the DDDRP framework, we began by establishing the relevance of our proposed model through a thorough literature-based justification. We demonstrated that key concepts such as demand-driven distribution, variation isolation, and protection buffers are rooted in well-established paradigms, including lean distribution principles and the theory of constraints.

Following this theoretical grounding, we presented the model's formulation, including the set of equations and the implementation algorithm. The mathematical model for buffer positioning relies on two core parameters: Average Daily Usage (ADU) and Decoupling Lead Time (DLT).

- ADU represents the average consumption rate of a product at a specific location and plays a central role in buffer calculation. It is important to note that ADU accuracy increases when calculated over shorter horizons. In our study, we adopted a one-week time window, as it offers a more responsive measure than longer-term averages.
- DLT, the second cornerstone, is defined as the total lead time from the decoupling point to the final delivery point. It includes the distribution lead time of the parent node, capturing the full time span across the distribution network.

Regarding the optimization of buffer positioning, the model involves evaluating total storage costs across all possible buffer configurations. However, minimizing storage costs alone does not always lead to the most effective solution. Strategic buffer placement should also consider other performance metrics, such as service level, responsiveness, or financial indicators. A more holistic approach—such as incorporating a Return on Investment (ROI) framework—could provide a better balance between cost efficiency and flow reliability by aligning inventory decisions with broader supply chain goals.

5 Conclusion

This article aims to enhance the theory and practice of flow management in distribution networks by introducing a demand-driven model that replaces traditional methods reliant on forecasts and push-flow notions, thereby mitigating the emergence of the bullwhip effect.

Grounded in a systematic literature review, the proposed Demand-Driven Distribution Resource Planning (DDDRP) model integrates principles from lean distribution, the theory of constraints, and traditional DRP frameworks. Central to the model are the concepts of buffering, decoupling points, pull-based logic, and demand-driven management.

Building on these theoretical foundations, we introduce a mathematical model designed to optimize buffer positioning. The model minimizes total inventory holding costs across the distribution network, offering a practical and strategic approach to mitigate the Bullwhip Effect. To illustrate its applicability, we applied it to a real-world distribution context, showing how it can support strategic decision-making in buffer placement. While performance improvements are not quantitatively assessed in this study, the model provides a structured framework that can be adapted and extended to various industrial settings.

The established work is open to several perspectives:

Capacity considerations:

The current model assumes infinite storage capacity at distribution nodes. Future work should incorporate finite capacity constraints to increase realism and applicability.

Product family considerations:

Most distribution networks handle multiple product families, significantly increasing flow complexity. Extending the model to account for multiple product types (N products) will improve its practical relevance.

Supply and Management Variability:

While this work focuses on demand variability, other forms—such as supply delays and managerial inconsistencies—also affect performance. Future models should assess these sources of variability and incorporate tools to manage human resource-related flow dynamics.

Network Complexity and Scalability:

The inclusion of lead time introduces non-linearity into the optimization model. As the network size increases, linearization may become necessary to maintain computational tractability. This invites future exploration into heuristics or metaheuristics capable of efficiently solving large-scale buffer positioning problems.

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Review process

Single-blind peer review process.