

A Systematic Review of Planogram: Research Gaps and Opportunities

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ABSTRACT

A business faces challenges in terms of product structuring, design, and space layout; it needs to adapt traditional design management models to scientific developments, like customer shopping behavior data. This article contains a systematic review of planograms and is essential because a similar complete literature review has yet to be found. Therefore, this research is necessary, especially for business actors such as retailers and suppliers. This research aims to analyze studies on shelf-space allocation and store layout and provide advice for future research. This study used the systematic review methodology to incorporate relevant literature, of which 50 articles were later obtained. The review protocol guides a comprehensive and systematic analysis of the articles. This study proposes potential avenues for future research to offer a thorough and precise examination of the impact of shelf-space allocation and store layout. The gaps in previous studies are opportunities to create more complex and comprehensive research results on similar topics. This article added scientific value by presenting an exhaustive literature review, and it can fill the theoretical gap by completing the previous literature review.

KEYWORDS: In-store logistics; Retail store operations; Shelf space allocation; Store layout; Visual merchandising.

1. Introduction

The global retail industry grows yearly with the increasingly diverse products needed and traded. This provides challenges for industry players to manage the course of business, such as product allocation on the shelves or the store layout to maximize the use of existing resources. Businesses nowadays face new technical challenges in managing shelf space on retail store shelves, which can be solved, for example, through the system using image analytics [1]. The potential development of the retail environment can also be done by navigating according to consumer behavior through modeling and forecasting [2]. This can provide symbiosis mutualism where customers can find the product's location by carrying a trolley with navigation. Meanwhile, for retailers, this helps attract customers' interest and experience of shopping, as well as knowing the best location of the product layout and improving sales. Research on a reasonably broad planogram certainly affects the mathematical approach model used to make decisions accordingly. Retail shelf space planning is associated with the available space or quantity

and the position of each item on the shelf [3]. The investigation, utilizing literature methodologies, might be applied to address various gaps in the planogram research. Many research studies in journals or proceedings published on reputable websites have stated that managing shelf space and planning layout is essential for operational continuity. Planogram development has occurred globally.

Focus on the disparities between the planogram development factor and the difficulties that arise with unique variations in each country.

Each industry employs diverse strategies to achieve its aims. Nevertheless, it is indisputable that alterations and difficulties may occur. Since multiple factors are involved in each sector, this research intends to identify and analyze the issues in shelf-space management and layout planning that have implemented a planogram. In addition, this research is essential and new because no analysis has been found that extracts various planogram studies by applying systematic reviews in 2023-2024 to identify possible solutions to problems for further investigation.

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2. Literature Review

In the last two years, empirical research on the topic of planograms has used a variety of approaches to problem-solving. Melek et al. research field [4] created a step-by-step process for planogram compliance, keeping track of stock on shelves, and providing customer service. Morán et al. [5] suggested a realistic way to do shelf audits in supermarkets. Paolanti et al. [6] suggested a way for retailers to see how different store layouts and planograms affect sales. And Yücel & Ünsalan [7] suggested a new way to solve the problem of planogram compliance control.

Czerniachowska et al. [8] used the heuristic technique for the shelf space allocation problem and Ke [9] for the merchandise placement optimization problem. Meanwhile, another approach was carried out by Laitala & Ruotsalainen [10], who discussed computer vision-based planogram compliance evaluation; Pietrini et al. [11] analyzed embedded vision system techniques for real-time shelf row detection for planogram compliance checks. Kapoor et al. [12] presented a concept-based anomaly detection approach using a vision transformer capable of marking misplaced objects; Febrianti et al. [13] suggested designing the layout and planogram of the store based on the analysis of association rules made in their research; and Yanti et al. [14] designed a planogram for the priority shelf based on customer behavior by applying the merchandising decision model;

Apart from empirical research, based on searches for planogram articles indexed by Scopus with the keywords literature and reviews, in the last two years, no complete systematic review articles on planograms were found. Düsterhöft & Hübner [15] have presented the results of various optimization model applications in retail space planning, highlighting new issues. At the same time, Febrianti et al. [16] conducted a bibliometric analysis to map planogram research. However, this research did not address the gaps in planogram research, which could serve as opportunities for future investigations. Therefore, to provide comprehensive insight, this study is essential to answer the following question: What are the results of the latest systematic review on the topic of planograms?

3. Research Method

A systematic review encompasses the relevant literature sources in the research. This more structured and systematic method aims to identify and analyze the components and problems of writing. The process can be divided into three primary stages: conducting a literature review,

implementing filtering criteria, and analyzing the literature review. Consequently, gaps between studies could be identified from the process, and the study's novelty could be formulated.

A. Plan the review

This phase is the first stage of the systematic literature process. Bibliographic searches are done through the website using specific keywords matching the relevant material or topic. Later, to conduct a systematic review of the study, the statements should be placed accurately to lead to a particular case and study subject. This research is more concerned with planograms, specifically for retail, grocery, supermarket, hypermarket, minimarket, pharmacy, and vending machines. This study employs constraints to establish the particular scenario and facilitate the systematic writing process. All keywords must be relevant to the study's theme. In order to streamline the process of identifying research, this study utilizes keywords: planogram, shelf-space allocation, shelf space, shelf allocation, store layout, layout planning, rack layout, on-shelf availability, assortment planning, space management, and shelf design.

B. Apply screening criteria

This is the subsequent phase of the systematic literature research procedure. The literature retrieved using the keyword is further categorized and chosen depending on criteria similar to those of the study. The keywords in each document are compared to the topics discussed. In order to expedite the process, the screening procedure often encompasses the study type, publication year, and language. This study aims to identify scholarly articles, master's theses, and doctorate dissertations published during a specific timeframe of 12 years, from 2011 to 2022. The literature mainly examines planograms from various global regions, with English being the language of focus.

C. Analyze the review

This phase represents the ultimate stage of the systematic literature search method. Following the screening process, relevant material is identified based on the specific topic and constraints of the problem. The screening results were further analyzed to reveal research gaps—a review protocol consisting of a bibliography, detailed case studies, focus, and publication content. The bibliography included the author's name, year of publication, title, type, term, and journal scope. The second part comprises case study details, including industry, area/country, and cases. The third part means the focus and content of the

publication, including motivation, objective of the study, explanation of the results, advantages of the survey, shortcomings of the study, and future studies.

4. Result and Discussion

This section is the final stage in determining adjustments to the literature's impact. There are gaps between the literature with different issues, but they still have the same scope planogram. Thirty-seven international journals and publications are collated with the review protocol to facilitate problem identification and conclusions. Next is the research on the case study

details, focus, and publication content.

A. Bibliography analysis

The bibliography analysis is displayed in a graphic format to show the summary in detail. Figure 1 displays a bibliographic chart that presents the distribution of publications over the years 2011 to 2022. In 2011, one article was collected. In 2012, there was one publication; in 2013, there were two publications; in 2014, there was one publication; in 2015, three publications; in 2016, with five publications; 2017 with eight publications, 2018 with five publications, 2019 with one publication, 2020 with five publications, 2021 with four publications; and in 2022, with one publication.

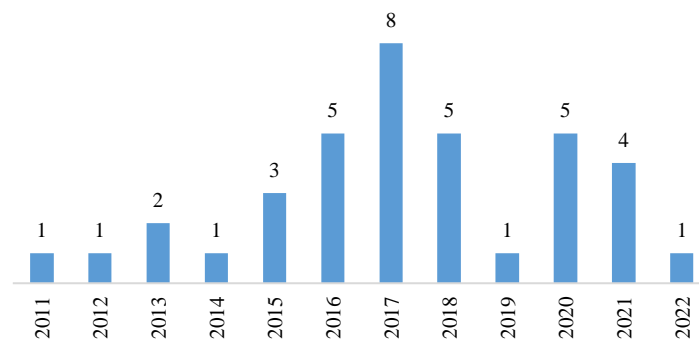


Fig. 1. Year of publication

From 2011 to 2022, the most often related literature was produced in 2017, with eight publications. This indicates that planogram

development continues to improve every year. All literature can be accessed in the journal publications, as shown in Table 1.

Tab. 1. List of reviewed journal

Journal	Number of article
European Journal of Operational Research	4
Journal of Retailing and Consumer Services	3
Journal of the Operational Research Society	2
Doctoral Dissertation from Wright State University	2
Magister Thesis from Wright State University	1
British Food Journal	1
European Journal of Economics and Business Studies	1
European Journal of Marketing	1
IBM Journal of Research and Development	1
International Journal of Computational Intelligence Systems	1
International Journal of Computer Integrated Manufacturing	1
International Journal of Management	1
International Journal of Management Research and Review	1
International Journal of Nonlinear Analysis and Applications	1
International Journal of Retail & Distribution Management	1
International Journal of Strategic Management and Decision Support	1
Systems in Strategic Management	1
International Journal on Soft Computing, Artificial Intelligence and Applications	1
Journal of Entrepreneurship, Business and Economics	1
Journal of Experimental Psychology: Applied	1

Journal of General Management Research	1
Journal of Indian Business Research	1
Journal of Industrial Engineering and Management Systems	1
Journal of Intelligent & Robotic Systems	1
Journal of Production Research	1
South Asian Journal of Management	1
The International Journal of Advanced Manufacturing Technology	1
Magister Thesis from Universidade do Porto	1
Doctoral Dissertation from University of Rochester	1
Doctoral Dissertation from Stellenbosch University	1
Doctoral Dissertation from McMaster University	1

Table 2 shows an example of a literature-based review protocol over the last two years [17].

Tab. 2. Review protocol

Author(s)	Hübner, A.; Düsterhöft, T.; Ostermeier, M.
Year	2021
Title	Shelf space dimensioning and product allocation in retail stores
Type of Publication	Journal
Name of Publication	European Journal of Operational Research
Scope of Publication	International
Industry	Grocery
Area/Country	Eastern Europe
Case	Shelf-space Allocation
Background	The shelf planning model depends on more than the assumption that the rack configuration is only related to product allocation. The size of the shelf segment and product allocation are mutually dependent.
Descriptive Impact	The specified shelf dimensions calculate product allocation. The approach can improve certain planning situations and corresponding profits by up to 3-7% in various stores and categories.
Opportunity	1. Consider seasonal demand and demand effects caused by promotion or pricing 2. Using the model in this study by applying only one large shelf that in each shelf has the same dimensions 3. See the effect of demand on standard and varied shelf sizes 4. Use models in research by considering detailed merchandising decisions and the order of items 5. The integration of election decisions and related effects for out-of-assortment or out-of-stock situations 6. Reconcile and optimize the upper and lower limits for the number of racks of each item according to the up-stream logistics process. 7. A comprehensive technique that addresses the issue of product allocation for a specific category, as well as determining the required amount of shelf space. This can further enhance the support model of decisions for retailers

B. Details of case study analysis

From the publications, planograms in its implementation are carried out in various industrial fields with other cases. This can provide opportunities for developing knowledge about the planogram and its uniqueness so that it can be identified and what needs to be further researched. On the customer shopping experience, product allocation, product variations, product prices, and product sizes significantly affect purchasing behavior. Therefore, retailers can use this knowledge to improve store layouts and maximize profits [18] [19].

Figure 2 presents the cases related to planograms in research. From the reviewed journals, it was found that the problems related to the planogram are shelf space allocation (27%) [17] [18] [20] [21] [22] [23] [24] [25] [26] [27], store layout (16%) [19] [28] [29] [30] [20] [31], category management (13%) [32] [33] [34] [35] [36], buying behavior [37] [38] [39] [40], shelf space layout/design (8%) [2] [41] [42], shelf space management (8%) [1] [3] [43], visual merchandising (5%) [44] [45], backroom (3%) [46], on-shelf availability (3%) [47], product displays (3%) [48], and assortment planning (3%)

[49]. Most problems are related to shelf space allocation, with the discussion in 10 journals and store layout in 6 journals.

Figure 3 illustrates the percentage of several industries in the study case. They are retail (34%), supermarket (20%), grocery (13%), hypermarket (10%), retail chain and pharmacy (7%), minimarket, discounter, and automatic vending machine (3%).

Figure 4 displays the proportion of various regions included in the case study, and the European continent dominates even though it is divided into several parts. They are Europe (31%), United States and South Asia (22%), Southeast Europe (9%), South America, South Africa, Southeast Asia, and Eastern Europe (4%).

C. Focus and content analysis

In shelf space allocation and store layout, the distribution of limited shelf space with product variations is a problem related to the design and atmosphere of the store [18] [40]. This is inseparable from the need to plan the number, place, and time of the product to be placed on the shelves so it can be known whether the change in customer demand shows a positive value, which means the profit increases or not. Several methods are used to optimize shelf-space allocation analysis and store layouts. Likewise, the algorithms used in planning planograms are hidden Markov Models, Market Basket Analysis, Lift Analysis, and Difference-in-Difference (DID) Analysis.

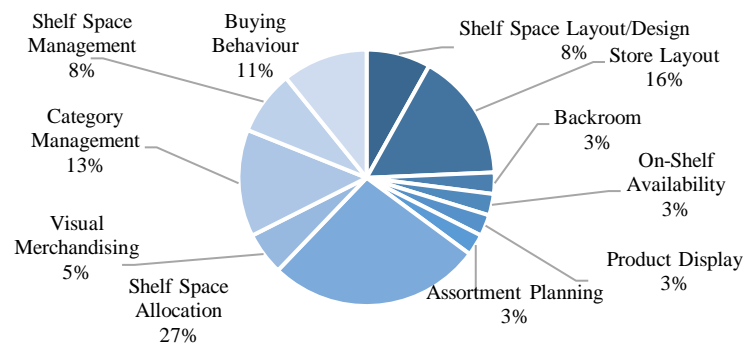


Fig. 2. Case study

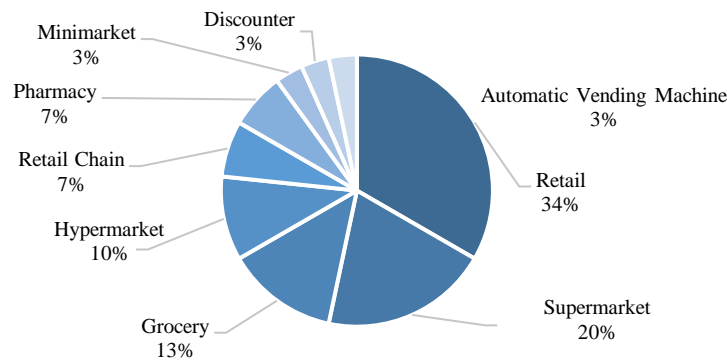


Fig. 3. Industries

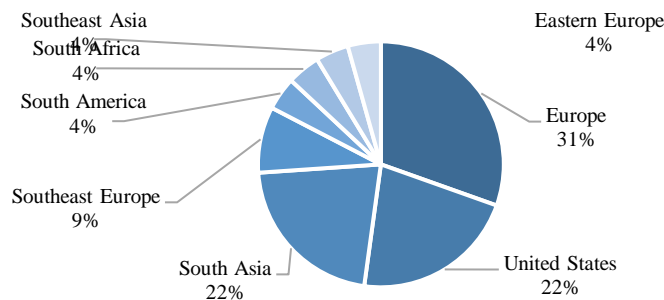


Fig. 4. Case study area

The role of the layout is to help customers find products and information. This certainly provides

a pleasant customer experience and has a positive influence on the customers [45]. In applying category management, retailers need to give variations of space modifications that fit the category. At the same time, suppliers also need to reorganize for market research that can provide a better understanding of managing businesses [35]. Technology and significant data opportunities will likely improve the accuracy of retailers' decision-making and category management [33]. Many layout designs result in the same exposure; it depends on the designer. However, the non-traditional layout provides more direction in the field [42]. Products placed on sharp-angled shelves provide impulsive advantages.

Retailers can also realize profit increases of up to 8.2% through the Joint Rack Configuration and Shelf Space Allocation (JRC-SSA) [26]. Adjustable rack design can increase profit by up to 6-7% compared to conventional models. In

addition, price changes increase profits by 21-22% compared to traditional models. Therefore, combining the shelf height design and price changes can increase earnings by more than 30% compared to conventional models [27]. Increased revenue is also obtained for non-homogeneous planograms when the shelf design can be adjusted based on the variation in the SKU according to the family product [40].

D. Research gap

All the references were systematically reviewed, and research gaps were formulated, which will enable future researchers to conduct more in-depth research into planograms. Research gaps exist due to limitations or the need for previous studies. Therefore, future researchers should see this as a reference to substantiate future research results. The research gaps are shown in Table 3 later.

Tab. 3. Research gaps and opportunities

Research Gaps and Opportunities	References
Test validation with implementations in different retail/chains/objects.	[47], [49], [23], [43], [37], [33], [45], [18], [42]
Add other variables in the study.	[32], [38], [25], [31], [42], [39], [40], [27]
Analysis of the impact of price and promotion policies on demand.	[3], [49], [17] [37], [35], [38], [27],
Exploration of other methods, models, or algorithms.	[22], [20], [45], [19], [26], [39], [27]
Analysis of the impact of shelf type and position in the shelf on demand.	[17], [43], [29], [24], [26], [40]
Technology development.	[1], [2], [50], [28], [36]
Inventory-related analysis with replenishment synergies.	[3], [46], [49], [39]
Store modifications based on customer shopping behavior.	[3], [48], [24], [35]
Supplier and retailer relationships in shelf space planning.	[3], [28], [35]
The role of shelf management in omnichannel retail.	[3], [50], [49]
Analyze attributes and layouts based on consumer perception.	[30], [37], [38]
Analysis of effects in category captainship.	[49], [33]
Analysis related to assortment with shelf-space and replenishment planning.	[49], [25]
Conduct a comprehensive profitability analysis.	[29], [40]
Checking for long-term effects.	[24], [37]
Concept of service level targets and service constraints.	[3]
Integration of demand forecasting in PPAD optimization studies.	[31]
Optimization of the number of facing product items.	[18]
Integrated planning of the layout and allocation of shelf space.	[21]

Application of merchandising decision models and order of items in detail.	[17]
Integration of election decisions and related effects for out-of-stock situations.	[17]
Reconcile the number of shelves of each item according to the logistics process.	[17]
Combining shelf space planning and waste management.	[3]
Analysis of alignment of assortment planning with demand impact.	[49]
Develop integrated models for shelf space issues.	[28]

Based on Table 3, the most likely opportunity for research is to implement studies conducted with different objects to carry out validation tests. This is useful for testing whether the same test method will get the same results. The next opportunity is for research to be done by adding different variables [38]. Analysis of the impact of the type of rack, interdependency demand with price and promotion [3]. Retailers and suppliers can conduct further studies on algorithms or other methods to gain new knowledge and support more accurate decision-making [22].

8. Conclusion

After reviewing and considering the literature about planograms, it can be concluded that performing a planogram has both advantages and challenges. The anticipated advantages may stem from the allocation of shelf space and the arrangement of the store, which are the primary rationales for implementing a planogram. An impediment that could develop is the implementation of technology. This obstacle can become a trend in future research, namely the application of planograms with technology.

The majority of literature focuses on researching a specific sector or on a limited size, but the development of planograms takes place globally. Focus on the gaps between the development of planning programs and the obstacles that arise with typical variations in each country. According to the findings from a systematic evaluation of the literature, there is a research gap that might be addressed in future studies.

The constraint in this research is the limited number of articles that discuss specially planograms in Scopus journal databases, so the literature search uses other appropriate terms. Hence, forthcoming research is anticipated to yield more exhaustive findings to aid retailers and suppliers in new or implemented planograms. This study provides managerial implications for retail store managers to improve business performance

by paying attention to the importance of planograms.

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