Reengineering Discontinued Article Management at IKEA Through a Decision Support System

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Abstract

This dissertation explores the reengineering of the discontinued article management process at IKEA, with a focus on two stores in the North Market of Portugal. The primary objective was to design and implement a Decision Support System (DSS) to optimize markdown strategies, reduce operational inefficiencies, and support data-driven decision-making in the handling of discontinued stock. Simultaneously, the project involved comprehensive process mapping and the redesign of the article phase-out workflow.

The Action Research methodology was employed, involving stakeholder interviews across Sales, Fulfillment, Recovery, Business Navigation, and Operations, as well as an in-depth review of internal support systems and tools used for markdown decisions. Key inefficiencies identified included inconsistent decision criteria, reliance on intuition, and underutilization of existing digital retail systems.

The DSS developed as part of this study consolidates and standardizes price reduction criteria, incorporating relevant price elasticity insights and operational data to support markdown decisions. It provides a clear, automated interface to reduce margin losses, optimize stock management, and enhance interdepartmental workflow clarity. Preliminary evaluations demonstrated improved decision consistency, increased transparency, greater clarity in interdepartmental workflows and notable scalability potential to other IKEA locations.

The study concludes that leveraging collaborative process design, retail analytics, and decision support technologies significantly improves the management of discontinued inventory. Future integration with broader analytical platforms and expansion to other functions and markets is recommended.

Resumo

Re-Engenharia do Processo de Gestão de Artigos Descontinuados na IKEA Através de um Sistema de Apoio à Decisão

A presente dissertação explora a reengenharia do processo de gestão de artigos descontinuados na IKEA, com foco em duas lojas do Mercado Norte de Portugal. O principal objetivo foi conceber e implementar um Sistema de Apoio à Decisão (SAD) para otimizar as estratégias de redução de preços, reduzir ineficiências operacionais e apoiar a tomada de decisões baseada em dados no tratamento de stock descontinuado. Paralelamente, o projeto envolveu um mapeamento abrangente dos processos e a reformulação do fluxo de descontinuação dos artigos.

Foi aplicada a metodologia de Investigação-Ação, envolvendo entrevistas com stakeholders dos departamentos de Vendas, Logística, Recuperação, Administração Financeira e Operações, além de uma análise aprofundada dos sistemas de suporte internos utilizados nas decisões de cortes de preço. As principais ineficiências identificadas incluíram critérios de decisão inconsistentes, dependência de intuição e subutilização dos sistemas digitais de gestão existentes no retalho.

O SAD desenvolvido neste estudo consolida e padroniza os critérios de redução de preços, incorporando informações relevantes sobre a elasticidade-preço da procura e dados operacionais para apoiar decisões de cortes de preço. A solução apresenta uma interface automatizada e clara, com o objetivo de reduzir perdas de margem, otimizar a gestão de inventário e melhorar a clareza nos fluxos de trabalho interdepartamentais. As avaliações preliminares demonstraram maior consistência nas decisões, aumento da transparência e um potencial de escalabilidade significativo para outras unidades IKEA.

O estudo conclui que a aplicação de metodologias colaborativas de redesenho de processos, análises de dados no retalho e tecnologias de apoio à decisão melhora substancialmente a gestão de inventário descontinuado. Recomenda-se, como desenvolvimento futuro, a integração do SAD com outras plataformas analíticas e a sua extensão para outras áreas funcionais e mercados.

Acknowledgements

This dissertation marks the conclusion of a five-year academic journey at FEUP. Its completion reflects not only the knowledge acquired but also the contributions and support of many individuals and institutions along the way.

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"There are only two ways to live your life. One is as though nothing is a miracle. The other is as though everything is a miracle"

Albert Einstein

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Acronyms and Symbols

AR	Action Research
ARIMA	Auto Regressive Integrated Moving Average
ARTNO	Reference code of an IKEA article
AWS	Average Weekly Sales
BNOM	Business Navigation and Operations Management
BOH	Base On Hand
CALC	Cost Price of an article
DSS	Decision Support System
EDS	End Date of Sale
EOQ	Economic Order Quantity
IKEA	Ingvar Kamprad Elmtaryd Agunnaryd
KPI	Key Performance Indicator
LOAW	Last Order Arrival Week
MHS	MöbelHusSystem
MOQ	Minimum Order Quantity
NM	North Market
PCD	Product Change Date
RPA	Robotic Process Automation
RTO	Rest-to-Order
RTR	Return-to-Recovery
RTS	Rest-To-Sell
SAD	Sistema de Apoio à Decisão
SGF	Store Goods Flow
SKU	Stock Keeping Unit
SPA	Sales Price Adjustment
TT440	Transition type used to classify products removed from active sales

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Chapter 1

Introduction

This dissertation is the result of a five-month project conducted in collaboration with IKEA, developed within the scope of an academic, corporate agreement. Due to the necessity of upholding confidentiality obligations, certain sensitive information has been masked throughout the document. Specifically, all monetary values, operational thresholds, and article cost prices have been proportionally scaled using a random constant.

The first chapter provides the background for the work undertaken in the development of this dissertation. It begins by outlining the context and motivation behind the project, followed by an explanatory section on the IKEA stores where the work was carried out. The chapter then presents the project's objectives, describes the methodology used to approach the issue of discontinued article management in the company, throughout the research and thesis development, and concludes with an overview of the dissertation's structure in the final subchapter.

1.1 Project's Context and Motivation

In the current landscape of business, with the ever-increasing volatility and competitiveness of most industries, companies must remain agile, adapting quickly to internal inefficiencies and external pressures. Retailers face a constant need to optimize operations, reduce waste, and improve profitability, especially in areas often overlooked, such as the use of circular economies, management of discontinued products and appropriate pricing strategy alignment.

Specifically, the furniture industry, has undergone considerable changes, including technological breakthroughs, globalization and shifting consumer preferences (Teng et al., 2023). Supply chain interruptions (Caridi et al., 2012), increased competition (Carpano et al., 2006) and the adoption of online sale channels for a traditionally full-physical focused business, make for necessary reforms to assure companies long-term survival. The furniture industry is in the midst of this required digital transformation, with the increasing adoption of advanced technologies such as artificial intelligence, automation and Internet of Things (IoT) (Sudarno, 2023). This makes room for improvement for all parties of the supply chain, from suppliers, up until furniture retailers.

In order to achieve this business sustainability, organizations can leverage the data they collect across their business operations to help build a cohesive business structure. For retailers, one of these approaches comes from utilizing this data to define an appropriate pricing strategy. In fact, over the past decade, pricing has risen in importance on the corporate agenda. Most top executives recognize the importance of price and value management to achieve profitable growth (Nagle and Müller, 2017a). Particularly, the area that offers the most potential is in retail pricing (Ahmetoglu et al., 2014; Bolton and Shankar, 2003). The challenges that arise in this area are biparted: firstly, in terms of developing a distinctive and sustainable strategy and secondly, developing routines and practices to sustain it. Thus, it is clear that the importance of this topic should not be overstated since the pricing strategy is considered a powerful growth lever when it comes to eihter drive or disrupt a company's operating margins (Gao et al., 2024).

Apart from these issues, organizations that work in retail need to have a concise stock management system. This activity plays a pivotal role in the management of economic entities due to the implications it has on their financial results (Iliescu et al., 2019). A particular issue arises in this area for many companies that work with article discontinuity. This area of management is particularly important and complex since it intends to improve inventory turnover, while simultaneously considering supply chain capabilities and customer satisfaction (Zhu et al., 2025). Moreover, it can deeply affect the stock management efficiency of the businesses if not approached in a proficient manner. On top of these impacts, research shows that product obsolescence also poses significant environmental and social challenges worldwide (Sierra-Fontalvo et al., 2023).

IKEA, like many other businesses, particularly within furniture retailing, is equally affected by these challenges. Although there have been some efforts to address these issues, such as the use of the Circular Area (CA) model in stores, there is still significant room for improvement. Several processes have been implemented in the streamline of the operations, to address most of these concerns. However, efficiency is far from perfect, as some steps of the processes still involve approaches somewhat archaic.

In fact, for several time, the processes have been identified by the company as inefficient. These concerns come not only from the heterogeneity of processes across stores for this particular issue, but also for the lack of clarity on how to approach the management of discontinued articles. Although efforts have been made to equip pricing managers with comprehensive information and tools, the intended results have not been achieved. Due to the company's large scale and international scope, this information overload has often led to the use of outdated or underutilized tools, prompting a return to manual methods, an approach that is unsuitable for a modern, large-scale organization.

For this reason, the current project was conducted in order to standardize the process of managing discontinued articles across two IKEA stores. The clear need for process mapping and improvement and problem-solving across different areas related to logistics, economics, marketing and more show the opportunities related to the core areas of Industrial Engineering and Management. Given that these types of issues fall directly within the scope of this area of engineering, they offer a solid foundation for developing a Master's thesis focused on this problem.

The possibilities of improvement are cross-areas and have the chance of affecting several different departments and stores. In fact, given the high degree of standardization and operational homogeneity across IKEA units, both nationally and internationally, the findings and proposed solutions presented in this dissertation can be extrapolated to other stores within and beyond the Portuguese market. This uniformity in procedures, systems, and organizational structure facilitates their practical application on a broader scale.

1.2 IKEA Portugal

IKEA is a multinational company founded in 1943 in Älmhult, Sweden, by Ingvar Kamprad. It is globally recognized as one of the leading home furnishing retailers, offering functional, well-designed, and affordable products. IKEA's vision, "to create a better everyday life for the many people," is reflected in its flat-pack furniture concept, sustainable practices, and customer-oriented approach. In the Fiscal Year 2024, IKEA operated in more than 60 countries, with more than 460 stores and approximately 216000 coworkers worldwide (IKEA, 2024). With global sales of EUR 45.1 billion, the company has been a world powerhouse of the sector, often stated as the world's largest furniture retailer (Danziger, 2024).

IKEA entered the Portuguese market in 2004 with the opening of its first store in Alfragide, Lisbon. Since then, it has expanded to other locations including Matosinhos, Loures, Braga, and Loulé. IKEA Portugal combines the global values of the brand with a local adaptation strategy, incorporating Portuguese suppliers and adjusting product offerings to meet market-specific needs. It currently employs over 3000 co-workers and actively engages in sustainability and community development initiatives across the country (IKEA Portugal, 2024).

The IKEA Portugal North Market (NM) comprises the stores in Braga and Matosinhos, forming a key regional cluster within the national operation. Strategically located, this market plays a crucial role in the company's commercial and operational performance. The two stores, together with the associated PAOPs (IKEA's Planning and Order Pickup Points) in Gaia, Aveiro, Viseu, Coimbra and the recently opened one in Guimarães, represent approximately 25.39% of the market share of IKEA Portugal, serving a broad customer base from urban centers to surrounding regions.

The NM benefits from centralized coordination in logistics, stock management, human resources, and strategic planning, enabling it to operate efficiently while responding to regional needs. Thus, the stores work, not only to provide service to store-going employees, but also support the surrounding PAOPs in the nearby areas. Both stores follow most of IKEA's global standards regarding store layout, sustainability and customer experience, but also engage in continuous improvement efforts tailored to local challenges.

The current project was conducted under supervision of the Business Navigation and Operations Management (BNOM) department which manages the financial side of both stores that

constitute the NM and their respective operations. Since the processes under analysis are inter-departmental, there was continuous contact with several departments, namely Fulfillment Integration, Sales and Recovery.

As stated previously, the main issues under focus are both the lack of efficiency across the process streamlines and the lack of standardization in the management of discontinued products. These problems consist of matricial issues that combine, on one side, issues relative to the internal operations of each of the units considered, and conversely the lack of a more normalized approach across both stores as shown in Figure 1.1.

		Issues to be Approached		
	Store	**Local issues**	**Cross-store issues**	
North Market	IKEA Braga	Internal issues at the Braga store unit (regarding pricing and TT440 management inefficiencies)	Standardization and integration with operations in pricing and TT440 management at IKEA Matosinhos	In Scope
	IKEA Matosinhos	Internal issues at the Matosinhos store unit (regarding pricing and TT440 management inefficiencies)	Standardization and integration with operations in pricing and TT440 management at IKEA Braga	
	Other Stores	Internal issues specific to each store unit (regarding pricing and TT440 management inefficiencies)	Standardization and integration with operations in pricing and TT440 management at other IKEA stores	Out Of Scope

Figure 1.1: Matrix of issues across the IKEA stores under analysis

In addition, these issues can be further extrapolated to other stores in other markets, as shown. To address the issues in the scope of this thesis analysis, the project's objectives are outlined in the following chapter.

1.3 Project's objectives

This dissertation aims to tackle the inefficiencies in the processes of the company regarding their pricing and management of outgoing products. By developing an advantageous standardized solution that will bring improvements to the flow of these processes, the present study will provide a framework that can be adopted by other stores and possibly other companies. Therefore, the overarching objectives of this research are as follows:

- Minimize the portion of gross margin lost through Sales Price Adjustments (SPA) — a markdown budget tied to store sales, which teams can allocate strategically to reduce prices — and through transtypes associated with discontinued articles (TT440), which are applied when the Sales team determines that an item should no longer be available in the regular sales area. This transtype financially writes off the item, giving it a final chance to be sold in the Recovery section.

- Minimize cubic meters occupied by discontinued products (UTG)
- Reduce the amount of hours spent in the process of sales and product placement
- Reduce the number of TT440 originated by inconsistencies between stores of the NM

These goals were defined at the beginning of the work in the company in order to provide better planning of the time and efforts involved. The objectives allowed for clarity along the execution of the work, granting the chance to explore valuable academic research topics while also delivering tangible and impactful solutions to the company.

1.4 Research Methodology

The research method selected for the present study is the Action Research (AR) methodology (Reason and Bradbury, 2008; Baskerville and Wood-Harper, 1996). This methodology provides a collaborative and iterative framework for solving practical organizational challenges while simultaneously generating academically relevant knowledge. AR is particularly appropriate in contexts like this study, where the goal is to co-develop and evaluate a standardized approach to pricing and discontinued article management at IKEA — a process that demands close interaction with practitioners, reflection, and continuous refinement.

AR can be conceptualized as a cyclical process consisting of five distinct phases (see Figure 1.2): diagnosing, action planning, action taking, evaluating, and specifying learning (Susman and Evered, 1978). All five phases contribute to the richness of the Action Research methodology, though the specific number and duration of each may vary depending on the nature of the project.

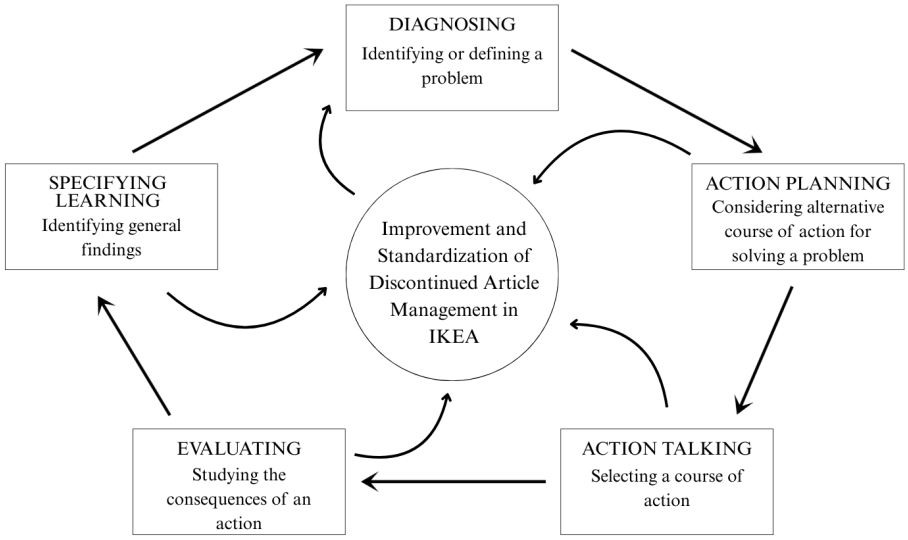


Figure 1.2: The phases of the cyclical process of Action Research adapted from 'An assessment of the scientific merits of action research' (Susman and Evered, 1978)

The AR method was adapted to fit the specific goals and practical constraints of the present project. Its structured, iterative approach enabled ongoing engagement with stakeholders and constant refinement of ideas through real-world application. Further details on how each phase was implemented in this thesis, including activities carried out and the corresponding timeline, are provided in Chapter 4, Methodology.

1.5 Structure

This dissertation is organized into six chapters.

- Chapter 1 introduces the project by outlining its context within the company, its main objectives, and its methodology. The chapter establishes the motivation and relevance of addressing inefficiencies in the descontinued article management process.
- Chapter 2 presents the theoretical foundation supporting the project. It explores key methodologies and concepts, such as markdown management, stock management techniques, and process analysis, pricing strategies and forecasting, that guide the development of the proposed solutions.
- Chapter 3 describes the company's initial situation, identifying the main inefficiencies and sources of complexity in the markdown decision-making process. The chapter highlights the organizational challenges observed and improvement opportunities uncovered during the diagnostic phase.
- Chapter 4 details the solutions developed to address the identified issues. These solutions include technological and procedural changes designed to increase the efficiency, clarity, and consistency of the markdown decision-making workflow.
- Chapter 5 evaluates the outcomes of the implemented improvements, highlighting their impact on the overall process and alignment with initial project goals, as well as estimating their financial and operational benefits
- Chapter 6 evaluates the impact and strategic relevance of the project, outlines potential future developments, and presents final reflections and recommendations for sustaining and expanding the work.

Chapter 2

Literature Review

The second chapter offers a comprehensive review of the literature relevant to the core themes of this thesis. It begins with an exploration of Stock Management and Forecasting, followed by a section on Stock Keeping Unit (SKU) Rationalization, and Range Allocation. The discussion then transitions into Optimal Price Markdowns and Price Elasticity of Demand before moving into the topic of Pricing Strategies. Finally, the chapter examines existing literature on the Automatization and Digitalization of Retail Management.

2.1 Stock Management and Forecasting

The present subchapter aims to highlight the importance and relevance of Discontinued Stock Management, one of the central focuses of the thesis. It begins with an overview of stock management as a whole, including key techniques commonly used in the field. The discussion then narrows to the specific challenges and strategies associated with managing outgoing or discontinued stock, addressing topics such as the product lifecycle and common approaches for handling this matter effectively. Finally, it is followed by an exploration of the benefits of forecasting for businesses, along with a summary of the main mathematical approaches used to implement it effectively.

2.1.1 General Stock Management

Effective inventory management is a cornerstone of supply chain performance and business profitability. It encompasses a range of processes aimed at maintaining optimal stock levels, minimizing holding and ordering costs, and ensuring product availability (Wang et al., 2024). Poor inventory control can lead to increased operational costs, excess or obsolete stock, and lost sales, especially in volatile or seasonal markets. The importance of this topic is evident, since it has been observed that an increase in profits is largely attainable through a reduction in losses associated with stock management (Deveshwar and Modi, 2024). In a company of IKEA's magnitude, which utilizes both self and third-party warehouses, this benefit is particularly evident.

Demand, cost structure, and the physical characteristics of a system are key variables in inventory management. However, these variables are not static and often change over time. Uncertainty arises primarily from fluctuating demand, supply inconsistencies, and limitations in information accuracy or availability. This complexity necessitates the application of systems analysis and the development of a structured approach to inventory management (Inegbedion et al., 2019). Several classical techniques continue to be widely used to manage inventory effectively.

The Economic Order Quantity (EOQ) model provides a foundation for determining the optimal replenishment quantity that minimizes total inventory costs. It has proved useful in optimizing resources and thus, minimizing associated cost (Agarwal, 2014). The EOQ has been previously defined as the ordering quantity which minimizes the balance of cost between inventory holding cost and re-order costs (Dervitsiotis, 1981; Monks, 1996; Lucey, 1992; Schroeder, 2000). One of the biggest advantages of this model is the easiness to compute it (Agarwal, 2014). According to the author the EOQ models have been effectively employed in several industries such as retail, automotive and pharmaceutical, for many years. The fact that the model provides the solution in closed form helps to know about the behavior of the inventory system. This model balances fixed ordering costs against inventory holding costs, leading to an optimal order quantity that increases with demand but at a diminishing rate, following a square-root relationship. It is very robust to parameter changes, partly because it has been adopted in environments with stochastic demand (Roumiantsev and Netessine, 2007).

Just-in-Time (JIT) systems, on the other hand, aim to align production and inventory replenishment closely with actual demand, thereby minimizing excess stock and reducing storage costs (Ghelani, 2024). JIT is a cornerstone of lean manufacturing, promoting efficiency by eliminating waste and enhancing responsiveness. The effectiveness of JIT relies heavily on accurate and timely demand forecasting, which becomes increasingly challenging in the face of volatile markets and rapidly changing consumer preferences (Pal, 2024). Despite these challenges, JIT has been widely adopted in sectors such as automotive manufacturing and electronics, where high efficiency and low inventory levels are essential. Unlike EOQ, which buffers against uncertainty through inventory, JIT seeks to eliminate such buffers entirely, making the system more sensitive but also more streamlined when functioning correctly.

2.1.2 End-Of-Life Stock Management

Management of outgoing or discontinued products, however, poses distinct challenges that extend beyond traditional models. Discontinued items often face rapid demand decline, heightened obsolescence risk, and spatial limitations in warehouses facilities. Without targeted strategies, these products can accumulate, tying up capital and reducing storage efficiency . In order to comprehend the potential approaches to this problem, it is first necessary to understand the distinct stages of the product timeline. These can be described in what is known as the product life cycle. The product life cycle can be described as the period of time over which an item is developed, brought to market, and eventually removed from the market due to reduction of demand for that item (European

Space Agency, 2015). More specifically, on the matters of the market presence of the product, the cycle consists of four sequential phases hereby described as follows:

- Introduction phase: occurs once a new product is conceived, fabricated and made available in the market. This phase can be characterized by the need for substancial investment, low sales due to its small market presence and high cost of research and development (Udokporo, 2021)
- Growth phase: stage where the product experiences rapid gains. During this time the service level in terms of availability of a product responding to an unpredictable demand is the key OW (order winner) - competitive factor that directly determines why a customer chooses one product or supplier over another (James Childerhouse, 2003)
- Maturity phase: known to last longer than others (R.B., 1986) and is characterized by a drop in sales, more competition, a reduction in market share, a reduction in profits, further reduction in costs and innovation (aimed at improving market share).
- Decline phase: market becomes saturated at this stage. Demand for the product stars to witness a reduction, bringing sales down as consequence. In this phase, costs see a further reduction, demand reduces, the market starts to decline as competitors gradually withdraw, sales volumes drop, profits are seriously affected and the product is ultimately withdrawn from the market.

The phases stated are represented in the product lifecycle graph in Figure 2.1:

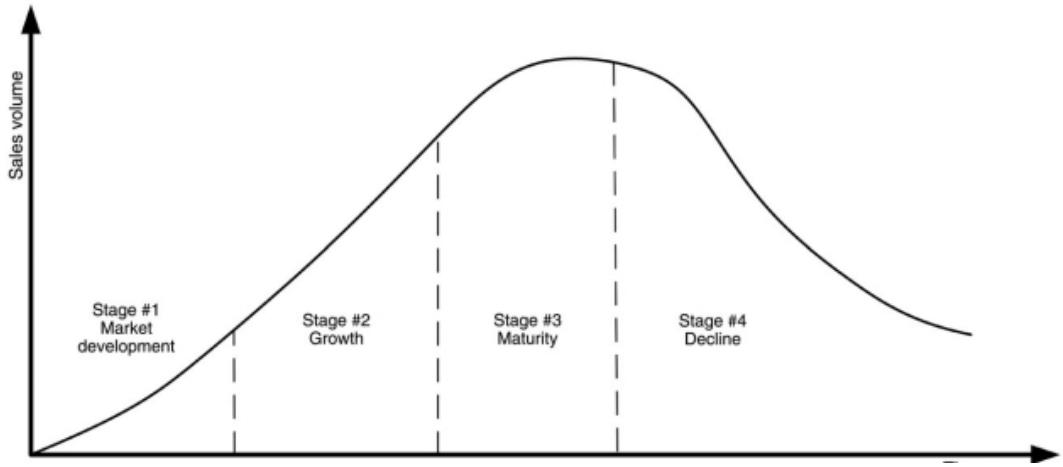


Figure 2.1: Product Life Cycle Graph. Source: Cao and Folan (2011)

Depending on which phase an item currently is in, the product strategy becomes crucial for determining how to handle the circumstances, for instance, forecasts of sales and production. The first two phases are mainly characterized by a willingness to get the product accepted on the market. Therefore, it is crucial to be able to deliver according to the demand as to not create a shortfall. It is also crucial to be able to acquire market shares through increased sales, which in turn

demands considerable flexibility from the production and distribution systems in place (Jonsson and Mattsson, 2003). When it comes to the maturity phase the businesses should adapt their strategies to reach for market segmentation and develop cost management strategies to overcome the threat of increased competition. Price adjustment is one of the key strategies to apply and align with the competitive landscapes, market demands and value propositions in order to thrive in this phase (Nege and Werke, 2024). Companies may decide to discontinue the product, reduce marketing support, or explore alternative strategies such as harvesting or rejuvenating the product (Chillala, 2024).

In the final stage of the PLC, companies often opt to discontinue products. Managing inventory for such outgoing items requires strategic adjustments to avoid financial losses. (Emsermann and Simon, 2007) propose a continuous-review inventory management model that explicitly accounts for the risk of simultaneous obsolescence. Their approach involves dynamically adjusting order quantities over time, reducing replenishment volumes as the probability of obsolescence increases. Specific techniques include modeling demand using a stochastic compound Poisson process, applying dynamic programming to minimize the expected total costs of ordering and holding stock, and adopting simplified control strategies under special conditions, such as maintaining constant order levels if obsolescence is memoryless (exponentially distributed) or implementing linear stock reduction when obsolescence follows a deterministic timeline. These types of strategies have the potential to enable companies to balance reordering costs against the risk of surplus obsolete inventory, thus improving operational and financial outcomes when managing discontinued products.

Beyond optimizing the timing and quantity of orders, businesses must actively manage the diversity within their obsolete inventory. Segmenting inventory into categories based on obsolescence levels enables companies to design differentiated management policies for each cluster, thus improving the handling of outgoing or slow-moving stock (Halilović et al., 2023). The ABC analysis is a common method that classifies inventory by value and consumption rate, allowing managers to focus efforts and controls on the most impactful items (Nallusamy et al., 2017). This method often categorizes inventory items into three groups: "A" items are the most valuable and require tight control, "B" items have moderate importance, and "C" items are low-value goods requiring simpler management. Using this classification supports decision-making in inventory management by helping prioritize resources, reduce waste, and guide investment towards the most critical items (Bruno and Cleidice, 2017).

Another increasingly applied solution is dynamic pricing, which allows firms to adjust prices in real time based on stock levels, product age, and demand signals. This technique supports faster depletion of slow-moving or end-of-life inventory and reduces the need for deep clearance discounts (Zhang et al., 2022). In industries with fast product refresh cycles, coordinating inventory management with design refresh planning also helps firms avoid an excessive build-up of outdated products (Shi and Liu, 2020).

Additionally, reverse logistics and end-of-life product strategies play a growing role in discontinued stock management. These include product take-back programs, refurbishing, and recy-

cling, which not only allow companies to reclaim value but also align with sustainability objectives (Govindan and Soleimani, 2016).

Inventory management must therefore be viewed as a dynamic process that accounts for the full product lifecycle. As new products are introduced, older ones exit the assortment, requiring tailored strategies to manage inflow and outflow efficiently. Managing both ends of this cycle is critical to sustaining profitability, operational agility, and long-term competitiveness (Mourtzis, 2016; Govindan et al., 2015).

2.1.3 Forecasting

With increasing market complexity and the availability of large-scale data, businesses are progressively shifting toward automated pricing systems. These models leverage algorithms and machine learning techniques to set or adjust prices in real time, considering variables such as inventory levels, competitor prices, and demand elasticity (Elmaghraby and Keskinocak, 2003).

The advantages of automation include enhanced pricing accuracy, faster response to market shifts and reduced reliance on manual intervention. These systems also support data-driven decision-making, enabling more granular and predictive pricing strategies that align with overall business goals (Rodríguez et al., 2022). Furthermore, automation ensures scalability and process standardization, allowing firms with broad product portfolios or multi-channel operations to maintain pricing coherence and minimize operational friction (Kienzler and Kowalkowski, 2017).

The integration of mathematical models such as Auto Regressive Integrated Moving Average (ARIMA) for time-series analysis, Ridge, Lasso, and Elastic Net regression for modeling variable interactions, and machine learning algorithms such as decision trees, random forests, gradient boosting, and neural networks significantly enhances demand forecasting (Ma et al., 2024). The same author highlights ARIMA models due to their capability to forecast declining demand for discontinued products, enabling firms to adjust inventory and pricing strategies effectively to minimize overstock and lost revenue.

While the adoption of automated pricing models requires upfront investment and careful change management, their long-term benefits in efficiency, responsiveness, and revenue optimization linked to stock management are increasingly recognized across industries.

2.2 SKU Rationalization and Range Allocation

SKU rationalization is a critical process for companies aiming to manage product complexity and maintain operational efficiency. While the expansion of product variety has the potential to meet diverse customer needs, unchecked proliferation can impose a substantial burden on operations. Empirical evidence indicates that SKU proliferation can lead to a 15–30% increase in operational costs, with only 20–30% of products contributing meaningfully to profitability (Wilson and Perumal, 2009). However, SKU rationalization is a complex problem due to its implications for multiple organizational functions and relationships with customers and suppliers (Olavson and

Fry, 2006; Enz et al., 2019) . The significance of a particular SKU is likely to be perceived differently by marketing, sales, R&D, manufacturing, procurement, and finance, each of which typically has conflicting objectives that both influence and are influenced by decisions to add or eliminate SKUs.

The proliferation of SKUs is driven by several factors, including aggressive customer segmentation, the creation of an excess of products tailored to niche needs, rising consumer expectations for variety, the introduction of multiple price points within categories, and competitive strategies that emphasize assortment as a means of differentiation (Quelch and Kenny, 1994). This proliferation poses significant challenges, as it disperses customer demand across a broader range of products, thereby increasing overall demand uncertainty and variability, complicating forecasting and inventory management throughout the supply chain (Padmanabhan and Lee, 1997).

In this context, identifying low-performing SKUs and implementing a structured elimination strategy are essential steps for improving a company's operational efficiency and profitability. One widely used method is Pareto analysis, which helps visualize that a small percentage of SKUs—typically around 20 percent generate approximately 80 percent of total sales. Through this analysis, firms can quickly pinpoint the large number of low-volume products that contribute minimally to revenue while adding significant complexity to operations. These underperforming SKUs often display erratic and unpredictable demand patterns, complicating both inventory management and sales forecasting (Gilliland, 2011).

Once low performers are identified, companies can initiate an elimination strategy aimed at streamlining operations. Pruning low-volume SKUs reduces warehouse congestion, simplifies inventory systems, and improves the accuracy of forecasting by minimizing the noise created by unpredictable sales data. This not only enhances inventory turnover but also frees up critical resources such as storage space, working capital, and managerial focus. Freed resources can then be reallocated to support high-performing products or strategic growth initiatives. Ultimately, a disciplined approach to SKU rationalization can increase operational agility, improve service levels, and strengthen overall business performance (Gilliland, 2011).

In addition to SKU rationalization, firms can employ complementary strategies such as demand pooling to manage variability and reduce inventory inefficiencies. Demand pooling is a supply chain strategy that involves consolidating demand across multiple locations or products to reduce variability and uncertainty. By aggregating demand, companies can decrease the overall safety stock required, leading to lower inventory costs and improved service levels.

Range allocation, defined as the strategic selection of the number and type of SKUs to offer within a product category to balance customer needs and operational efficiency (Hübner and Schaal, 2017), plays a crucial role in managing complexity and ensuring operational performance. Moreover, the concept of demand pooling is highly relevant to range allocation (Alfaro and Corbett, 2003). Their study demonstrates that consolidating product variants can reduce demand variability and associated inventory costs. By thoughtfully allocating product ranges and minimizing redundant SKUs, companies can leverage the pooling effect to enhance supply chain efficiency.

2.3 Optimal Price Markdowns and Price Elasticity of Demand

This section explores key principles behind optimal price markdowns, focusing on how businesses adjust prices to balance inventory clearance with profit maximization. It introduces foundational concepts such as Littlewood's Rule and outlines both time-based and inventory-driven strategies. Following this, the concept of price elasticity of demand is introduced, providing a framework for understanding how consumers respond to price changes, an essential input for effective markdown decisions.

2.3.1 Optimal Price Markdowns

The logic of optimal markdowns starts with one of the foundational insights of dynamic pricing: Littlewood's Rule (Littlewood, 1972). Originally developed for airline seat inventory, Littlewood's Rule addresses the core trade-off between selling a product now at a certain price versus waiting to sell it later at potentially a higher price. At its heart, it provides a threshold-based decision rule: accept a booking at a lower price only if the expected revenue from selling that seat later does not exceed the current offer.

Although designed for services such as airlines and hotels, Littlewood's Rule laid the foundation for understanding intertemporal trade-offs in pricing, a concept that directly translates into retail markdown optimization, where goods are perishable over time not because they expire, but because their value depreciates as fashion seasons turn or trends fade.

As retail industries evolved, so did the sophistication of markdown strategies. Retailers today face the continual challenge of clearing inventory without sacrificing more margin than necessary. Simply slashing prices uniformly is not optimal; rather, the goal is to time reductions carefully to maximize the total profit over a selling horizon. In fact, using reinforcement learning algorithms, can significantly improve profitability in retail by optimizing markdown decisions based on real-time demand forecasts and substitution effects (Sousa et al., 2024).

Markdown optimization models generally fall into two broad categories: time-based and inventory-based. Time-based markdowns involve setting a fixed schedule for price reductions (e.g., reducing prices every two weeks as a season ends). This approach often assumes that demand naturally decays over time, making early, aggressive markdowns potentially wasteful. Optimal Control Theory has been frequently applied to model these dynamics, treating pricing as a continuous decision variable that evolves over time in response to changes in demand elasticity (Kopalle et al., 1999). This approach frames pricing as a dynamic optimization problem, where the objective is to maximize revenue or profit over a time horizon, taking into account inventory constraints, time-sensitive demand, and competitive influences (Phillips, 2021). It enables firms to determine an optimal pricing path rather than a single decision point, making it especially relevant for managing prices over a product's lifecycle or during phase-out periods.

Inventory-based markdowns, on the other hand, react to the real-time status of stock levels. If inventory is depleting faster than expected, price cuts can be delayed or minimized; if inventory remains stubbornly high, sharper markdowns are triggered. Such models tend to use stochastic

inventory control techniques, often coupled with adaptive learning from demand data (Hübner and Riesenegger, 2025).

At the frontier of this literature is the realization that inventory-driven pricing and demand learning are inseparable. Early demand signals should inform markdown paths dynamically. More advanced work in data-driven dynamic pricing (Chen et al., 2000) shows that even modest improvements in reacting to early sales trends can significantly boost profitability.

Moreover, the broader field of Revenue Management, from which markdown optimization is a specialized branch, emphasizes the importance of integrating price elasticity estimates, consumer choice behavior, and competitive response into markdown strategies (van Ryzin and Talluri, 2005).

2.3.2 Price Elasticity of Demand

At the core of price markdowns, and aiming for the optimal adjustments, when managing the prices of the products, is the concept of price elasticity. This technique, pioneered by British classic economist Alfred Marshall in the early part of the 20th century built the foundations of microeconomics (Anderson et al., 1997).

The price elasticity of demand measures the percentage change in the quantity demanded resulting from a 1-percent increase in price. Denoting the quantity of a good by Q and its price by P, the price elasticity of demand is given by Equation 2.1.

$$E_p = \frac{\Delta Q/Q}{\Delta P/P} = \left(\frac{P}{Q}\right)\left(\frac{\Delta Q}{\Delta P}\right) \tag{2.1}$$

(Pindyck and Rubinfeld, 2013)

The elasticity of demand can be explained as follows:

- Elastic Uniter (E = 1); If the price goes up / down by 1%, then the demand will go up / down by 1% (the percentage of the number of goods demanded is the same as the percentage change in price).
- Elastic (E > 1) ; If the price goes up / down by 1%, then the demand will go up / down by more than 1% (the percentage change in the number of goods demanded is higher than the percentage change in price; demand is susceptible to price changes)
- Inelastic (E < 1); If the price goes up / down by 1%, then the demand will go up / down by less than 1% (the percentage change in the amount requested is smaller than the percentage change in price; demand is not sensitive to price changes).
- Perfect inelasticity (E = 0); If demand is not responsive to price changes, so whatever the market price is, then the number of goods demanded remains (demand curve parallel to the vertical axis/price axis)
- Perfect Elasticity (E = ∞): In this case, consumers are willing to purchase any quantity of a good at a specific price, but none at even a slightly higher price. The demand curve

is parallel to the horizontal axis, indicating that demand is infinitely responsive to price changes (Johansyah et al., 2022).

The same author argues that this metric can be influenced by a series of factors such as: availability of substitutes, household income, consumer preferences, expected duration of price change, and the product's share of a household's income (Pindyck and Rubinfeld, 2013).

2.4 Pricing Strategies

Pricing strategies are a critical aspect of business operations, shaping profitability, competitive positioning, and customer perception. Traditionally, businesses have relied on structured, human-managed pricing approaches rooted in financial logic and market behavior.

Among the most widely adopted is cost-plus pricing, where companies determine prices by adding a fixed markup to the unit cost of a product. This method ensures cost recovery and provides a straightforward framework for pricing decisions but tends to neglect external factors such as market demand and competitive dynamics (Avlonitis and Indounas, 2005).

Another conventional method is competitive pricing, in which prices are set in alignment with or in reaction to pricing strategies of competitors. While this approach is effective in price-sensitive markets and helps maintain market relevance, it often triggers price wars and may lead to eroded margins if not strategically managed (Ingenbleek et al., 2003).

Value-based pricing represents a more customer-centric approach, where prices are set based on the perceived value to the customer rather than the cost of production or industry benchmarks. This strategy can lead to superior profitability, especially when targeting differentiated or premium offerings, but requires a deep understanding of customer behavior, market segmentation, and brand positioning (Hinterhuber, 2008).

Temporal strategies are also common. Penetration pricing involves setting low initial prices to gain market share quickly, particularly for new product entries. Although it can discourage competition and accelerate adoption, it often involves initial losses and requires a long-term profitability plan (Tellis, 1986). In contrast, price skimming sets high entry prices for innovative products and gradually reduces them over time to attract broader market segments. This strategy is frequently used in technology and consumer electronics markets, enabling firms to recover R&D investments and segment customers by willingness to pay (Nagle and Müller, 2017b).

2.5 Automatization and Digitalization in Retail Management

The digital transformation of retail operations has significantly reshaped stock management practices, transitioning from manual methods to increasingly automated and intelligent systems. Historically, many retail organizations relied on basic tools such as Excel spreadsheets for stock tracking, forecasting, and markdown planning—tools that, while flexible and accessible, were prone to errors and lacked real-time integration capabilities. Indeed, manual inventory tracking in Excel has

been shown to cause frequent inaccuracies impacting visibility, control, and profitability (Barratt et al., 2021). Digital transformation has since optimized these practices by improving accuracy and efficiency (Bharadwaj et al., 2013).

In response to the growing complexity of supply chains and consumer demand patterns, retailers are increasingly adopting Robotic Process Automation (RPA). RPAs enable the automation of repetitive and rule-based stock operations (such as stock count reconciliation, alert generation for low inventory, or the triggering of markdown workflows) thereby reducing human error and improving response time (Willcocks et al., 2017). RPAs are especially beneficial in high-SKU environments where volume and speed are critical.

Moreover, the use of Machine Learning and predictive analytics is gaining prominence in digital stock management. ML algorithms can analyze historical sales data, promotional effects, seasonality, and external factors (e.g., weather, events) to generate more accurate demand forecasts and stock optimization strategies (Choi et al., 2018). These systems evolve over time, learning from sales patterns and reducing the dependency on static rule-of-thumb thresholds often used in markdown or replenishment decisions.

Digitalization of price markdown management builds directly on automated stock control, embedding data-driven, algorithmic pricing into traditional markdown workflows.

Historically, markdowns relied on fixed schedules or inventory thresholds, but academic research emphasises the shift towards multi-period dynamic pricing models. These models combine demand forecasting with stochastic optimization (e.g. Markov decision frameworks) to determine the timing and amount of discounts throughout a product's lifecycle (Özlem Coşgun et al., 2013).

A growing body of literature explores the use of machine learning techniques, such as regression, clustering and reinforcement learning, to make more responsive markdown decisions. These systems continuously learn from real-time inputs, such as sales velocity, stock levels and market conditions, and adjust markdown timing and depth accordingly (Dash et al., 2024).

Furthermore, academic analyses of dynamic pricing frameworks emphasise the importance of combining demand modelling (including covariates such as seasonality or competition) with regret-minimising algorithms. This ensures that prices can adapt intelligently without the need for prior knowledge of the demand function.

Finally, it is worth noting that smart markdown strategies, which tightly integrate pricing rules with inventory and analytics systems, have become essential in competitive retail. Approaches that leverage data and apply appropriate analytical methods have been shown to improve margins and reduce the risk of excess inventory (McKinsey & Company, 2022).

These transitions to intelligent automation align with the broader trend of Industry 4.0, where integration between systems and data-driven decision-making is emphasized (Xu et al., 2018). For retailers such as IKEA, leveraging such tools allows for more consistent markdown decisions, enhanced alignment between departments, and reductions in operational waste.

Chapter 3

Problem Description

The purpose of this chapter is to present a comprehensive description of the problem this thesis seeks to address. It begins by outlining the strategic and operational context of product discontinuation at IKEA, detailing the mechanisms that generate markdown pressure at the store level. From there, it explores the core issues that compromise the efficiency of markdown decisions, including limitations in forecasting, inconsistent methodologies, and cross-departmental complexity.

The chapter further introduces the legal framework that constrains markdown flexibility, followed by a review of the key departments involved in executing pricing changes. It then examines the technological landscape and internal systems available to support decision-making, highlighting gaps in adoption and integration. Together, these elements form a foundational understanding of the problem, establishing the basis for the methodological interventions proposed in subsequent chapters. The final section summarizes the insights to the problem described.

3.1 Introduction to the problem

This section outlines the key factors that contribute to the inefficiencies in managing discontinued stock at IKEA. It begins by contextualizing the company's product lifecycle strategy and explains how stock pressure builds toward the End Date of Sale (EDS), creating the need for timely and effective markdown decisions.

3.1.1 Contextual Background: Discontinuation and Stock Pressure at IKEA

IKEA operates within a dynamic and highly competitive retail landscape, where product renewal is essential to sustain customer interest and respond to evolving consumer trends. In this environment, IKEA's global strategy includes the routine discontinuation of products across its catalog. This process is centrally managed and involves thorough market analysis, trend assessment, and lifecycle planning. The outcome of this process is the assignment of an EDS to articles that are to be phased out globally.

The EDS is a pivotal milestone. It indicates the point after which an article should no longer be available for sale and triggers a cascade of operational and commercial responses across the

organization. These responses include adjusting replenishment systems, launching communication campaigns, and initiating markdown strategies to ensure products are cleared from shelves in alignment with the EDS.

Throughout the fiscal year, IKEA introduces new articles during four scheduled events known as Product Change Dates (PCDs). These events are strategically positioned to coincide with expected shifts in consumer behavior and demand patterns. In addition to PCDs, seasonal campaigns notably during the Christmas period and the beginning of summer, (referred to internally as the "Outdoor Season") also serve as key opportunities for the introduction of new or promotional articles.

At the store level, product range flexibility introduces another layer of complexity. Not all IKEA stores carry the same product assortment. While some articles are classified as "Mandatory" and must be stocked in all locations, others fall into optional categories such as "Optional", "Seasonal", or "Free-Range", offering stores more discretion in their assortment decisions. This model allows for local market adaptation, but it also amplifies challenges related to inventory standardization and stock management during product transitions.

When an article is discontinued and receives an EDS, stores are alerted through centralized systems. However, due to the operational structure of IKEA's replenishment logic, stores often continue receiving deliveries of these articles even after the discontinuation decision has been communicated. This is largely a consequence of how incoming stock is managed through mechanisms such as the stock distribution logic based on historical sales (internally referred as SPLIT) and Rest-to-Order (RTO), which are calculated based on real-time forecasts and predefined distribution logic.

In particular, the SPLIT calculation (which determines how much stock each store will receive) is primarily based on the store's historical sales performance. This demand forecasting logic assumes that past sales are a reliable indicator of future need and allocates incoming stock accordingly. The formula incorporates each store's sales share from previous periods, adjusted for the product's overall forecasted demand. It also accounts for current stock on hand (BOH), goods in transit, and other operational thresholds. However, because the model relies heavily on retrospective data, it can continue allocating stock to stores even after an article is marked for discontinuation. This is especially problematic when dealing with bulk deliveries, such as multipacks or palletized shipments, which can result in quantities that far exceed the store's realistic sell-through potential before the EDS.

Furthermore, the calculation of Rest-to-Sell (RTS) — a relatively recent addition — defines the remaining inventory responsibility per store, but it does not necessarily prevent overstock situations, especially when multiple layers of distribution planning are involved. Combined with the legacy behavior of pushouts (final deliveries before EDS), this leads to frequent overstock scenarios just prior to product discontinuation.

Consequently, there is significant pressure placed on stores to reduce excess stock quickly, typically through price markdowns or TT440 transtypes. These markdowns are often reactive and lack systematization, leading to inconsistencies in their application across different locations and

product types. As such, the current state of this process represents a key inefficiency and presents a rich area for further investigation and improvement.

3.1.2 Core Problem: The Challenge of Markdown Decision-Making

The central issue explored in this thesis lies in the inefficiencies surrounding the price markdown decision-making process in IKEA stores, particularly following the discontinuation of articles. While forecasting systems and structured product lifecycle planning provide a strong foundation for managing inventory, there remain persistent and systemic limitations that hinder optimal execution at the store level.

At the heart of the problem is the inherent uncertainty of demand forecasting. Despite the use of historical data, trend alignment, and predictive analytics, IKEA—like all retailers—must operate within the limits of retrospective insight. Forecasting models, by their very nature, rely on past performance to project future behavior, which creates vulnerabilities when faced with shifts in consumer preference, local anomalies, or stock inconsistencies. Therefore, inventory mismatches around the time of discontinuation are not only probable but statistically expected.

However, the core inefficiency is not the forecasting limitation itself, but rather the absence of a systematic markdown framework capable of responding to excess stock conditions in a timely and optimized manner. Currently, markdowns are predominantly decided through manual assessments, often based on professional intuition or ad hoc criteria such as “feeling” or intuition, recent stock updates, or local judgment calls. While these decisions are informed by experience, they are prone to inconsistency and rarely backed by a standardized evaluation of price elasticity, gross margin trade-offs, or opportunity costs associated with prolonged stock occupancy.

As a result, this manual process contributes to:

- Lost gross margin through either unnecessary or delayed price cuts that fail to recover maximum value;
- Underutilized shelf and storage space, as overstocked articles remain in inventory longer than necessary, potentially blocking the introduction of newer or higher-priority items;
- Operational inefficiency, as teams spend valuable time debating markdowns, coordinating updates, and adjusting plans without the support of an integrated tool or methodology.

Additionally, the problem is exacerbated by cross-departmental complexity. Pricing decisions are not confined to a single team: they impact and are influenced by multiple departments, including Sales, FI, BNOM, and Recovery. Each of these teams engages with the markdown process from different operational standpoints and with distinct objectives, creating friction and misalignment. For instance, Sales may prioritize sell-through rates, while Fulfillment is more concerned with inventory health and capacity optimization. Without a unified protocol, these interdependencies often result in miscommunication, redundancies, or delayed actions.

In summary, the challenge lies in the absence of a standardized, data-driven markdown process that can guide decision-makers in identifying when and how much to adjust prices post-discontinuation. Addressing this gap is essential to improving both financial performance and operational coordination, and it forms the basis for the investigation and methodological development presented in the following chapters.

3.2 Overview of Relevant Departments and Roles

This section identifies and describes the key departments involved in the markdown decision process at IKEA. Each plays a specific role in how discontinued items are handled, from strategic pricing and operational execution to budget validation and stock clearance. Understanding their responsibilities and interactions is essential to analyzing where inefficiencies arise and how the process might be improved.

To fully understand the complexity and inefficiencies of the current price adjustment process, it is essential to identify the key departments involved in the markdown lifecycle. Within the store's organizational framework, four areas are particularly relevant: Sales, Fulfillment Integration, BNOM and the Recovery section (a subdivision of BNOM). Each plays a distinct role in the way discontinued articles are handled, particularly after the EDS is defined. These departments are displayed in the relational orgnizational chart of Figure 3.1.

The Sales department plays a central role in the initiation and execution of markdowns. The responsibility for managing markdown decisions lies with the Sales Managers, who track product performance, coordinate actions across categories, and ensure that pricing adjustments support both sell-through and margin objectives.

Each Home Furnishing Business (HFB) area—such as bedroom, kitchen, or storage—is overseen by a Shopkeeper, who is responsible for operational execution within their segment. While Shopkeepers provide valuable local insight and are consulted for product-specific context, they do not make markdown decisions themselves. Instead, they support the Sales Manager's strategy by implementing changes on the floor and offering feedback regarding sales dynamics and merchandising impact.

The Fulfillment Integration team operates as the logistical and analytical engine of the store. This department oversees the flow of goods from distribution to sales floors and is highly involved in anticipating and managing excess stock that results from forecasting discrepancies or post-EDS replenishments.

They are responsible for controlling RTO and RTR (Rest-To-Receive) volumes and are key players in identifying when projected demand (often based on outdated or optimistic data) does not align with real-time sales. By doing so, they help surface candidates for markdowns and improve the efficiency of stock management leading up to and following a product's EDS.

BNOM is the store's administrative and financial control center. This team does not intervene directly in markdown planning or execution but plays a critical validation and oversight role.

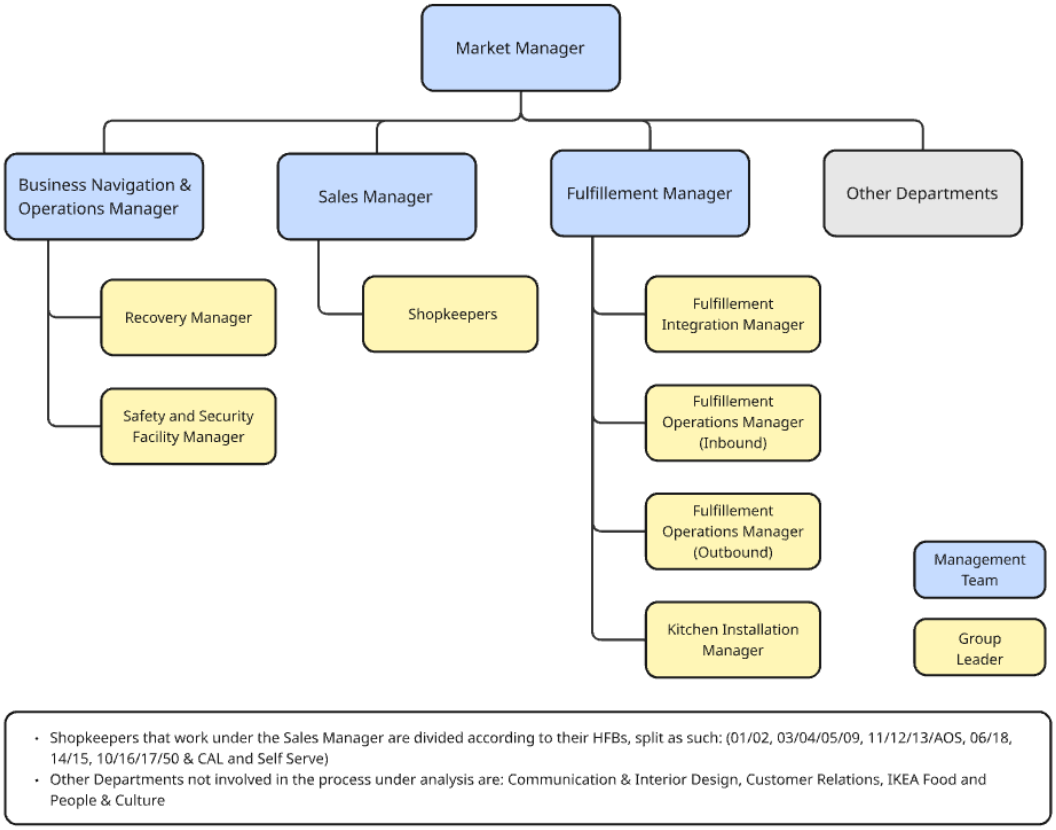


Figure 3.1: IKEA's Organizational Chart

Specifically, they ensure that the application of TT440 transtypes are financially justifiable and compliant with internal guidelines.

BNOM's broader responsibility includes tracking gross margin performance, aligning pricing decisions with financial forecasts, and assessing risk exposure. In this way, they act as a gatekeeper between commercial actions and fiscal accountability, ensuring that markdown activity contributes to sustainable business operations.

The Recovery department, situated under BNOM, is responsible for executing markdowns on items flagged for TT440 treatment. Once markdown approval is obtained, Recovery manages the pricing, presentation, and clearance of these articles. Their autonomy allows them to control the flow of stock through Recovery areas, ensuring that space is optimized and that all items are processed within legal and internal policy constraints.

This team also manages the Circular Area exhibition planning, monitors internal stocks and ensures the timely execution of markdowns to maximize item turnover. Their day-to-day activities often involve rapid decision-making and adjustments, especially for items that are underperforming or logistically challenging.

3.3 Legal Constraints on Markdown Strategy

In addition to internal process limitations, the markdown decision-making process at IKEA is shaped by strict legal and regulatory frameworks. These rules define how prices can be adjusted, communicated, and promoted, especially during clearance periods and the handling of discontinued items.

A primary constraint is the prohibition on selling below cost. In Portugal, as in many other countries, products cannot be sold for less than their purchase price except under specific conditions, such as seasonal clearance. This restricts IKEA's ability to quickly liquidate overstock and may force stores to rely on alternative strategies like Recovery or internal redistribution, each carrying its own inefficiencies.

Promotional language is also tightly regulated. Continuous or misleading discount campaigns are not permitted, which prevents IKEA from relying on aggressive or repetitive markdowns. Instead, campaigns must use terms like "Now or Never" to signal urgency without breaching consumer protection standards.

These challenges have grown with new EU regulations implemented in Portugal in 2022. Notably, any advertised discount must reference the lowest price of the previous 30 days, and further reductions must use the last discounted price - not the original - as the comparative reference. This prevents artificial price inflation and limits how promotions can be structured over time.

These constraints stem from two separate legal frameworks. First, DL 166/2013 (Article 5(2)) prohibits the sale of goods below their effective purchase cost, ensuring that pricing practices remain economically fair and legally compliant (República Portuguesa, 2013). Second, DL 70/2007, as amended by DL 109-G/2021, which took effect in May 2022, mandates that any advertised discount must reference the lowest price applied in the preceding 30 days. This update aims to prevent artificial price inflation and ensure transparency in promotional strategies (República Portuguesa, 2007).

Altogether, these rules significantly restrict how markdowns can be deployed and communicated. Legal compliance must be integrated into any systematic markdown strategy, ensuring that pricing actions remain within regulatory boundaries while still supporting operational and financial goals.

3.4 Internal Tools & Systems

This section reviews the digital tools available at IKEA to support pricing and stock management decisions. While a variety of platforms exist, ranging from markdown optimizers to sales analytics dashboards, their use in the evaluated stores is limited. Many tools remain disconnected from daily operations, underutilized, or poorly integrated, leading to a continued reliance on manual methods like Excel. The following subsections highlight key systems, their intended functions, and the reasons behind their limited impact on current workflows.

3.4.1 EDS Markdown Software

One of the most pertinent tools identified is the EDS Markdown Software, which was developed to optimize the clearance of discontinued products. Its main goal was to reduce the number of "carryover" items - products that remain in the store past their discontinuation period (i.e., their End Date Sale or EDS) - to a maximum target of 75 per store.

The software was officially launched in Portugal in November 2020, with full adoption planned for February 2021. However, due to the onset of the COVID-19 pandemic and the resulting shift of strategic priorities toward online channels, the implementation was never completed. Resources were redirected, and the tool eventually became obsolete.

Functionally, the EDS Markdown Software leveraged various inputs such as stock levels, pricing history, SPA limits, article classification, and historical sales behavior. It also imposed constraints related to discount ceilings, furniture classifications, and budgeted markdown limits (e.g., a maximum of 400 articles marked down in the first round of price changes). However, one of its most significant shortcomings was its inability to account for the legal constraints governing price communication, an aspect that is essential for compliance in local markets, particularly in Portugal. Interviews with staff revealed that even store-level users who were expected to rely on the tool were unfamiliar with it or had never received formal onboarding.

3.4.2 Excel Decision Support Models

In the absence of a standard digital solution, most operational pricing analysis is performed using Microsoft Excel. These spreadsheets serve as the primary working documents for identifying items that require price adjustments, simulating discount effects, and monitoring progress toward sell-through targets. Each store maintains its own version of these tools, resulting in inconsistent methodologies across different locations.

Although Excel enables flexibility and fast iteration, it also introduces numerous inefficiencies. The process remains heavily dependent on human input and judgment, lacks transparency across departments, and creates difficulties in scaling or standardizing markdown decisions. Errors, delays, and misalignment between teams are recurring issues attributable to the manual nature of these tools.

3.4.3 QlikSense Dashboards

IKEA's QlikSense ecosystem includes dashboards developed by internal teams across different countries. These dashboards offer functionality such as price elasticity modelling, markdown performance tracking, and competitor price benchmarking. Despite their analytical potential, these dashboards are not actively used in the two stores evaluated in this research.

This limited usage is explained by three primary factors: the dashboards are not tailored to store-specific data; they are not embedded in the workflow of price decision-making, and operational staff often lack awareness or training to access them. As a result, they function more as informational resources for specific markets than as tools for action.

3.4.4 MHS Phase In/Phase Out Software

The MöbelHusSystem (MHS) is a core operational platform used by IKEA stores to support article-level management across various phases of the product lifecycle. Within the scope of discontinued article management, MHS plays a crucial role in monitoring stock metrics, tracking replenishment operations, and supporting decision-making for markdowns or recovery actions.

The interface includes several modules that assist Fulfillment Integration teams in real-time execution and analysis. Below are the key functionalities and how they support coworkers in the office and on the warehouse floor:

- **Workload Overview Dashboard**: Presents real-time task distribution, goods receiving status, movements to/from storage, and daily stock check completion. It enables Fulfillment coworkers to prioritize urgent tasks and identify areas of operational backlog. Visual elements like red/green status bars offer immediate clarity on incomplete tasks.

- **Article View Interface**: For each article, this screen aggregates all critical data, including Store Goods Flow (SGF) stock, physical stock, average sales, forecast, and sales area availability. It also includes logistics metadata (RTO quantities, delivery lead times, item volume) and pick location status. Fulfillment teams use this tool to understand stock levels holistically and make tactical RTO or markdown decisions.

- **Forecast Tab**: This section includes both Tactical and Operational Forecasts, Country Activity Forecast, and Local Activity Forecast. Coworkers monitor weekly sales evolution and compare it against forecasted values. The system highlights forecasting errors and helps identify misaligned articles early. This is one of the main data sources that feed the process for the Fulfillment Department.

- **Availability Charts and Legal Constraints**: Includes modules that project expected availability over the coming days and flag any compliance alerts, especially around legal price minimums or missing sales data. This is essential when deciding between markdowns or transfers to Recovery.

- **Replenishment Planning Tools**: MHS also calculates automatic replenishment proposals and determines whether an item is "Ready for Planning." It displays multipack, Minimum Order Quantity (MOQ), and picking unit constraints, allowing Fulfillment Integration to validate if a SKU should still receive stock or be closed for incoming flow.

These features empower the Fulfillment Integration team to:

1. Identify stock buildup early (via BOH and goods-in-transit monitoring).
2. Validate if the article's volume justifies early markdowns based on SPA impact.
3. Coordinate RTO corrections and forecast adjustments around 2–3 months prior to EDS.

4. Avoid over-ordering by confirming storage space and delivery logic (e.g., pallet/multipack constraints).

5. Provide downstream teams (Sales, BNOM) with visibility into logistical feasibility of markdown or TT440.

The tools described in this section reflect the range of digital resources currently available to support markdown-related activities across IKEA stores. These include purpose-built platforms such as the EDS Markdown Software, general-purpose tools like Excel spreadsheets, business intelligence dashboards through QlikSense, and integrated planning features within the MHS system. Each tool serves specific functions, from forecasting and sales tracking to stock management and legal compliance monitoring. However, their deployment and integration into day-to-day operations vary across locations and departments, contributing to diverse usage patterns and levels of adoption.

3.4.5 Problem Landscape Summary

In sum, the current markdown process at IKEA operates within a complex intersection of forecasting limitations, regulatory constraints, decentralized decision-making, and underutilized digital infrastructure. Despite the availability of purpose-built tools and organizational expertise, markdown activities remain reactive and inconsistent across stores. This fragmentation is rooted not only in the structural disjunction between departments such as Sales, Fulfillment, BNOM, and Recovery but also in the absence of an integrated, data-driven framework to guide pricing decisions post-discontinuation. The resulting inefficiencies, ranging from delayed stock clearance to avoidable margin losses, underscore the need for a more systematic, cross-functional approach. Understanding this operational landscape lays the groundwork for the next chapter, which details the methodology used to map current practices, identify areas for improvement, and develop focused solutions.

Chapter 4

Methodology

This chapter presents the methodology adopted throughout the project and is structured in two main parts. The first section describes the qualitative research conducted through interviews with key stakeholders across relevant teams. Here an overview of how the current markdown process was mapped can be found, along with how activities were analyzed in terms of execution time, and how these insights helped validate the need for a structured solution. This phase lays the groundwork for understanding the operational context and the specific challenges that the proposed system was designed to address.

The second section focuses on the development of the DSS, that underpins the proposed solution. It details the key features of the tool, the data sources it connects to, and the logic applied to generate relevant insights. In addition, this section outlines the critical process improvements derived from the DSS, which enabled the reconstruction of a more efficient and aligned swimlane model. Together, these two methodological components form the foundation for the analytical and design work carried out in the present thesis.

4.1 Action Research applied in the Project

As previously discussed in Chapter 1, the method chosen to guide the research of the present thesis was the AR method. As stated, this system comprises five different, sequential stages, that contribute to solving practical, organizational issues. For this thesis the phases, and respective timeline, can be explained as follows:

The Diagnosing phase focused on understanding current practices related to pricing adjustments and the management of discontinued articles. This involved interviews and workshops with key stakeholders across departments, as well as the analysis of internal documentation and data flows. The aim was to uncover process inefficiencies, inconsistent practices, and decision-making bottlenecks. This phase also served as an opportunity to gain familiarity with IKEA's internal systems and lasted approximately one and a half months.

In the Action Planning phase, improvement opportunities were identified, and the foundation for a standardized framework was developed. This involved mapping existing workflows,

benchmarking internal best practices, and designing conceptual models for pricing and product phase-out processes. Attention was given to organizational realities such as systems integration, data availability, and cross-functional collaboration. This phase also spanned the remaining of the second month as well as the first weeks of the third.

The Action Taking phase focused on creating the core solution for the identified problem: a decision support system. Designed in collaboration with key stakeholders, the DSS was built to align with the company's existing tools, particularly Excel-based workflows, ensuring ease of adoption and integration. This phase was carried out over the course of 1 month.

The Evaluation phase involved testing the developed program in a real operational context and validating it against previous feedback. This process identified improvement points and allowed for fine-tuning of the solution before its broader application. The evaluation primarily relied on qualitative input from key stakeholders and took approximately 2 weeks to complete.

The final phase, Specifying Learning, focused on synthesizing key insights from the project and formalizing them into a proposed standardized model for pricing and discontinued article management. This stage also included recommendations for further improvements and proposed adaptations for future integration. This phase also lasted about two weeks.

Aligning these five phases with concrete actions and reflective practices within IKEA ensured that the research was both practical and methodologically rigorous. The thesis's structure mirrors the AR cycle, facilitating iterative learning, active stakeholder involvement, and content validation. This approach supports developing a scalable, standardized framework for managing pricing adjustments and discontinued products while contributing to organizational learning and continuous improvement.

4.2 Process Mapping and Interviews

This chapter provides a descriptive analysis of the current markdown process for discontinued products (UTGs) and identifies key challenges based on stakeholder input. The objective was to understand what aspects of the process needed improvement and how best to approach them. This investigation was conducted through interviews with stakeholders directly involved in the process at the store level.

These interviews first enabled the development of a detailed process map for UTG management in the analyzed stores. The resulting Swimlane diagram, which outlines the main activities and responsibilities of each stakeholder group, is presented in Appendixes D1 and D2. Building on this foundation, the interviews also revealed the core pain points within the existing system, helping to identify areas of greater urgency and opportunity for improvement.

Interviews were conducted in a semi-structured format to allow for a natural and open conversation. This approach allowed the protocol to be adapted depending on the interviewee's role and insights.

Each interview was divided into three sections. The first focused on understanding the participant's role in the markdown process, the relation between their activity and other departments and

the digital tools they used. The second explored any constraints or limitations they experienced in their work. In the final section, participants were encouraged to share their views on inefficiencies, communication gaps, and improvement opportunities, both within their responsibilities and across the broader process. The complete interview protocol and technical sheet can be found in Appendix A.

4.2.1 Mapping the Process

This section provides a comprehensive walkthrough of the markdown decision-making process at IKEA's store level, focusing on the workflow associated with managing discontinued products (tagged with an EDS). The goal is to identify process bottlenecks and lay the foundation for strategic improvements. The methodology is grounded in interview data, direct observation, and visual modeling using a swimlane diagram. This process involves multiple departments and is dependent on both data-driven and experience-based decisions.

4.2.1.1 Process Trigger & Stock Categorization

The markdown process at IKEA begins once an item is officially discontinued at the global level and assigned an EDS. From this point forward, stores are expected to begin clearing the item's stock. However, due to the structure of IKEA's replenishment logic, they often continue receiving deliveries of the item, even after its EDS designation as detailed in Chapter 3.

The Fulfillment Integration team begins weekly monitoring of EDS-tagged articles, usually at the start of the workweek. Through systems like MHS, they analyze stock metrics including average weekly sales (AWS), BOH, goods in transit, and pending deliveries. Based on this data, articles are grouped into three categories, utilizing the ABC stock categorization mehod applied to their operational context:

- A (Safe): Will sell out well before EDS.
- B (Borderline): Expected to sell out around EDS.
- C (Excess): Likely to remain unsold after EDS.

Only categories B and C are escalated. The resulting shortlist is recorded in an Excel analysis file and passed to the Sales department for evaluation.

4.2.1.2 Sales Evaluation & Pricing Strategy

Sales Managers, in collaboration with shopkeepers (each responsible for a specific HFB), begin evaluating the flagged items. Initial checks determine whether poor sales are due to visibility, location, or bundling, issues that may be corrected operationally without a markdown.

When pricing intervention is deemed necessary, the process enters its most complex phase. Using Excel-based tools, the Sales team performs a detailed analysis, considering:

- Item size, volume, and repackaging feasibility
- Past 16-week AWS
- Total stock (BOH + RTR)
- SPA budget availability
- The article's cost structure (Cost Price - CALC vs. proposed retail)
- Previous pricing and promotional history

Heuristics often play a critical role here. For instance, items with more than 20 units and under €225 in value may be flagged for TT440 transfer. Conversely, high-value or large-volume items may be prioritized for markdown to avoid Recovery handling overhead.

A crucial conflict underpins this step: whether to cut the price or send the item to Recovery, through a TT440 transtype. This decision is influenced not just by demand potential, but also by shelf space, handling cost, item visibility, and impact on SPA budgets. For example, some high-traffic SKUs are deliberately marked down early to avoid deep discounts closer to EDS.

This step is highlighted in Figure 4.1 which intends to display both possibilities that the sales manager consider and underline that developing this stage is one of the core objectives of the present project.

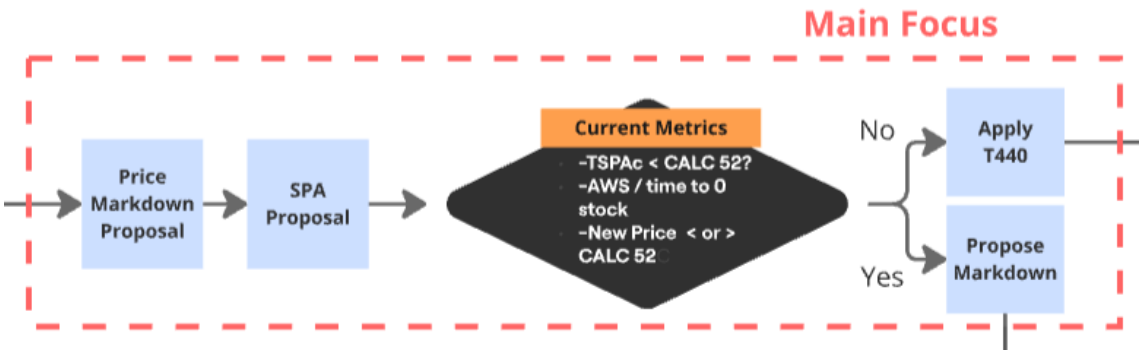


Figure 4.1: Main step under focus in the process of UTG Management

SPA usage is tracked manually, often informally. Some sales teams work with thresholds such as €6,000–€7,500 in SPA per week and attempt to distribute markdowns across categories. However, real-time SPA depletion is not always visible during decision-making.

4.2.1.3 TT440 Governance & Approval Cycle

When a product is determined unsuitable for markdown, it is proposed for transfer to Recovery via the TT440 process. The Sales department prepares a list of proposed items and sends it to the BNOM manager for initial validation. The BNOM does not verify specific technical thresholds or financial ratios, but instead checks whether the proposal appears coherent, reasonable, and aligned

with store-level strategies and budget expectations. This review acts as a governance step to ensure markdown actions are being applied judiciously.

Once this initial review is complete, the items are physically counted and prepared for transfer by the Fulfillment floor team. Recovery then performs a second count independently, confirming that the quantity and type of items match the documentation. This duplication adds labor, but is considered part of the store's internal controls.

Following this second count, a final approval from BNOM is required. Although largely a procedural step, it serves as a formal confirmation before Fulfillment removes the items from store stock records. The TT440 items are now officially under the control of the Recovery team, both physically and within IKEA's inventory systems. This stage of the process involves repetition of certain actions, which can be observed in the segment of the swimlane model of the process in Figure 4.2.

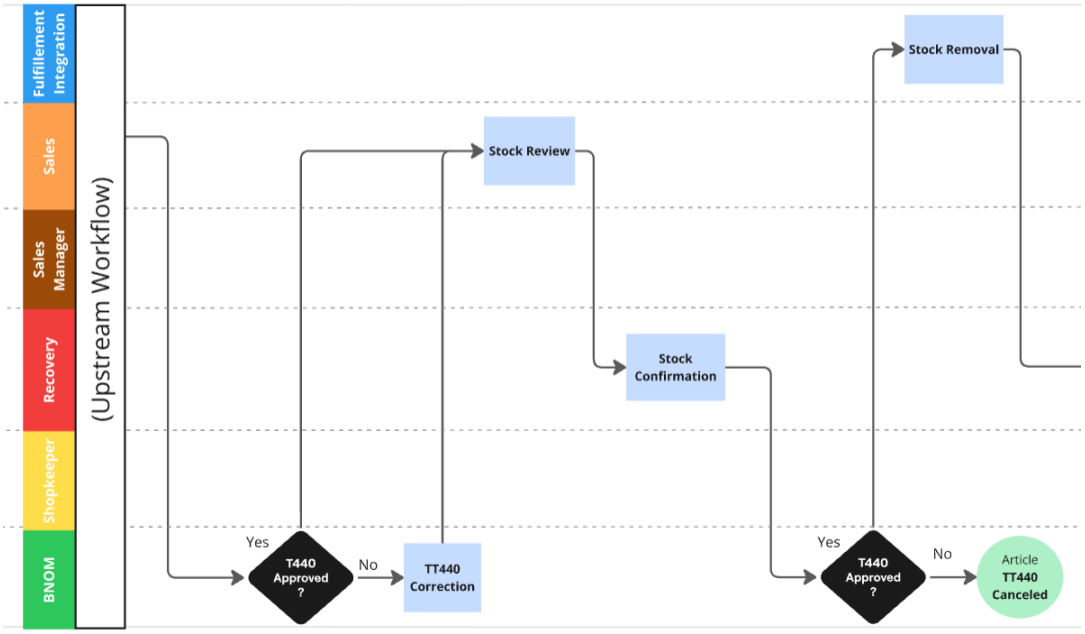


Figure 4.2: Segment of Swimlane of the process that highlights repetition of tasks

This highlighted segment underlines the redundancy of certain stages of the process that must be addressed. The subsequent section transitions to the concluding stage of the initial state process Swimlane.

4.2.1.4 Recovery Management & Process Closure

Recovery assumes responsibility for pricing and merchandising the transferred TT440 stock. Operating with considerable autonomy, Recovery teams apply a markdown matrix based on product condition, original price, and expected appeal. They are also supported by a dedicated tool that identifies the minimum price allowed for each item, helping ensure compliance with regulatory standards.

Items are then either displayed in the Circular section of the store or held in back storage depending on their appeal, size, or urgency to clear. Notably, the Recovery team monitors the turnover of these items and retains the ability to apply additional discounts if items remain unsold for extended periods. This phased discounting model is responsive to customer behavior and available space.

Recovery also plays a key role in managing articles that are better suited to alternative use contexts, such as parts or components that do not sell well alone (e.g., bed legs), but may have greater appeal in a flexible, second-hand retail environment. These insights, gathered over time, influence how Recovery prioritizes storage space and manages stock exposure.

By this stage, the markdown decision lifecycle is complete. The item has either been discounted and remains on the main sales floor, or it has been transferred and repriced through Recovery. Each path reflects distinct operational constraints, budget strategies, and sales forecasts, all carried out within a predominantly manual and fragmented system.

4.2.2 Insights from Interviews

This section compiles the main insights drawn from interviews with key stakeholders involved in the pricing and stock reduction processes. These insights provide a deeper understanding of the internal dynamics, pain points, and areas of opportunity observed within the Braga and Matosinhos IKEA stores. Observations are grouped by role and followed by a synthesis of overarching themes.

4.2.2.1 Pain Points and Observations by Stakeholder

Table 4.1: Stakeholder Insights from UTG Markdown Process

Store	Stakeholder	Key Insights
Braga	Fulfillment Integration	Explained SPLIT and RTO from 36 weeks pre-EDS. Clarified Last Order Arrival Week (LOAW) timing - LOAW is the last intake week for an article, scheduled by the Fulfillment team. EDS Markdown tool was unused. Suggested automated TT440/markdown logic.
Matosinhos	Fulfillment Integration	Aims to minimize LOAW stock. RTO adjusted 2 months pre-EDS. Sales controls SPA. Uses pallets. Suggested using m^3 as a metric.
Braga	Sales	Emphasized balanced markdowns. Flagged unsalable items. Criticized AWS for lack of context. Weekly markdowns €2,250–€3000.
Matosinhos	Sales	Coordinates with Braga via Excel. Supports price elasticity and TT440 automation. Uses 20 units/€225 rule. Tracks removals manually. Holds 75 carryovers. Fights auto-replenishment. SPA budget €6,000–€7,500. Cites BILLY/AWS misclassification.
Braga & Matosinhos	Recovery Team	Operates autonomously. Double counts with Fulfillment. TT440 items treated as sunk cost / are written off, financially. Loose items, such as bed legs sell better in Recovery.

4.2.2.2 Common Themes Across Stakeholders

The main themes presented in the table below were identified through a thorough analysis of the interviews conducted with stakeholders involved in the UTG markdown process. These themes represent recurrent issues, patterns, and inefficiencies reported across departments. By categorizing the insights into overarching topics, it becomes possible to better understand the structural and operational challenges that hinder markdown effectiveness. The summary provided in Table 4.2 synthesizes the most significant observations and pain points raised during the qualitative phase of the research.

Table 4.2: Common Themes Identified Across Stakeholders

Theme	Description
Disconnection Between Departments	Communication between Sales, Fulfillment, and Recovery teams is often informal and manual. Practices such as Excel-based coordination or redundant stock counting highlight inefficiencies.
Underuse of Existing Systems	Tools like the EDS Markdown Software and QlikSense dashboards are accessible, but not fully adopted or integrated. There is low awareness of their availability and even lower usage in the stores analyzed.
Lack of Context in Metrics	Metrics like AWS are not enriched with context, leading to inappropriate markdowns. Examples include stockouts resulting in false categorizations.
Process Driven by Experience	Despite available data, decisions often depend on professional intuition. Rule-of-thumb methods, such as 20 units/€225, are commonly used.
Redundant and Manual Workload	Tasks such as manually flagging empty sales areas, re-counting stock, or maintaining outdated Excel files are prevalent. These introduce delays and increase the risk of error.

4.2.2.3 Quantitative Data Gathered

In order to evaluate the operational impact of the current discontinued article process, a form was shared across both IKEA Braga and Matosinhos stores. Fourteen coworkers responded: 7 from Sales, 3 from Recovery, 2 from FI, and the BNOM department. The form was distributed to a total population of 30 coworkers across both stores, covering the relevant departments involved in the discontinued article process. The 14 responses represent a response rate of approximately 47%, which is a moderate sample size for an internal operational evaluation. While this sample does not include every coworker, it includes representatives from all key departments, providing a sufficient basis to identify trends in time spent and perceptions of process effectiveness. The consolidated results can be found in Figure 4.3.

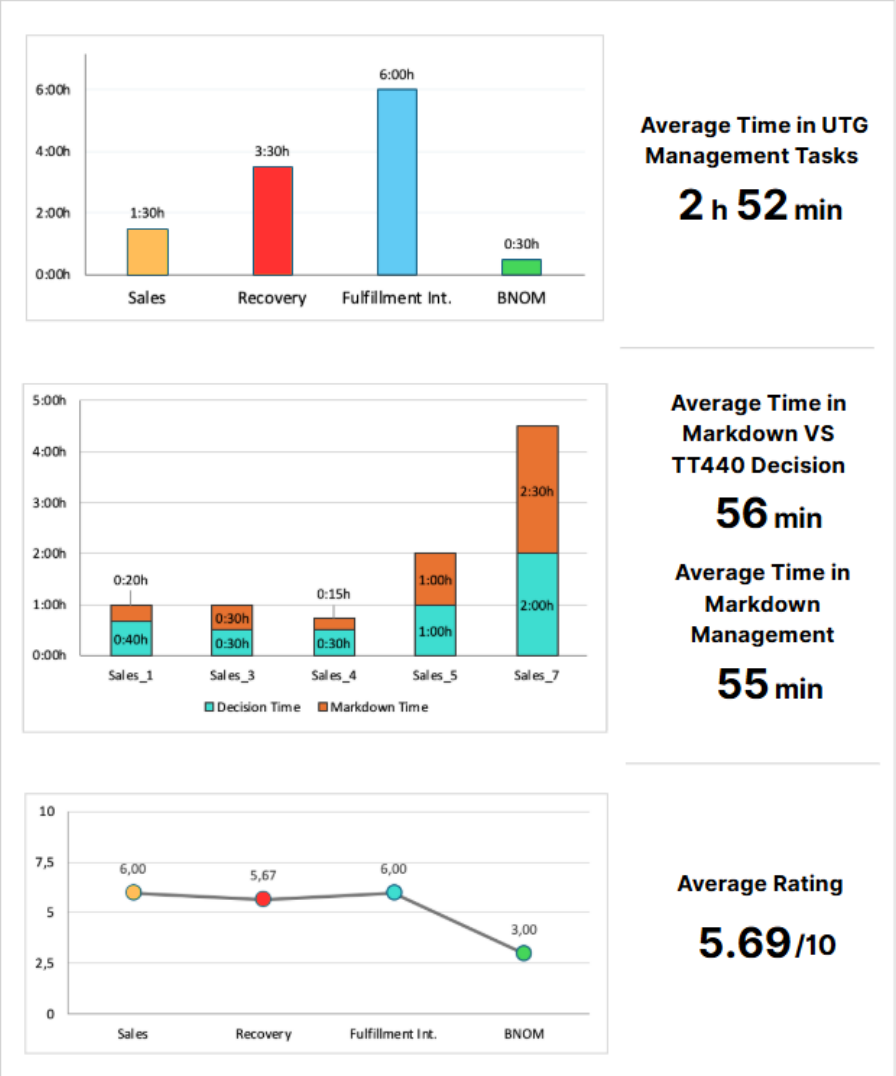


Figure 4.3: Time graphs and averages from the data gathered

The responses revealed that the average time spent on UTG management tasks is 2h52min per week. When broken down, Sales reported an average of 1h30min, Recovery reported 3h30min, Fulfillment Integration 6h, and the BNOM indicated 30min. This variance reflects how differently the process impacts each team, both in volume and in role complexity.

Sales respondents were also asked to provide more detailed input regarding their decision process when handling discontinued articles. Two timeframes were analyzed: first, the average time to decide whether to apply a markdown or route the item through TT440 (Recovery), which was reported as 56 minutes; and second, in cases where markdown was chosen, the additional time spent managing that markdown averaged 55 minutes. This breakdown highlights how decision-making and execution together represent a significant portion of the weekly workload. It also reinforces the need for a more standardized and possibly automated decision framework, which could reduce the time required, improve consistency across stores, and free up valuable time for other operational tasks.

It is worth noting that fewer Sales respondents answered this part of the form, as not all of them are price managers. While they are involved in the workflow, they don't directly handle price setting and therefore skipped the related questions.

Still regarding the sales team responses a 100% acceptance rate was registered across all respondants in the three following possibilities:

- Having access to a tool that gathered the most important metrics for pricing management (stock across stores, volume, price elasticity of demand, etc.)
- Including price elasticity metrics based on the Product Area (PA) of the articles to make the tool more advantageous
- Utilizing a cross-store approach in the tool to foster cooperation and data accessibility across both stores

The validation of these ideas with those who will be the main users of the solution developed is an essential step to move on further with its building and implementation.

On top of this feedback, it was also registered that the Recovery-related responses showed an average of 167 received articles per week, with respondents claiming receipt days of Monday, Thursday, and Friday. Although the difference in volume received can be explained by the difference in size of the stores, the fact that there is no specific data for the receipt of the articles shows yet another lack of necessary standards and possible room for improvement.

Lastly, the process received a relatively low average satisfaction rating of 5.69 out of 10, clearly indicating that there is room for improvement, both in terms of time efficiency and user experience.

4.2.3 Main Takeaways and Opportunities for Improvement

The insights gathered from process mapping and stakeholder interviews reveal a systemic issue in how markdowns and discontinued stock (UTGs) are managed at the store level. While the existing markdown process is structured and repeatable, it suffers from fragmentation, manual workload, and underutilization of available tools. There is no unified or automated logic guiding end-of-life pricing decisions. Instead, the workflow relies heavily on individual judgment, informal coordination, and experience-based heuristics.

Inefficiencies appear throughout the process. Redundant validations and stock counts, for example, consume valuable time and introduce avoidable delays. Key metrics like AWS are used without sufficient contextualization, leading to poor decision outcomes, especially in cases involving stockouts, promotional distortions, or bundled products. Legal and operational constraints, such as SPA budget limits and the rigid structure of TT440 validation, further complicate the ability to act flexibly and strategically.

Based on these observations, the following improvement opportunities have been identified:

- Automated Markdown Suggestions: Introduce a decision support tool that combines critical variables such as AWS, SPA, CALC, stock levels, and time to EDS to generate markdown recommendations. This would reduce guesswork and improve consistency.
- Dynamic UTG Management Monitoring Dashboards: Enable real-time tracking of UTG managing progress, while incorporating valuable insights related to user-driven inputs such as average discount levels, distribution of markdown intensity across product areas, projected uplift, and completion status, supporting informed decision-making and process oversight.
- Heuristic Standardization: Codify common decision rules—such as the "20 units / €225" threshold for TT440 transfers, into formal guidelines. This would ensure consistency across stores while allowing for exceptions when needed.
- Contextual Metrics for AWS: Enrich AWS with contextual markers that flag anomalies caused by stockouts, promotions, or recent PCDs. This would minimize misclassifications and improve forecasting accuracy.
- System Integration and Tool Adoption: Encourage consistent use of available tools like QlikSense dashboards by embedding them into routine workflows and providing better training. These tools can support more data-informed decisions through access to historical trends, elasticity insights, and cross-store comparisons.
- Reduction of Redundant TT440 Validation: Simplify the TT440 approval process by eliminating the need for a second BNOM check or by replacing it with a unified digital approval that includes audit trails.
- Cross-Store Price Coordination: Establish a shared markdown pricing database across stores to harmonize strategies and improve customer experience. This would allow for knowledge-sharing and reduce inconsistencies in pricing decisions.

Taken together, these improvements aim to standardize the markdown process, reduce workload duplication, and increase the precision and agility of pricing actions. A more data-driven, integrated, and transparent approach will not only enhance operational efficiency but also ensure compliance with internal policies and external regulations. The findings from this chapter form the foundation for the reengineering and system design proposals developed in the following section.

4.3 Solution Development

4.3.1 Implementation of a Decision Support System

This chapter introduces the DSS developed for enhancing markdown strategy decisions, in the context of UTG Management. It provides an overview of the conceptual structure and technological components involved in the DSS and establishes the context for the detailed breakdowns presented

in the following sections. The chapter also outlines the integrated tools used, the rationale behind their selection, and the objectives pursued in building the system.

In order to tackle the primary inefficiencies identified in the markdown pricing swimlane, specifically those related to managing discontinued products, the DSS was developed. Its creation aimed at consolidating the most critical decision-making metrics into a single interface. The goals of the DSS include improving usability for sales personnel responsible for price management, enhancing the clarity and efficiency of the pricing workflow, and ultimately optimizing the business process surrounding end-of-life product pricing.

The DSS consists of a tightly integrated set of tools and components:

- Power BI: used for data visualization, user interaction, and Key Performance Indicators (KPI) tracking.
- Power Apps: enables user input, specifically uploading article reference codes (ARTNOs) for analysis
- SharePoint: serves as the intermediary data storage and integration layer between Power Apps and Power BI
- External Data Sources: including Excel files linked to the internal PDS stock management system
- QlikSense for elasticity analysis and competitor benchmarking data

Each of these components plays a critical role in supporting dynamic, real-time pricing decisions. The upcoming sections explore these elements in detail, explaining how they are used, connected, and integrated into the final report solution.

4.3.2 Functional Architecture of the DSS Interface

The DSS developed in Power BI consists of a series of interactive report pages. Each page is designed to serve a distinct role in the markdown strategy workflow. These pages guide users, who are typically sales analysts or pricing managers, through the process of uploading data, analyzing relevant variables, simulating pricing decisions, and reviewing results. The layout and sequencing of the pages support a logical user journey from data entry to decision evaluation. This enables transparency, agility, and informed action.

The system architecture illustrates the overall program flow and details the connections between the DSS, the Power BI dashboard which is used for data vizualization and decision-making, external data sources, embedded Power Apps components and feedback loops originating from the output file. Figure 4.4 presents the complete system architecture.

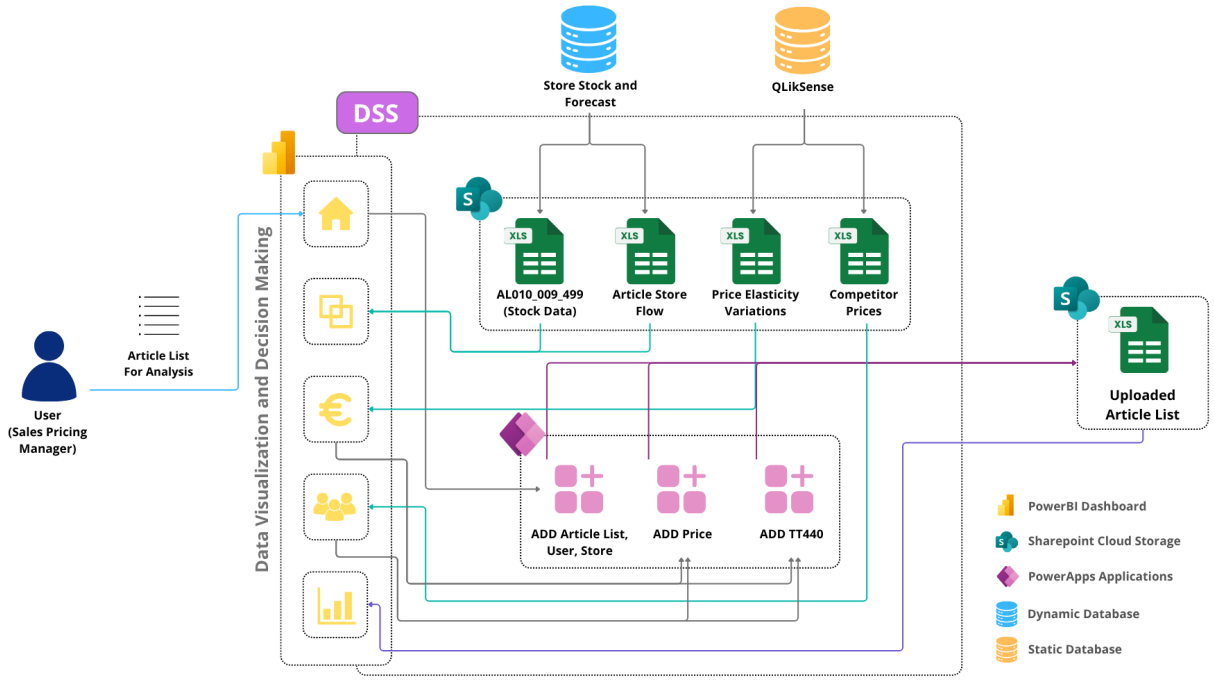


Figure 4.4: DSS - System Architecture

In addition to the visual elements displayed, Power BI was enhanced with internal DAX (Data Analysis Expressions) measures to support calculated insights, including indirect value displays, dynamic filtering, and seamless interaction with the connected Excel files. Examples of such measures include conditional aggregations, cumulative totals, and logic-based indicators used to classify product statuses, compute average stock values, and track discontinuation trends across different time frames.

Each page in the report has a clear function, contributing to the overall goal of facilitating strategic markdown decisions for discontinued articles. The following is an explanation of the core pages and their role within the DSS.

4.3.2.1 Welcome Page

The Welcome Page introduces users to the Decision Support System and serves as the entry point to the Markdown workflow. It provides access to two primary datasets:

A full product database for available articles in stores 009 and 499, and a second dataset based on user uploads. Although users can freely explore the full product database, the intended workflow is for users to upload their own list of articles for targeted analysis. This user-submitted list, which typically represents discontinued or clearance candidates, is processed through the full DSS pipeline, which allows the system to simulate markdown impacts, compare pricing, and evaluate feasibility.

The Welcome Page is designed to guide users toward this focused workflow while allowing general exploration of the article database.

4.3.2.2 Upload Page

On this page, users initiate the markdown analysis workflow by uploading a list of articles (through their respective ARTNOs) they wish to evaluate. The upload is performed via an embedded Power Apps interface, which collects the list of items, usually supplied by the Fulfillment Integration team, and writes it to a centralized Excel file stored in the cloud.

This Excel file is a core element of the system architecture because it serves as the main input data source for all subsequent pages of the DSS. Power BI retrieves the uploaded list during its next data refresh cycle, making the input available immediately for elasticity modeling, pricing simulation, and logistical feasibility analysis.

This page is designed to focus on controlled user input rather than raw data display. The page validates that the uploaded list is correctly formatted and that the entered ARTNOs exist within the internal product master file, with the data regarding all the articles available in both stores. This linkage enables the uploaded data to be enriched with key attributes. Dashboards of both Welcome and Upload pages can be found in Figure 4.5.

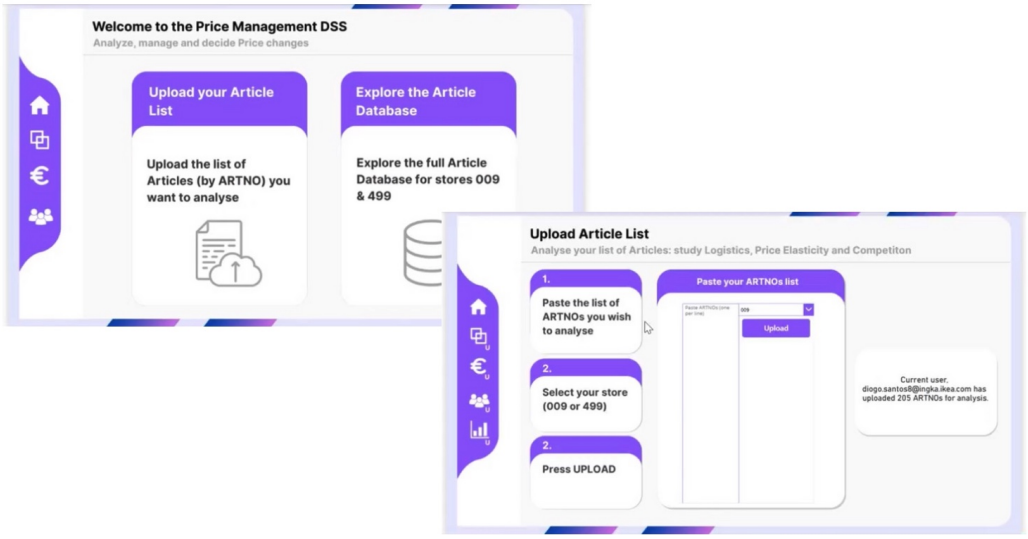


Figure 4.5: DSS - Welcome and Upload pages

After confirming the upload, users proceed to the downstream analysis pages, where the system dynamically builds simulations and insights based on the uploaded set of articles.

4.3.2.3 Price Elasticity Page

This page is the analytical core of the DSS. Here, users can simulate different discount levels and assess their projected effect on sales volume. It combines internal pricing data with elasticity metrics derived from historical patterns to inform data-driven markdown decisions.

The primary dataset used on this page is the filtered list of uploaded articles, now enriched with information from the internal product database and the Combined Variations dataset. The latter

holds elasticity insights per PA (these were collected in the aforementioned QLikSense programs which register price elasticity in two-year intervals, considering the Portuguese market history). For the program development, the more recent data was used. Users can interactively adjust discount levels and observe the projected changes in quantity sold structured around the following data points:

Original Price: The starting price of each article is retrieved from the internal database file. This serves as the baseline against which all markdown simulations are calculated.

Simulated Quantity at Discount Intervals: For each item, the page shows estimated sales volumes across multiple predefined discount levels (e.g., 5%, 10%, 15%, 20%). These projections are derived from historical elasticity coefficients and illustrate how sensitive demand is to price reductions.

The DSS provides two uplift projections. One assumes the discount is applied in isolation. The other accounts for affinity items—related products whose sales are influenced when the target item is discounted. This distinction enables users to evaluate the expected increase in sales of the discounted item and the broader indirect effects on related items in the same product category. This provides a more comprehensive view of the potential commercial impact of markdowns and was one of the data points retrieved from the QlikSense database.

Affinity Item Count: Counts the number of affiliated items utilized for the sales increase quantities that considered affiliated articles.

PA Elasticity: The core of the price elasticity analysis, that enables the program to display the projected impacts of the discount level selected. Rather than relying on product-level elasticity, the system uses average elasticity values at the PA level, thus reflecting broader consumer behavior patterns within each category. This provides a scalable, data-driven basis for quantity projections.

With this combination of data, users can perform what-if simulations to quantify the trade-off between reduced margin and increased sales. Users can test pricing hypotheses before implementation and prioritize markdowns where the expected increase in sales justifies the discount.

By centralizing these simulations, the page ensures that pricing decisions are based on modeled projections of real behavior across product areas, not guesswork.

4.3.2.4 Competitor Pricing Analysis

This page provides users with a comparative overview of how the internal pricing of uploaded articles aligns with market conditions. It draws from a QlikSense dataset that consolidates competitor pricing data from multiple retailers. Integrating this external information allows for a more strategic assessment of markdowns by evaluating internal elasticity projections and relative competitiveness in the market.

The page's main feature is a side-by-side comparison of the current internal price and the lowest competitor price for each article. The system adjusts for items sold in multi-unit packaging by converting competitor prices to a per-unit basis to ensure a consistent and fair benchmark.

In addition to the direct price comparison, the page displays the price gap as a percentage. This is calculated in two ways:

First, it uses the current internal price to understand the article's existing positioning without any markdown applied.

Second, it uses a rounded commercial price (based on the intended markdown level) to evaluate whether the proposed price reduction would make the item more competitive in the market.

This dual-perspective approach enables users to determine if a markdown is strategically justified based on external pricing dynamics. If the internal price is already below or closely aligned with competitors' prices, an aggressive discount may be unnecessary. Conversely, when a significant price gap exists, users can assess whether a targeted markdown could close the gap and potentially drive higher sales through improved price attractiveness.

Situating markdown decisions within the broader competitive context ensures that pricing actions are informed by actual market behavior and benchmarks rather than being made in isolation.

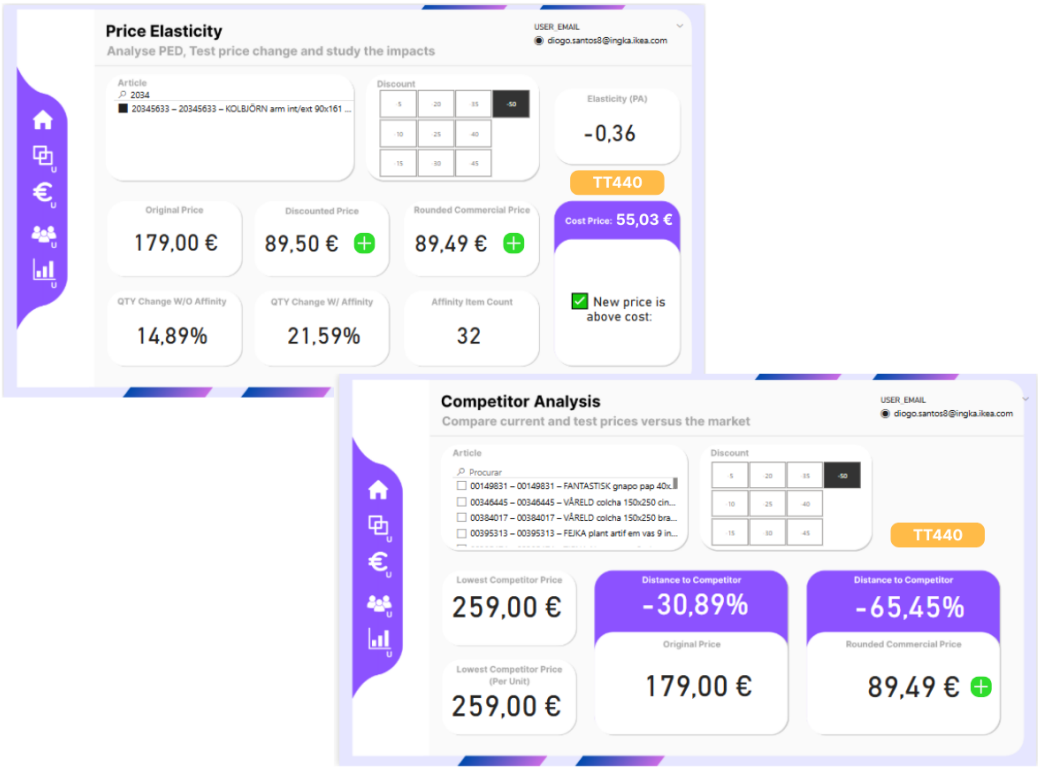


Figure 4.6: DSS - Price Elasticity and Competitor Analysis pages

In both of the previously described pages (whose dashboards can be seen in Figure 4.6), users can directly input their selected price, commercial price, or TT440 value through "Add" buttons embedded with their respective PowerApps. These inputs are automatically recorded in the cloud-based Excel file alongside the uploaded article list, the logged-in user, and the user's assigned store, ensuring traceability and integration with the broader decision-making workflow.

As previously mentioned, these pages retrieve their data from the QlikSense database. To complete the series of analytical pages, it is essential to include a logistics page. This page operates based on an Excel file, which is dynamically populated by an internal company database that

consolidates various inputs, including stock levels and forecast data for the articles. The logistics page is presented in the following section.

4.3.2.5 Logistics and Stock Overview

This page ensures the operational feasibility of markdown decisions by providing a detailed view of inventory levels and distribution patterns based on data from the internal master dataset. The main objective is to provide users with a clear understanding of product availability across stores. This helps ensure that markdown proposals are applied only where there is sufficient stock to support the expected sales increase.

The report displays the available inventory for each uploaded article, disaggregated by store. Users can verify not only whether a product is in stock but also its physical location. This helps avoid recommending markdowns on items that cannot be acted on operationally. Additionally, the tool displays the historical average weekly sales at the store level, offering insight into each product's typical sales velocity. This metric accounts for the past 6 weeks of sales as to balance out unusual sales spikes and provide a more transparent metric. This information is essential for estimating sell-through rates and determining if the stock will be depleted naturally or if markdown intervention is necessary to accelerate its exit.

Apart from showing wether the article has EDS date attributed to it or not, and support inventory optimization, the report includes simulations showing the impact of clearing 50% and 100% of the remaining stock. Based on the average volume of new items released in 2025, the simulation estimates how many new items could be accommodated in the freed-up space of each of the two main stores. This provides a practical view of the opportunity cost of retaining aging inventory.

4.3.2.6 Markdown Progress and Oversight Dashboard

This summary page is the final analytical layer of the DSS. It is designed to consolidate key performance indicators and markdown progress metrics from all uploaded articles. It supports professional oversight by enabling pricing teams and managers to monitor markdown execution, identify high-impact product areas, and ensure alignment with strategic goals. The completion rate is at the core of this page and quantifies how many uploaded articles have been reviewed and priced within the system.

The dashboard also displays the average discount applied, enabling benchmarking across categories and helping to detect inconsistencies in pricing aggressiveness. This information is supplemented by two additional KPIs: the average projected quantity uplift with affinity and the average uplift without affinity. Both KPIs are derived from elasticity-based simulations. These indicators not only show how much discounting has occurred but also how effective it is expected to be in driving incremental sales.

To further assist with prioritization, the page highlights:

The product areas with the highest and lowest discounts, along with their respective average discounts. This enables Sales managers to evaluate whether discounting efforts are proportionate across the assortment or overly concentrated in specific segments.

It also shows the top 10 product areas with the highest average discounts applied, as well as the top 10 product areas with the largest number of uploaded articles. This offers insight into areas of greatest operational focus.

By aggregating these metrics in a centralized view, the dashboard functions as a strategic control panel. It supports ongoing project governance and cross-functional alignment between pricing and commercial strategy. Dashboards of both Logistics and Progress and Oversight pages can be found in Figure 4.7.

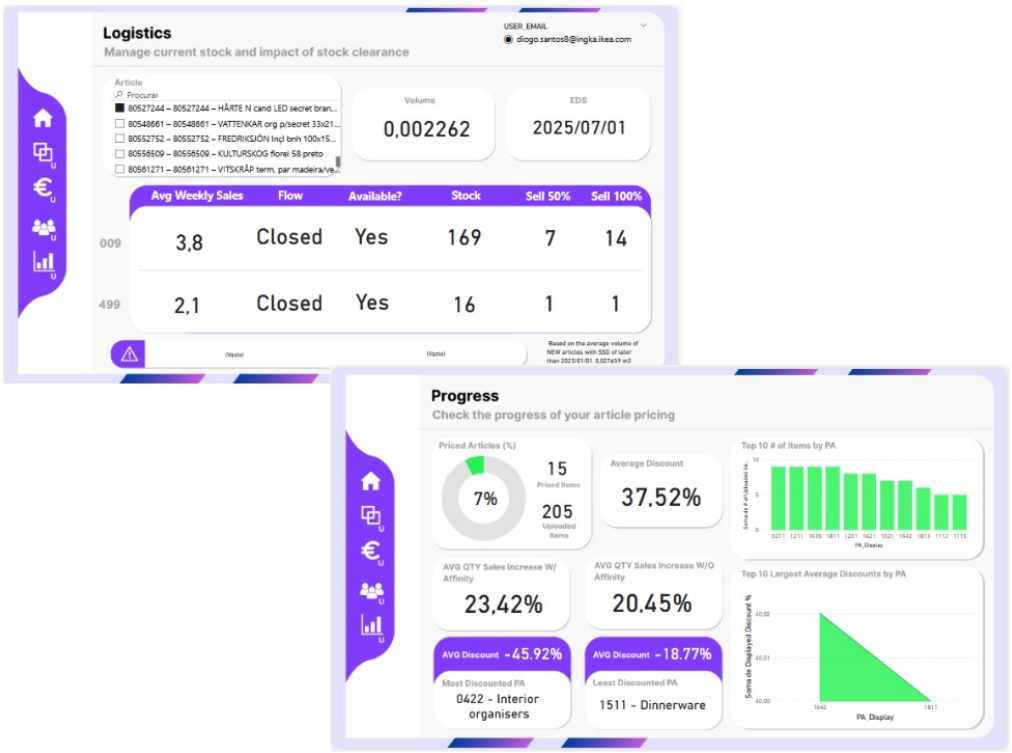


Figure 4.7: DSS - Logistics and Progress pages

Through building these practical and visual tools, the foundation is now set to revisit and refine the overall markdown workflow. The following section outlines how the DSS and dashboard insights support a reconfiguration of roles, responsibilities, and decision points, ultimately leading to a more structured, efficient, and data-driven markdown execution process.

4.3.3 Remapping the Markdown Workflow

This chapter presents the improvements proposed to address the inefficiencies identified in the discontinued product management process at IKEA. Following the in-depth analysis of the current

state, described in previous chapters, and the development of a DSS, it became clear that a more standardized, transparent, and data-driven approach was necessary to optimize cross-departmental workflows and reduce redundancies.

The proposed changes are directly aligned with the objectives of this dissertation, namely reducing markdown-related losses, reducing operational time, and improving decision consistency across stakeholders.

4.3.3.1 Key Process Reconfigurations

The first key change introduced in the redesigned process was to move shopkeeper involvement to the beginning of the markdown cycle. In the original workflow, shopkeepers were informally consulted after the sales pricemakers had already conducted initial analyses. This resulted in repeated adjustments, inefficient communication, and delayed decision-making. In the improved process, this step was made explicit and formalized. Shopkeepers now provide structured input through a standardized Excel file prepared before the DSS simulation.

This file includes their assessment of whether a given article "can be potentialized" — a valuable indication that the item might justify floor exposure or commercial support rather than proceeding directly to markdown analysis. Since this does not occur often, it is a significant advantage with minimal risk. Consequently, the data entering the DSS is more definitive and pre-filtered, enabling sales teams to concentrate on items with clear markdown eligibility. In practical terms, this adjustment eliminates ambiguity and the need for reclassification, streamlining the analysis flow from Fulfillment to Sales.

With the implementation of the DSS, the swimlane structure of the process has been significantly optimized. Previously, price managers were required to manually contact other stores to confirm stock availability, assess past sales behavior, or inquire about local markdown execution. These steps created delays and introduced communication inefficiencies. The DSS eliminates these frictions by centralizing all relevant data in one interface. Information on article stock levels, price elasticity, and AWS is readily available, enabling teams to make informed, timely decisions without relying on external confirmations. This not only reduces dependence on informal channels but also enhances consistency and accuracy in decision-making.

Moreover, the DSS provides automated simulations and volume impact projections based on uploaded items, removing the need for manual calculations or back-and-forth exchanges between departments. Price managers no longer need to cross-reference multiple sources to estimate uplift or assess risk: elasticity metrics and affinity-based projections are built directly into the system. This shift transforms a multi-step, error-prone flow into a streamlined, guided process. The system supports role-specific insights while maintaining alignment between Fulfillment, Sales, and BNOM, contributing to smoother transitions and a more proactive markdown execution model. Altogether, these improvements reduce operational time and effectively streamline the swimlane, enabling faster, more focused execution. Both discussed changes are visually presented in the segment of the rebuilt Swimlane in Figure 4.8.

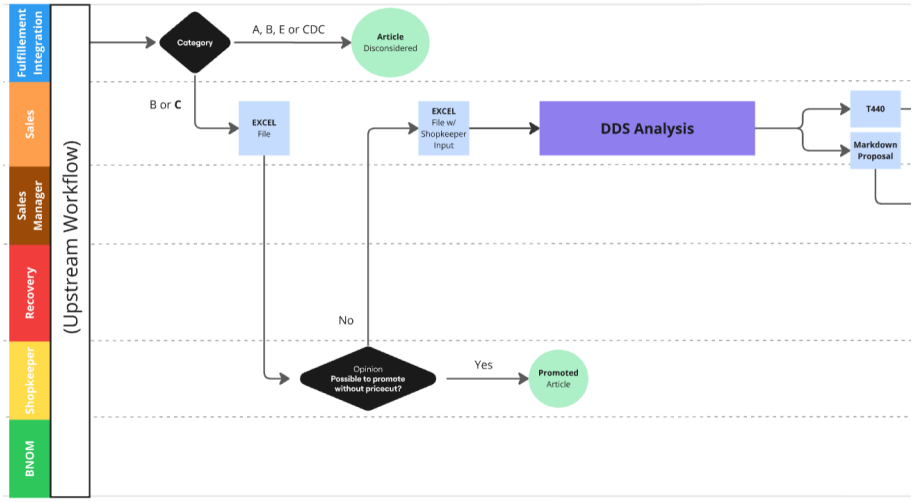


Figure 4.8: Redesigned Swimlane Segment Highlighting Shopkeeper Input and DSS Integration

Another structural improvement to the redesigned process is eliminating redundant validations by the BNOM team. In the previous model, BNOM had to approve the list of articles selected for markdown twice: once after the sales manager approved it and again after the stock count was finished and the final quantities were confirmed. According to the BNOM Manager, this second approval step was particularly archaic and could delay the process by up to a full working day, creating a significant bottleneck that disrupted the markdown execution timeline.

In the improved process, BNOM's validation is consolidated into a single approval step that occurs after the sales manager finalizes the markdown decisions (as shown in Figure 4.9). Additionally, the TT440 proposal list is continuously available to BNOM throughout the process via a shared file. This allows BNOM to proactively track the list's evolution and prepare for the final validation, eliminating the need for repeated approvals. This adjustment removes a key inefficiency, clarifies interdepartmental responsibilities, and contributes to a faster, more predictable markdown execution cycle.

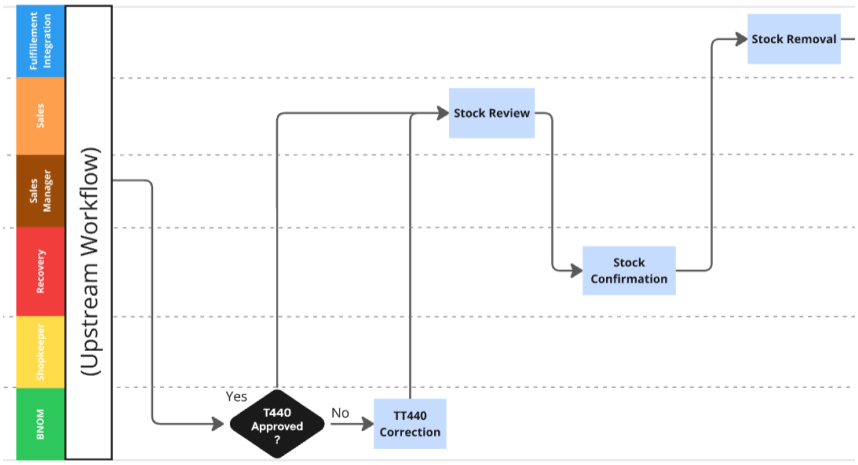


Figure 4.9: Reconfigured BNOM Approval Process in the Redesigned Swimlane

The adjustments described in this chapter reflect the most significant structural changes to the Markdown decision-making process. These changes focus on removing inefficiencies, clarifying responsibilities, and improving data flow. These modifications are represented visually in the improved swimlane diagram in Appendixes E1 and E2, which serves as a reference model for the redesigned workflow. The following chapter analyzes the impact of these changes in detail, highlighting the measurable benefits of implementing the proposed solutions.

Chapter 5

Results

This chapter presents an evaluation of the outcomes achieved by implementing the proposed improvements. While some of the project's impacts may require longer observation periods or more extensive data collection for full quantification, meaningful results have already emerged. These include reduced time in the markdown decision process, improved information flow between stakeholders, and standardized practices across stores. The evaluation is based on observed outcomes, comparative timings, feedback from key stakeholders, and an analysis of how the interventions align with the project's initial goals. In addition, this chapter presents an estimation of the expected operational and financial impact, grounded in practical assumptions and informed by stakeholder inputs.

5.1 Alignment with Project Objectives

The primary objective of this project was to minimize gross margin loss due to Sales Price Adjustments (SPAs) and markdown-related transition types (TT440s) associated with discontinued items. A core challenge previously observed was the tendency to make markdown decisions too late, often when stock levels were already high and aggressive price cuts were the only solution. This reactive behavior often resulted in margin erosion. Implementing the DSS addressed this issue by incorporating price elasticity estimates and competitor benchmarking into the markdown decision-making process.

By providing users with insight into how sensitive demand is to price changes, the DSS enables more deliberate and well-timed markdowns. At the same time, visibility into market pricing promotes competitiveness without resorting to unnecessary discounting. Consequently, markdowns can be executed earlier in the product lifecycle, preserving profitability while achieving stock clearance objectives. Although precise financial improvements in gross margin cannot be confirmed due to data limitations, the system's structural logic reflects a clear advance in margin protection strategy.

The second objective was to reduce the amount of space (in cubic meters) occupied by unsold, slow-moving, or discontinued stock. Before the intervention, stock clearance decisions were

primarily based on sales velocity and timing, with little consideration given to physical space constraints. The new DSS closes this gap by showing the cubic meter impact of each item and flagging those that would yield the most meaningful space recovery if cleared.

This new level of visibility enables users to consider space efficiency when prioritizing markdowns. By identifying which products consume the most valuable storage or display capacity, the tool promotes decisions that serve financial goals and free up space for new products. The new tool provides a perspective on the tradeoff of marking down UTGs and freeing stock space for new products, giving the price managers all the data they require to make an informed decision in the operational standpoint.

The third objective was to reduce the number of labor hours that coworkers across departments spent on the decision-making and execution of markdown processes. Previously, the markdown cycle was characterized by repeated iterations, lengthy chains of Excel-based communication, and disparate tools. The redesigned process significantly reduced these inefficiencies.

The new workflow eliminates redundant steps, particularly the duplicated validation previously required from BNOM, a frequent cause of day-long delays. Furthermore, the DSS compiles all relevant data, such as stock, price history, sales trends, and forecast accuracy, into one accessible platform. Because the tool is cloud-based, multiple departments can access and work with the data simultaneously, eliminating the need for manual coordination. Early observations suggest substantial reductions in time per article batch, particularly during peak cycles. This streamlines the process while maintaining rigor in decision-making.

The fourth and final objective was to minimize discrepancies and inconsistencies in the NM stores' approach to markdown and product phase-out decisions. Before the project, markdowns were often managed locally using different tools, criteria, and analysis formats. This resulted in inconsistent outcomes and missed opportunities for shared learning or coordinated action.

With the implementation of the DSS, however, both stores now operate within a shared environment. The system provides transparency by displaying real-time metrics for each analyzed product, including who is managing it and how it is performing across locations. This visibility promotes collaboration, aligns markdown logic, and standardizes processes. Furthermore, using a common structure for data input, including standardized Excel templates, ensures that all markdowns are evaluated equally, reducing variation in outcomes and supporting expansion to other markets or units.

5.2 Added Value of the Decision Support System

Beyond the process improvements already discussed, developing and deploying the DSS brought significant organizational and operational value. One of the DSS's most notable contributions is its role as a centralized, objective source of truth for markdown decision-making. Before its implementation, much of the analysis and communication between departments occurred via isolated Excel files and informal exchanges. This fragmented structure often resulted in duplicated effort, miscommunication, and inconsistent evaluation and treatment of discontinued products.

The DSS consolidates all relevant information, ranging from article classification and price history to forecast performance, competitor pricing, and price elasticity, into a single, cloud-based platform. This platform is accessible to stakeholders from both the Braga and Matosinhos stores. This centralization eliminated dependency on individual files and enabled multiple departments to perform parallel analyses, reducing delays caused by asynchronous coordination. The DSS provides users with clarity and continuity. Instead of cross-referencing multiple tools or waiting for updates from other areas, users now have access to all critical decision-making information in a structured, intuitive interface.

Furthermore, the DSS has proven to be a valuable tool for establishing objectivity and consistency in pricing logic. By making all inputs and calculations visible, the DSS reduced reliance on subjective judgment, allowing teams to focus on actionable insights rather than debating assumptions. Stakeholders such as Sales Managers and BNOM particularly appreciated this shift toward transparency, noting the clarity and justification the tool provided in support of pricing proposals.

The system was developed with future adaptability in mind. Its structure allows for the addition of variables and modules over time, providing the flexibility to evolve alongside organizational needs. Whether integrating real-time data sources, automating inputs, or expanding to cover other business decisions, the DSS is a foundational digital asset that supports current and future operational maturity.

5.3 Standardization as a Strategic Asset

One of the project's more strategic outcomes lies in the standardization it enabled, including the standardization of tools, workflows, decision logic, and roles throughout the markdown process. In this context, standardization has aligned how different departments and store teams understand and execute their responsibilities. Standardization created a common operational language for stakeholders across functions, ensuring that decisions were no longer contingent on individual judgment or local practices.

This was particularly relevant in addressing one of the project's key challenges: the inconsistency in how the Braga and Matosinhos stores approached markdown analysis and product phase-out decisions. The project eliminated divergent approaches by introducing a unified DSS and restructured process flow, ensuring that all stakeholders followed the same evaluation criteria, templates, and decision paths. This alignment reduces friction between teams and enables shared accountability across locations.

From an operational standpoint, standardization also makes it easier to onboard new coworkers. With a clearly defined process and a centralized support tool, new team members can be integrated and trained more efficiently using consistent logic. Furthermore, this consistency makes the process more auditable and less dependent on institutional memory. Decisions are documented and justified within the tool itself, thereby enhancing governance and traceability.

At a strategic level, the project laid the groundwork for potential replication and scaling. The redesigned markdown model, now anchored in a structured, visualized, and standardized process,

can be expanded to other stores in the region or adapted to other commercial processes, such as product reallocation or promotion planning. IKEA is better positioned to extend its practices beyond the NM by capturing operational knowledge in a formalized, digitized format. This promotes uniformity and efficiency on a broader scale.

5.4 Estimated Operational and Financial Impact

Despite the recent implementation of the DSS, and the fact that its full quantitative effects cannot yet be measured, early results suggest significant expected benefits, both operational and financial. The projected outcomes are grounded in the structural changes introduced by the system, as well as in realistic assumptions derived from stakeholder feedback and historical data.

From an operational efficiency perspective, the DSS has streamlined what was previously a fragmented and heavily manual markdown process. Prior to the implementation of the new workflow, it was estimated that a combined effort of 11.5 hours from the multiple departments: Sales, Fulfillment, Recovery, and BNOM, would be required on a weekly basis. The new system centralizes the relevant data, reduces the need for informal communication loops, and eliminates redundant validation steps, especially within the BNOM approval process. Based on observed simplifications and time savings in each department, a conservative reduction of 25% in weekly workload is anticipated. This equates to approximately 3 hours saved per week, or an annual reduction of over 150 hours.

From a financial perspective, the most substantial gains are expected to come from improvements in markdown decision quality, particularly in the form of reduced over-discounting and better-timed pricing actions. Whilst markdowns remain an integral and unavoidable aspect of inventory management, the DSS facilitates a more data-driven evaluation of article performance, stock levels and sales potential. This approach serves to enhance the probability that markdowns will be implemented solely when warranted, and at an optimal depth and timing.

Based on current UTG data, approximately 50 article references are reviewed each week, each with an average stock of 21 units and a gross margin of €33.49 per unit. These figures serve as the basis for estimating the financial impact of improved markdown decision-making. A conservative 10% improvement rate is assumed, reflecting the share of articles that benefit from better pricing actions.

If 25% of the gross margin is preserved on these improved cases, this results in an estimated margin saving of €8.37 per unit. Applying this to the 105 impacted units weekly (i.e., 10% of 50 articles × 21 units), and assuming 60% of those units are sold under improved conditions, the projected weekly gross margin savings are approximately €527.47. Extrapolated over the course of a year, this results in an estimated annual gross margin saving of around €27,428.

This projection illustrates how modest weekly improvements, when scaled over time and across article volumes, can lead to substantial financial benefits, reinforcing the value of implementing structured, data-informed markdown strategies.

It is acknowledged that these figures are intentionally conservative in nature, with the primary purpose of providing a visual representation of the scale of value that the DSS is capable of delivering. It is important to emphasise that the magnitude of performance enhancement may be amplified as an increasing number of users adopt the tool and seamlessly incorporate it into their workflows. Furthermore, as data accumulates across cycles, additional patterns in markdown timing, article behaviour, and outcome variance may emerge, thereby enabling future refinements to the DSS and further value generation.

In conclusion, the DSS contributes meaningfully to both operational streamlining and financial optimization. Although precise measurement of post-implementation gains will only be possible after a complete cycle of 6 to 12 months, the preliminary estimates already align strongly with the objectives of the project and underscore the strategic potential of intelligent support tools in retail markdown management. It is important to note that the tool has received favourable initial validation from key stakeholders across Sales, Fulfillment, and BNOM. These stakeholders have expressed that the tool meets their expectations and addresses longstanding inefficiencies in the process. This early feedback reinforces confidence in the system's relevance and supports continued adoption and refinement.

Chapter 6

Conclusion

This final chapter offers overall reflections on the project regarding the impact and strategic relevance of the improvements applied in the UTG Management process through the new tool conceived. In addition to outlining opportunities for further development, the chapter delivers the thesis's final remarks, consolidating its main contributions and emphasizing its broader relevance.

6.1 Evaluation of Impact and Strategic Relevance

This project provided a structured response to a long-standing challenge in IKEA's North Market, namely the inconsistent and inefficient handling of markdown decisions for discontinued products. The initiative has been successful in achieving results that extend beyond mere operational improvements, having also catalyzed a cultural shift in the manner in which decisions are made across departments. This has been accomplished through the creation of a DSS and process redesign.

From the perspective of stakeholders, the DSS has already demonstrated practical value. Preliminary feedback indicated that the tool was found to be intuitive by coworkers and that it was aligned with their workflow. Moreover, the tool was perceived to reinforce clarity and confidence in the decision-making process. These reactions indicate that the system not only solves functional pain points but also meets expectations in terms of usability and impact. Notably, responses collected from the Sales and Fulfillment teams emphasized the value of including price elasticity in the analysis, which they considered a long-awaited addition and highlighted the benefits of centralizing key data sources into a single, accessible platform.

The implementation of the new system has also yielded quantifiable benefits. The markdown workflow, which was previously hindered by fragmented tools and repeated validations, has now become considerably more agile. While the precise time savings may vary between contexts, the decentralized structure of the DSS and the elimination of duplicated steps suggest a substantial reduction in manual effort. The time that was once spent gathering and validating data can now be redirected toward analysis and action, enhancing the quality and speed of commercial decisions. Conservatively, this shift is estimated to save over 150 hours of effort annually, across departments.

From a financial perspective, even the most conservative assumptions point to meaningful savings. Based on average weekly decisions and margin retention, the system is estimated to generate annual gross margin savings of approximately €27,428. While based on generalized and scaled assumptions, these figures offer a credible indication of the DSS's financial contribution, reinforcing its strategic relevance in minimizing inefficiencies and protecting profitability

It is important to note that this project provides a solution that has the potential to contribute to a broader body of knowledge. The initiative establishes the foundations for a more standardized, transparent, and scalable decision-making culture within IKEA. The tool's modular design and its capacity to accommodate prospective enhancements position it as a long-term asset. The application of these principles to other markets, product flows, or decision contexts suggests the establishment of a framework conducive to the development of more intelligent and unified commercial practices.

In summary, the project addressed operational inefficiencies and delivered tangible value in terms of time and margin savings. The initiative has been shown to have had a positive effect on internal collaboration, with the use of data-driven logic having been supported. Furthermore, a framework has been created that is both sustainable and expandable. For IKEA, this represents a clear and strategic contribution, aligning with its broader goals of digital transformation, operational excellence, and customer-centric decision-making.

6.2 Future Developments and Recommendations

Although the current version of the DSS and the redesigned markdown process are significant improvements, there are still opportunities for further development. These prospective developments would enhance the tool's analytical capabilities, expand its scope, increase efficiency, and support broader scalability within IKEA.

One of the most impactful next steps is transitioning to a dynamic pricing model. Currently, markdown decisions are based on predefined cycles and manually triggered evaluations. In the future, pricing changes could be made more frequently (potentially weekly or daily) in response to demand, stock levels, and competitive movements. This would make pricing more agile and responsive to the market, reducing the risk of over-discounting or missing optimal clearance windows. To support this shift, the DSS could be integrated with machine learning algorithms that can continuously update demand forecasts based on real-time data. This would enhance forecast accuracy, allow for the early detection of underperformance, and increase the financial effectiveness of markdown strategies.

Another key opportunity is expanding the DSS beyond the markdown process. Given its modular, data-driven structure, the system is well-positioned to support other commercial decisions, such as demand forecasting and product categorization. The structured logic used to approach markdown candidates could be adapted to prioritize new product launches, identify outlier SKUs, and guide assortment planning based on regional sales behavior. With minor adjustments to the

input structure and analytical engine, the DSS could evolve into a broader commercial planning platform.

In order for the DSS to remain relevant and evolve with user needs, it is essential to implement feedback loops. These loops allow users, such as salespeople, BNOM managers and shopkeepers, to provide structured input on the tool's recommendations, usability, and blind spots. This feedback could be analyzed and used to make iterative improvements, which would enhance both the analytical logic and the user experience over time. In the long term, these feedback loops could help transform the tool from a static support system into a dynamic, continuously improving decision-making environment.

Finally, the structural standardization and transparency provided by the DSS and the new workflow position the model well for scaling across IKEA's national and intermarket operations. The challenges addressed in this project (such as slow decision cycles, fragmented logic, and inconsistent markdown execution) are not exclusive to the North Market. With appropriate contextualization, the system and process redesign can be adapted and deployed in other stores or regions, promoting a harmonized approach to commercial decision-making across the IKEA network.

In summary, the project's foundational work delivered immediate process improvements and created a flexible platform on which the company can build even more effective, efficient, and scalable decision-making tools.

6.3 Final Remarks

The project successfully addressed an intricate, cross-departmental issue within IKEA's North Market: the haphazard management of discontinued products. The development and implementation of a Decision Support System brought operational clarity and standardization to markdown decisions, demonstrating measurable improvements in process efficiency, gross margin preservation, and alignment across stakeholders.

While the primary results focus on IKEA's specific context, this dissertation highlights a recurring and often overlooked challenge across many organizations: processes that are not properly mapped, supported by fragmented tools, or obscured by data overload. These issues often result in reactive, intuition-based decision-making, even in highly structured companies with access to vast amounts of data.

The methodology and solution presented here demonstrate how a structured approach rooted in Action Research and supported by tailored decision-making tools can substantially improve business performance. The system's flexibility enables it to be replicated or adapted in other IKEA stores and in companies facing similar challenges related to discontinued stock, pricing, or cross-functional coordination.

Ultimately, this work demonstrates that even highly operationalized organizations benefit from revisiting core processes through a fresh, data-driven lens. As businesses continue to grow and

digitize, the need for clear, structured decision-support systems that connect strategy with execution will only become more critical. This project underscores how thoughtful process design, supported by practical, adaptable tools, can create lasting value across functions and markets.

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Reflection on the contribution to the Sustainable Development Goals (SDGs)

The work presented in this dissertation makes a meaningful contribution to several of the Sustainable Development Goals (SDGs) set out in the 2030 Agenda, particularly the following:

SDG 8 – Decent Work and Economic Growth: Standardizing and automating decision-making processes reduces manual workload and reliance on intuition-based decisions, improving working conditions for staff and enabling a more strategic and informed approach to resource management.

SDG 9 – Industry, Innovation and Infrastructure: Designing and implementing a Decision Support System (DSS) represents a step forward in the digitalization and innovation of IKEA's internal processes. Leveraging data to automate decisions regarding discontinued products strengthens technological infrastructure and promotes sustainable operational efficiency.

SDG 12 – Responsible Consumption and Production: This project helps to reduce product and resource waste by optimizing the management of discontinued articles, thereby minimizing margin losses and improving stock turnover. The proposed solution also decreases the volume of items discarded or sent for recovery, thereby aligning with the principles of the circular economy and responsible consumption.

SDG 13 – Climate Action: By reducing the storage space occupied by obsolete products and the need for unnecessary transportation and handling, the system indirectly contributes to lowering greenhouse gas emissions and supporting more environmentally sustainable operations.

This project shows that targeted improvements to internal management processes, based on technology, can contribute meaningfully to sustainable development within corporate environments and in broader societal contexts.

Appendix A

Stakeholder Interview Technical Sheet

Table A.1: Technical Sheet and Interview Guide – UTG Management

Category	**Description**
Technical Sheet	
Objective	To understand the process of Discontinued Article Management at IKEA (Matosinhos and Braga stores), identifying current practices, challenges, and opportunities for improvement.
Universe	Coworkers from the Matosinhos and Braga IKEA stores involved in Fulfilment Integration, Sales, and Recovery.
Sample	Non-probabilistic convenience sample of employees whose roles are directly related to the study topic (n = 5 participants).
Type of interview	Semi-structured interviews.
Data collection method	Individual face-to-face interviews.
Response type	Directed response, based on a pre-established interview script, allowing for deeper exploration of specific topics depending on the interviewee's role.
Average duration	Between 20 and 50 minutes per interview.
Period of data collection	March 2025 to April 2025.
Data analysis	The interviews were analyzed using qualitative content analysis, focusing on response patterns, thematic convergences, and contributions to the project's diagnostic and development phases.
Interview Guide	
Theme/Section	Questions
Introduction	Thanks given for attending the interview based on the theme of UTG management in the present unit. Presentation of the interviewer, work context and objectives.
Role in the process and relationship with other departments	1. How do you approach the management of UTGs and what is your part in the process? 2. What digital tools do you use to support those actions? 3. How do you relate to other departments in the process? 4. What type of data do you receive and send to other departments?
Constraints of the process	5. Are there any type of constraints to your activity inside the process, such as budget or legal? 6. How do you manage or overcome those constraints?
Pain-points and opportunities for improvement	7. What are the pain-points you can identify in your activity in the process of UTG management? 8. How do you think your activity could be improved? 9. Do you believe there are other points outside the scope of your activity that can be developed and improved?

Appendix B

UTG Management Process Feedback Survey Questions

Table B.1: Forms – UTG Management Feedback Survey Questions

Department	Questions
General Questions	
	1. What is your department? 2. How much time do you dedicate weekly to the UTG management process? 3. Of your tasks within the UTG management process, which is the most difficult? Why? 4. On a scale from 0 to 10, how do you rate the efficiency of the UTG management process? 5. In your opinion, which part(s) of the process should be improved? And how?
Sales	
	6. How much time do you dedicate weekly to deciding which items should have a price cut or be assigned a TT440 transtyping? 7. If you decide to reduce the price of a UTG (instead of assigning a TT440 transtyping), how much time do you dedicate weekly to deciding what price cut to apply? 8. Do you believe that a program that gathers and summarizes the most important metrics for price cut decisions would be useful for your tasks? E.g.: stock; volume; price elasticity (of demand). 9. Do you believe that including metrics related to price elasticity (of demand) would be advantageous for your analysis? E.g.: Based on the item's price elasticity, show the expected increase in volume following a specific price cut. 10. Do you believe that including metrics related to collaboration between the Braga (499) and Matosinhos (009) stores would be beneficial to your analysis? E.g.: Show the stock level of the item in both stores; suggest stock transfers.
Recovery	
	11. Approximately how many TT440 articles do you usually receive per week? 12. On which days of the week do you usually receive the TT440 items? And at what time of day?
Fulfillment Integration	
	13. How much time do you dedicate weekly to registering UTG records (ABC categorization, etc.)? 14. Do you believe a more complete analysis than the current ABC categorization—currently based on weekly average sales, weeks of stock, and time until EDS—would be useful for your activity? E.g.: include demand variability, price sensitivity
BNOM	
	15. In your opinion, are there any challenges in monitoring KPIs related to the UTG management process? Which ones?

Appendix C

Meetings Notes

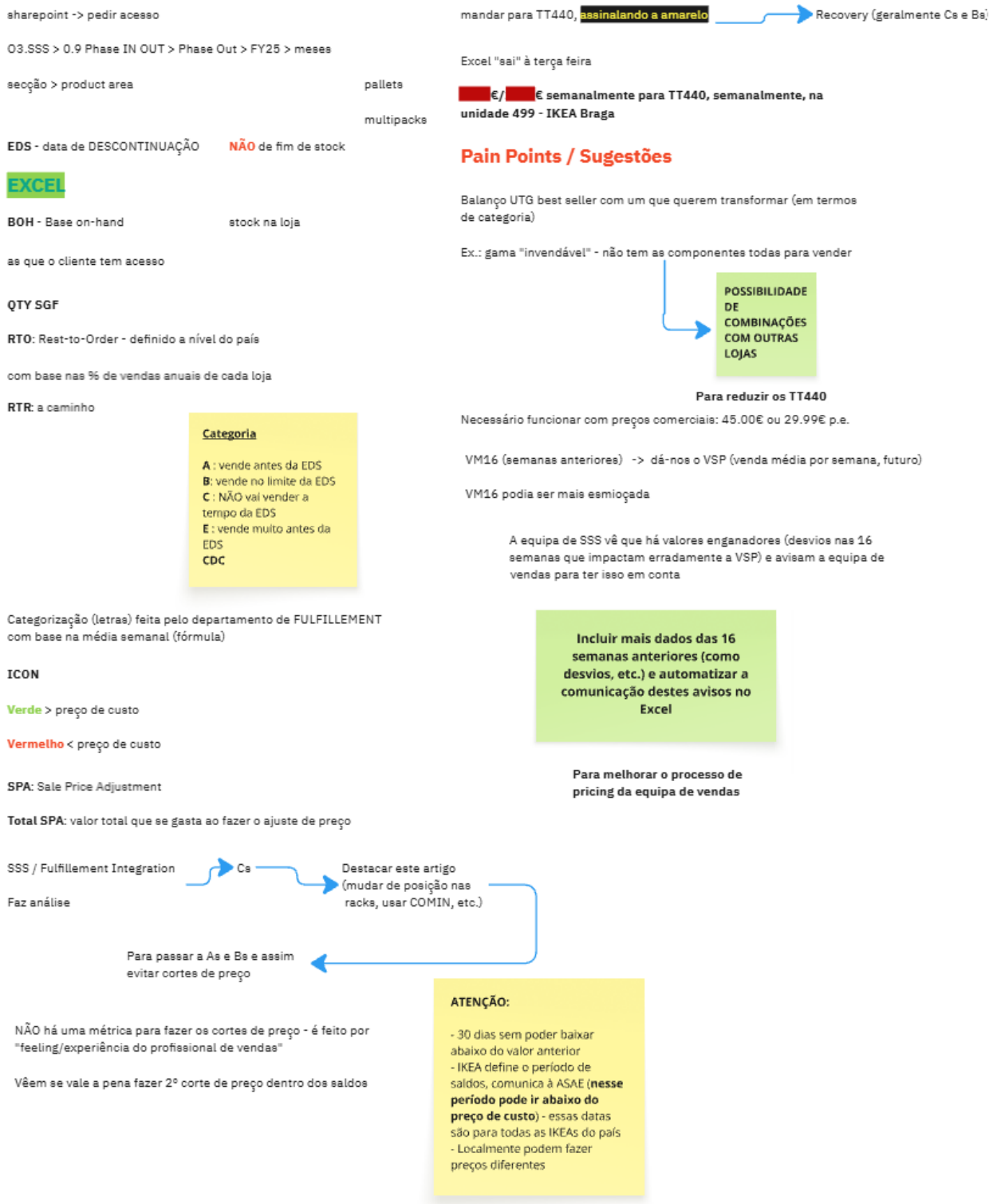
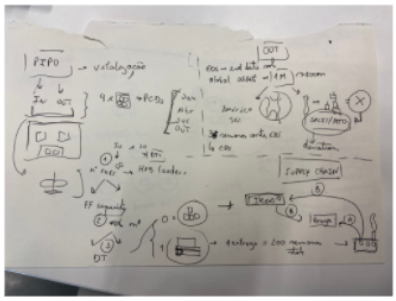


Figure C.1: Meeting Notes – Sales Price Manager, IKEA Braga - store 499



4 PCDS:
- Janeiro
- Abril
- Julho
- Outubtro

Balancear PIPO:

1 Nº REFERÊNCIAS

2 FULFILLMENT CAPACITY

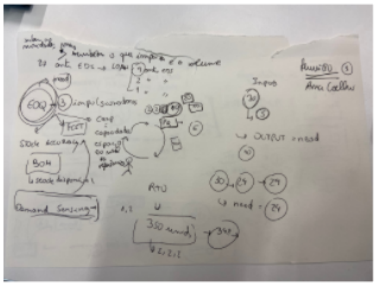
3 DT (Delivery Type)
- **0** : Multipacks
- **1**: pallets (que contêm vários multipacks)

36 semanas antes de EDS a GLOBAL decide o **SPLIT/RTO** para cada loja baseado no global asset e percentagem de vendas de cada loja

27 semanas antes do EDS - decidir o **LOAW**:

4 SEMANAS antes do EDS
2 SEMANAS antes do EDS
1 SEMANAS antes do EDS

sim, nessa data já sabem quais as novidades, **MAS O QUE IMPORTA NÃO SÃO QUAIS OS ARTIGOS QUE SÃO AS NOVIDADES MAS O VOLUME**



Software calcula a **EOQ (Economic Order Quantity) AKA need** baseada em 3 impulsionadores, os quais podem ser manipulados pelo operador do software
- **CESP**: capacidade de espaço ao nível de referência
- **Stock Accuracy**: BOH stock on-hand disponível
- **FCST** : Demand Sensing

De acordo com o RTO era definido um corte de x% usando o softaware

EDS Markdown saldos/cortes só em descontinuados

O EDS Markdown software foi implementado em 2020, mas não chegou a ter seguimento

Pain Points / Sugestões

Existem saldos específicos para o IKEA Family

Budget: **440** VS **Desconto de x%**

A solução pode passar por automatizar o método que define se a melhor solução é TT440 ou fazer um desconto de x%

- Neste caso segundo caso, o método automático também daria o x% de desconto que deve ser aplicado (depois ajustado aos valores comerciais)
- Este desconto seria tanto menor quão mais afastado o momento estivesse da EDS (ou seja, tanto maior quão mais próximo estivesse da EDS)

Para melhorar o processo de pricing e proteger a gross margin "média"

ATENÇÃO:

- Embora seja claro que os x% fossem menores mais longe da EDS, o método automático não tem que dar necessariamente um valor a todos o instante para o x já que há épocas genericamente específicas para as épocas de saldo

- Há as estas duas opções porque pode haver casos em que, pela questão do volume ocupado pode compensar fazer o TT440 (a redução de x% seria sempre a melhor opção se houvesse espaço ilimitado para armazenar stock)

Figure C.2: Meeting Notes – Fulfillment Integration Manager, IKEA Braga - store 499

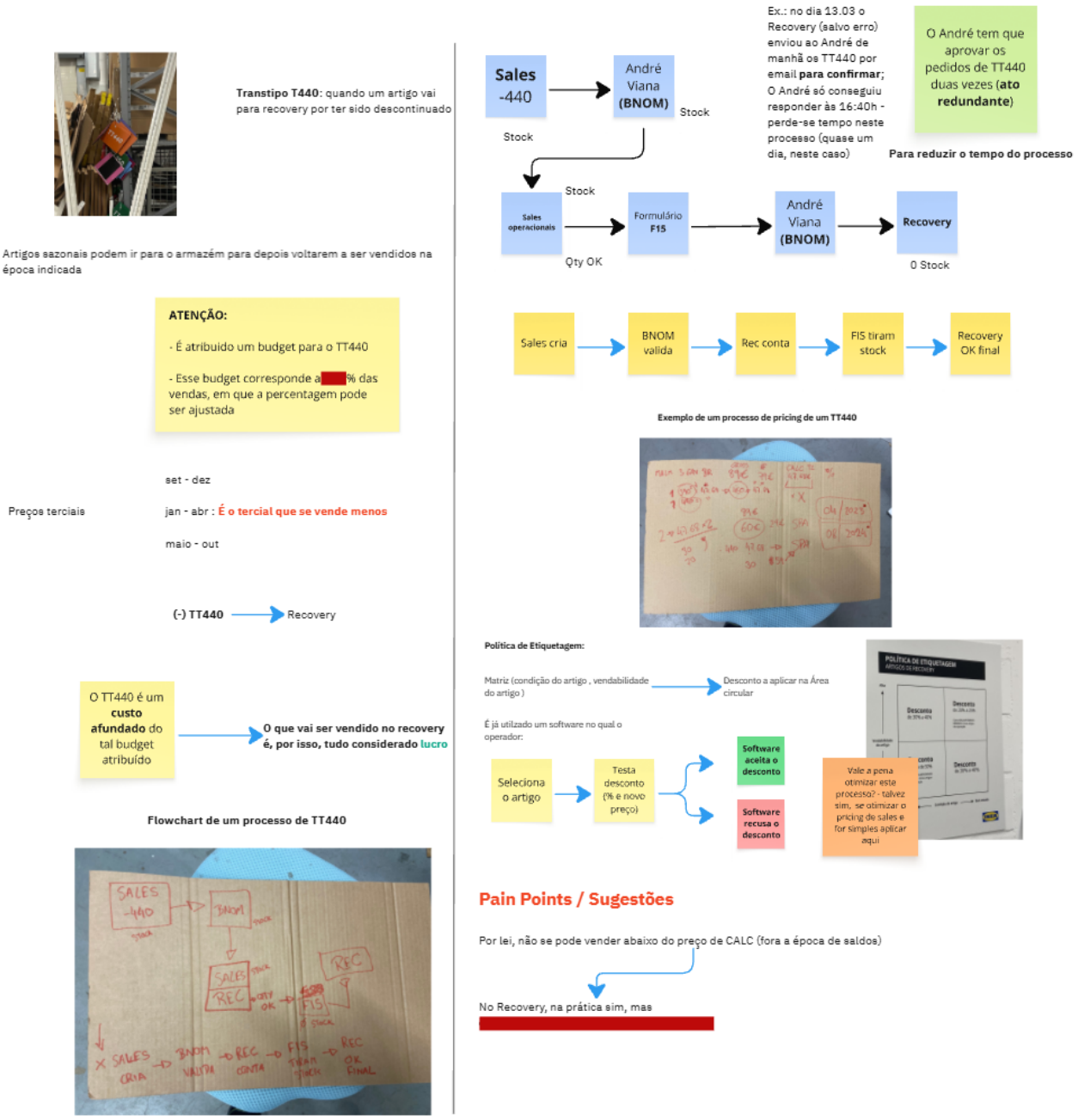
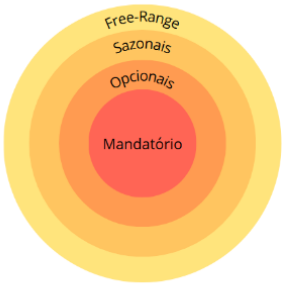


Figure C.3: Meeting Notes – Recovery Manager, IKEA Braga - store 499

4 PCDs - depois há coleções sazonais, como p.e. Natal

Em Matosinhos, o Ricardo vai buscar as listagens ao PowerBI (SSS não faz inputs)

Dependente da economia p.e. covid



- Época de Saldos --

só trabalham aqui os outgoings

alinhamento de preços com Braga já um pouco

tentado pelo interviewee (por escolha própria)

saldos nacionais ou locais depende do objetivo do SPA (sales price adjustment)

SPA = margem de lucro preço normal - margem de lucro preço promocional = **Lucro Perdido**

< lucro unitário, mas > qtd vendida (ELASTICIDADE DE PREÇO) compensa o lucro perdido por SPA

Trabalham à semana

3 saldos por ano (só sobre os outgoings - em Matosinhos) - SO notifica ASAE

"Agora ou Nunca" por motivos legais - todo o ano

Marketing e Dep Legal - ambos centralizados

!Existe uma vaga atualmente para Marketing do North Market

CALC: preço custo com IVA

Durante 30 dias ficam de "quarentena" - voltam ao preço original

Ficheiro utilizado no Excel foi herdado - possivelmente pelo Henrique (?)

Interviewee GERE SPA! e propõe TT440

Por lei, é obrigatório fazer inventário uma vez (por mês ou ano ou semana?) - IKEA faz todos os dias

OUTRA VEZ: TT440 VS %

TT440: ex só pernas de sofá - **INTEGRAÇÃO ENTRE LOJAS**

%: Pode compensar por SPA, mas p.e. 5 cabos não compensa**!! CASOS A OLHO!!**

Rule of thumb utilizada; até [redacted] unidades, preço de [redacted] euros - decidir se vai ou não para TT440

todas as semanas TT440 + alertas para as equipas ("este artigo está sem stock mas ainda tem local de venda atribuído")

---NÃO TÊM AUTOMATIZADO TIRAR LUGAR DE VENDA ATRIBUÍDO QUANDO UM ARTIGO FICA SEM STOCK

Aceitável até [redacted] carryovers como visto antes a partir p.e. de 01/04

POSSIBILIDADE DE COMBINAÇÕES COM OUTRAS LOJAS

Automatizar a rule of thumb

Automatizar tirar o local de venda atribuído - ao invés de colocar "0000" no Excel

Às vezes NÃO chega todo o que o shopkeeper pede, por isso podem surgir artigos de PCDs antigos

AL.0.10 -> FMS Reporting (PowerBI)
SLM003

Em Matosinhos usam os termos: **chão - o que está ao pé do cliente**
ar - armazém

!!Supply Plan Based (vermelho) - qt mais venderem mais vai vir de split !!**SILO LOCAL CONTRA GLOBAL!!**

Tudo UTGs "de julho" - até julho ainda há muito tempo para receber mt mais que não querem

PA: Product Area dentro do HFB

BTI: Breath Taking Item

BULLA: Em volume

SLID: Local de venda primário - **AJUDA A DECIDIR P.E. NÃO RECEBER DEVOLUÇÕES E NÃO VOLTAR PARA VENDAS**

<[redacted]unidades - vê a questão do local de venda - SSS faz mais ou menos o oposto

?? - tem este "semáforo" no Excel de Braga?

Class - calcula automaticamente

CDC - só por encomenda

(IKEA Food está a mais no Excel, não trabalham com isto)

Figure C.4: Meeting Notes – Sales Price Manager, IKEA Matosinhos - Part 1 of 2

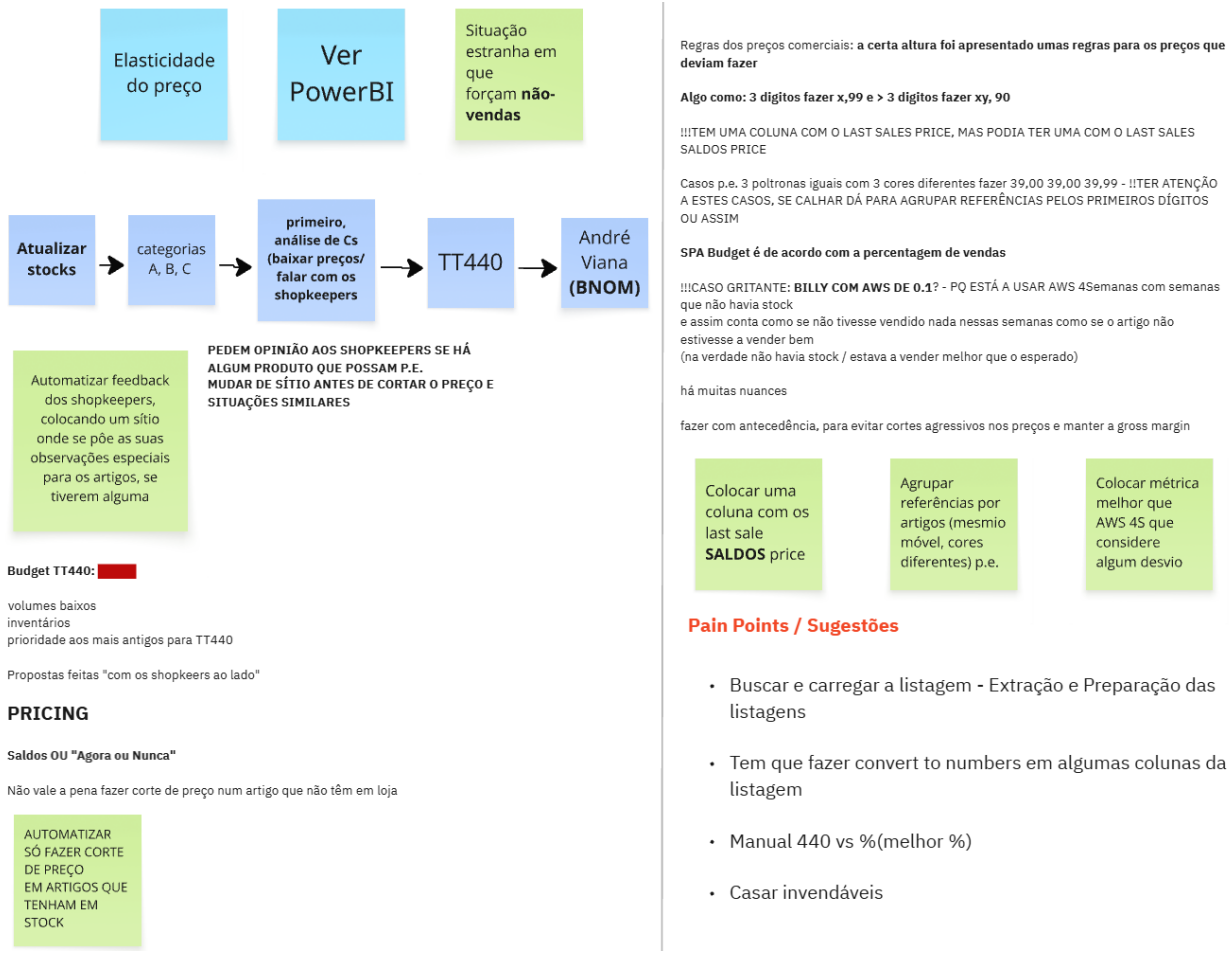


Figure C.5: Meeting Notes – Sales Price Manager, IKEA Matosinhos - Part 2 of 2



PCDs que é quando acontece PIPO - É em PCD que há os UTGs

8 meses antes da PCD há venda de distribuição - SPLIT/RTO

Ideia é deixar o mínimo possível até ao LOAW (última vez que recebem) para poupar SPA

2 meses antes há review/correção do RTO Control - o aplit só muda se for "encontrado stock em armazém"

Supply Plan Based: situação de forçar não venda que vi com o Ricardo Resende

-> ficheiro elasticidade de preço

PRICERA - APENAS PARA SUBIR OS PREÇOS

Toda a gestão de SPA é feita por vendas

!!! SITUAÇÃO BOCA A BOCA: A SSS pode sugerir que potenciem certos produtos por ter demasiado stock no ar

--!! Henrique - tentou usar EDS MarkDown, que depois caiu em desuso

HENRIQUE PODE PERCEBER MAIS DE EDS MARDOWN

Sales Managers aprovam descida deo preço !!! O QUE FAZEM? REPETEM E AVALIAM O RACIOCÍNIO DO [redacted],
NESTE CASO?

O que fazem os sales managers no processo de corte de preço?

Retail Order Information (ROI) - ajuda a saber onde estão as encomendas -> !! PODE SER UMA MÉTRICA DE CONFIANÇA
PARA SABER SE É SEGURO DESCER O PREÇO OU NÃO CONSOANTE A PROBABILIDADE DE CHEGAR MAIS STOCK
ANTES DO LOAW

SSS também lança os TT440, mas só faz isso (só os lança)

O que faz SSS/Fulfillement Integration

Analisam stock semanalmente para ver as situações mais críticas

AVIN: Availability situation

- todas as semanas podem pedir parte do RTO por múltiplos do respetivo delivery type (pallet ou multipack)

- senão, vai vir muito no RTO (? no LOAW)
  - teoricamente, podem até pedir todo o RTO antes do LOAW

Forecast global

SDS -> Forecast

!!USAR m3 - PODE-SE COLOCAR MIXES DE ARTIGOS

DTFP: olhar pelo scope de eficiência

Quando tiver SLM - Rui Mendes

USAR m3 - PODE-SE COLOCAR MIXES DE ARTIGOS

Ideia é deixar o mínimo possível até ao LOAW (última vez que recebem) para poupar SPA pq depois é preciso fazer cortes de preço

SSS sugere manualmente certos artigos para serem potenciados por Sales

ROI como possível métrica de confiança para corte de preço

Figure C.6: Meeting Notes – Fulfillment Integration Manager, IKEA Matosinhos

Appendix D

AS-IS Process Swimlanes

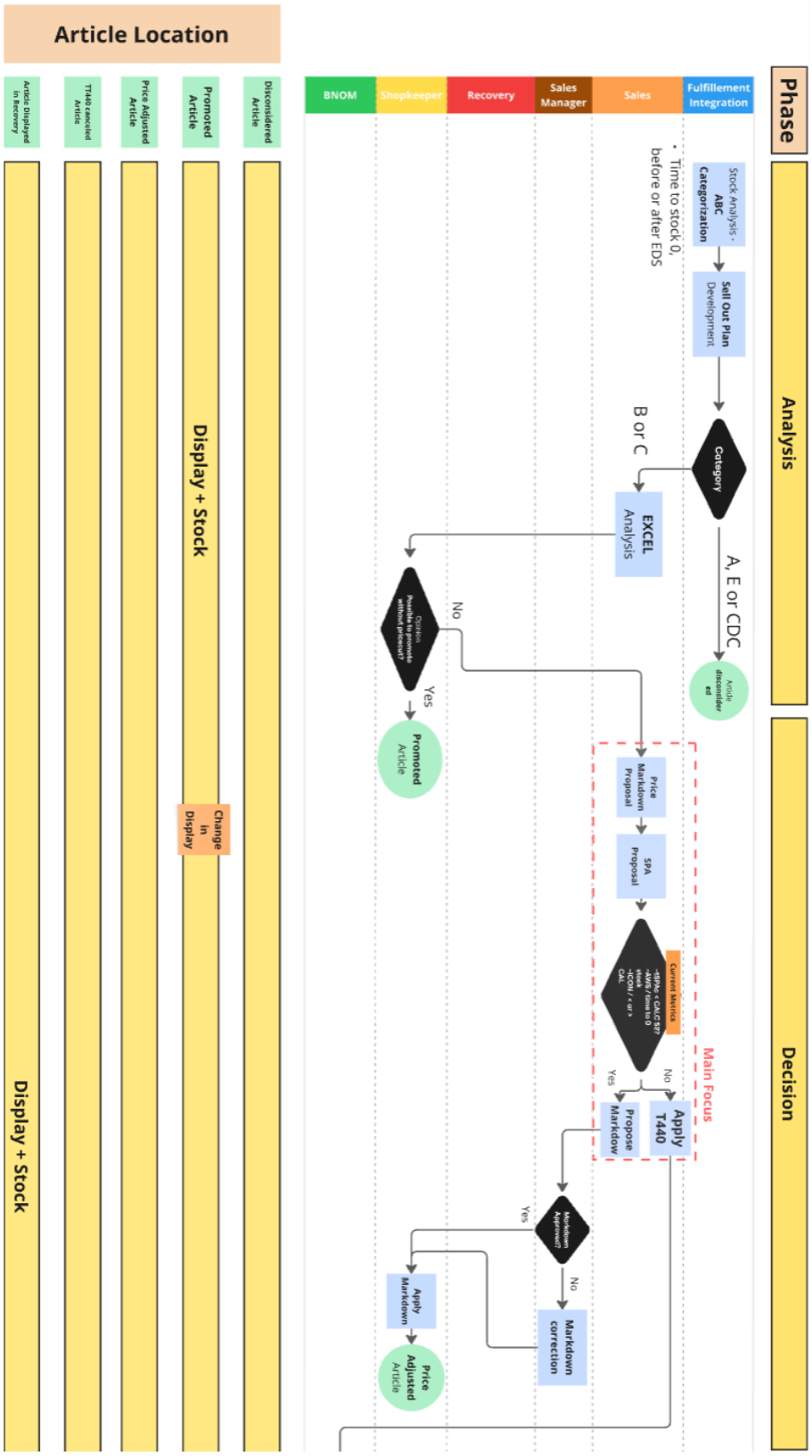


Figure D.1: UTG Management Process AS-IS Swimlane Part 1 of 2

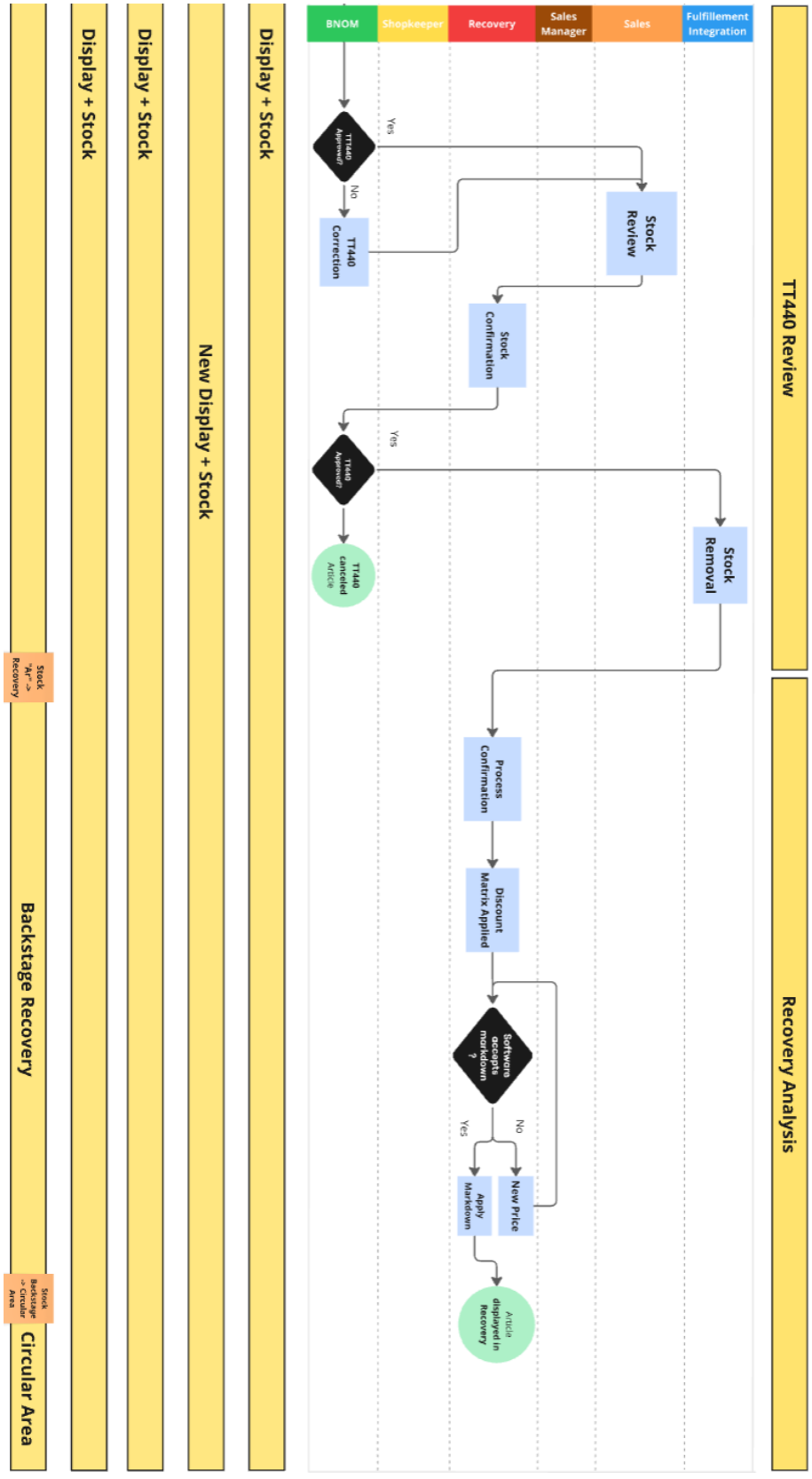


Figure D.2: UTG Management AS-IS Swimlane Part 2 of 2

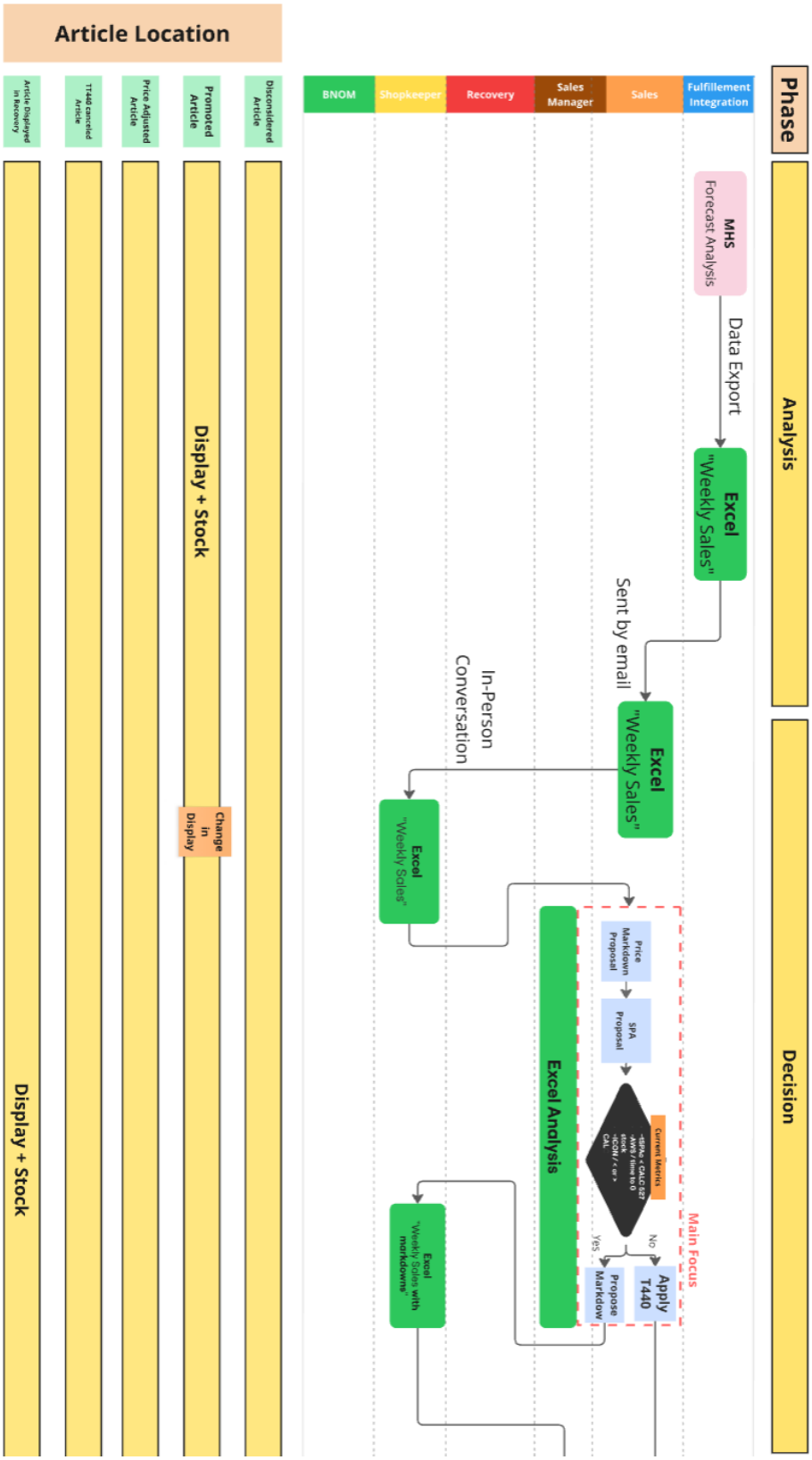


Figure D.3: UTG Management Data Flow AS-IS Swimlane Part 1 of 2

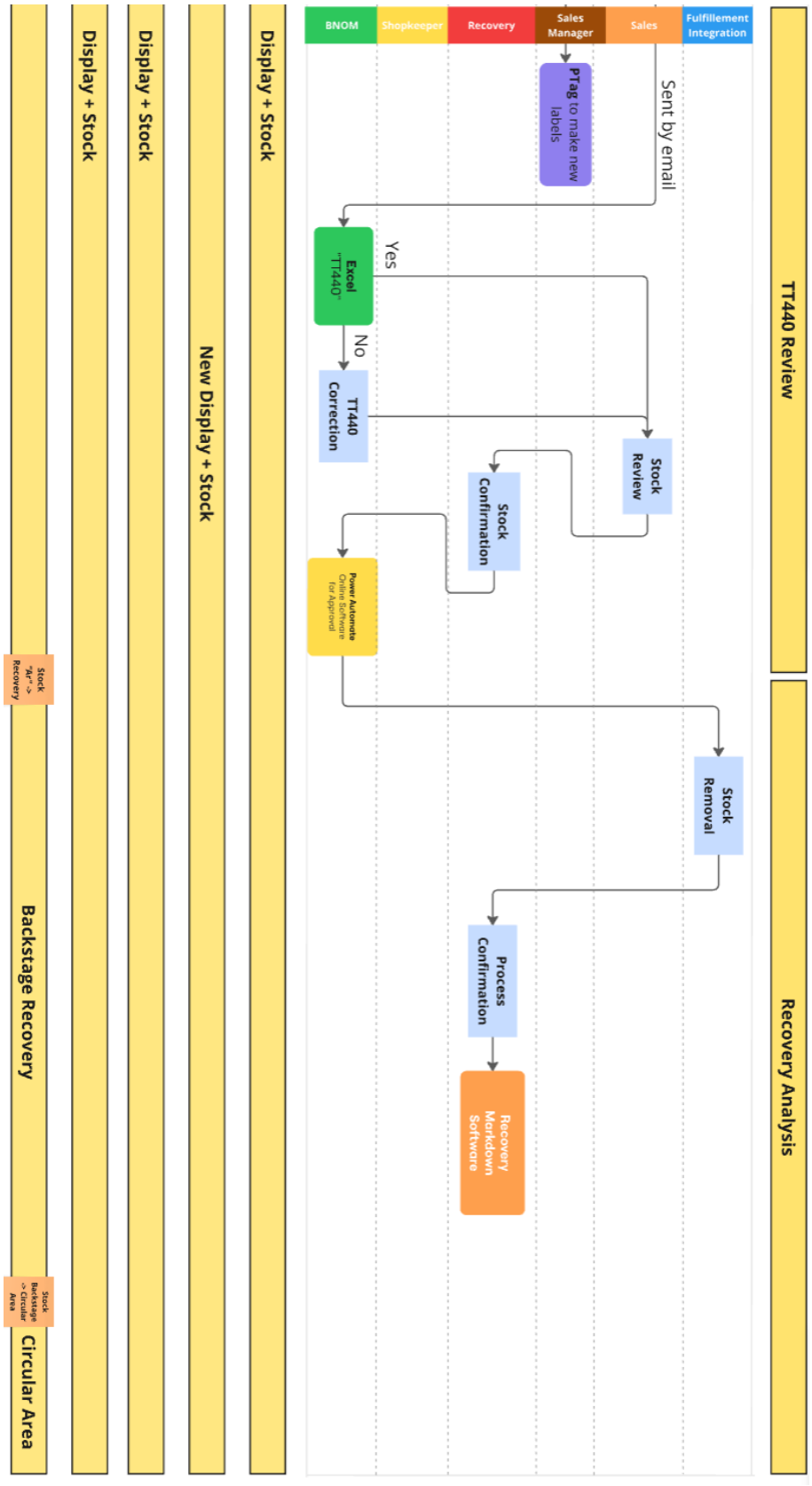


Figure D.4: UTG Management Data Flow AS-IS Swimlane Part 2 of 2

Appendix E

Rebuilt Process Swimlanes

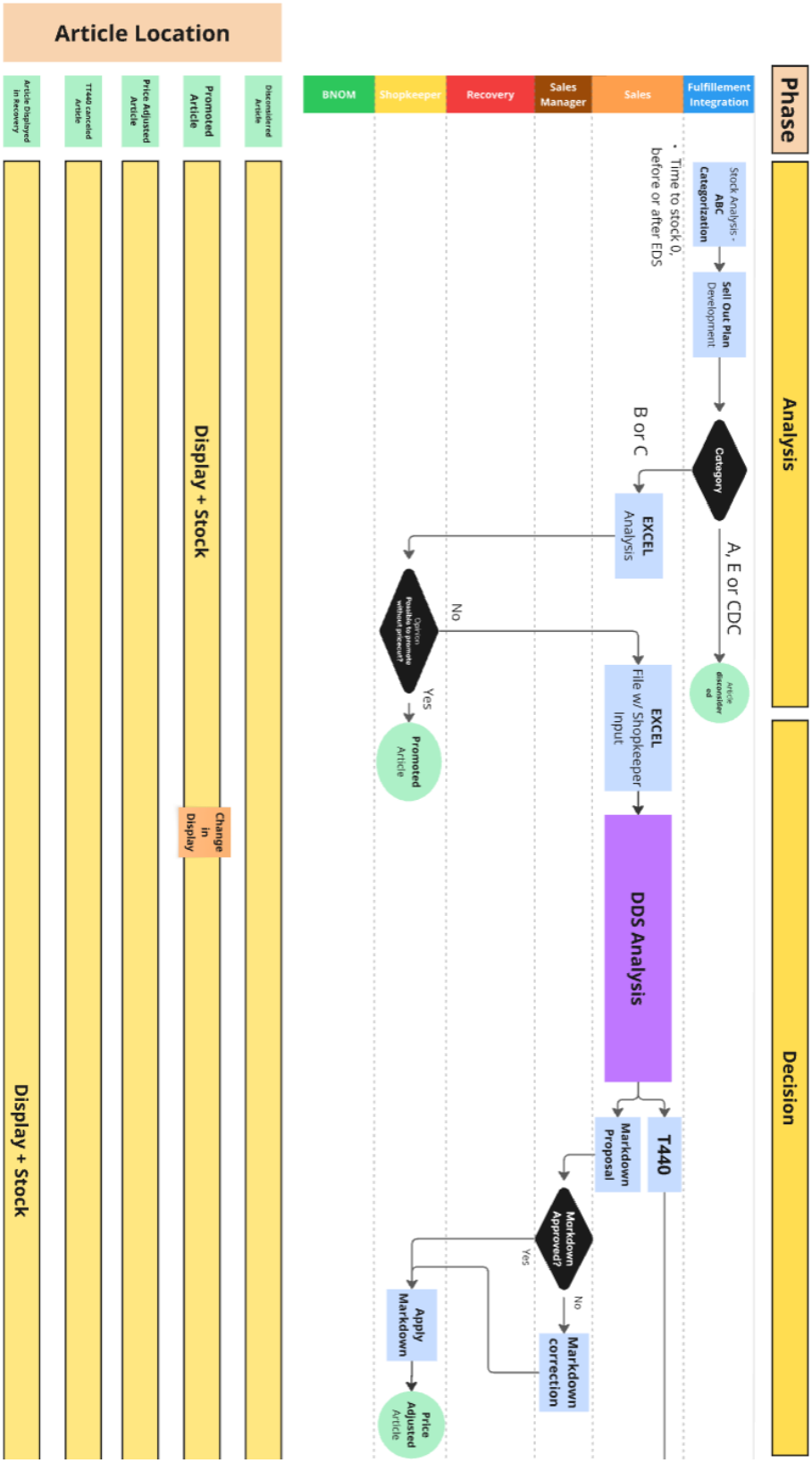


Figure E.1: UTG Management Process Rebuilt Swimlane Part 1 of 2

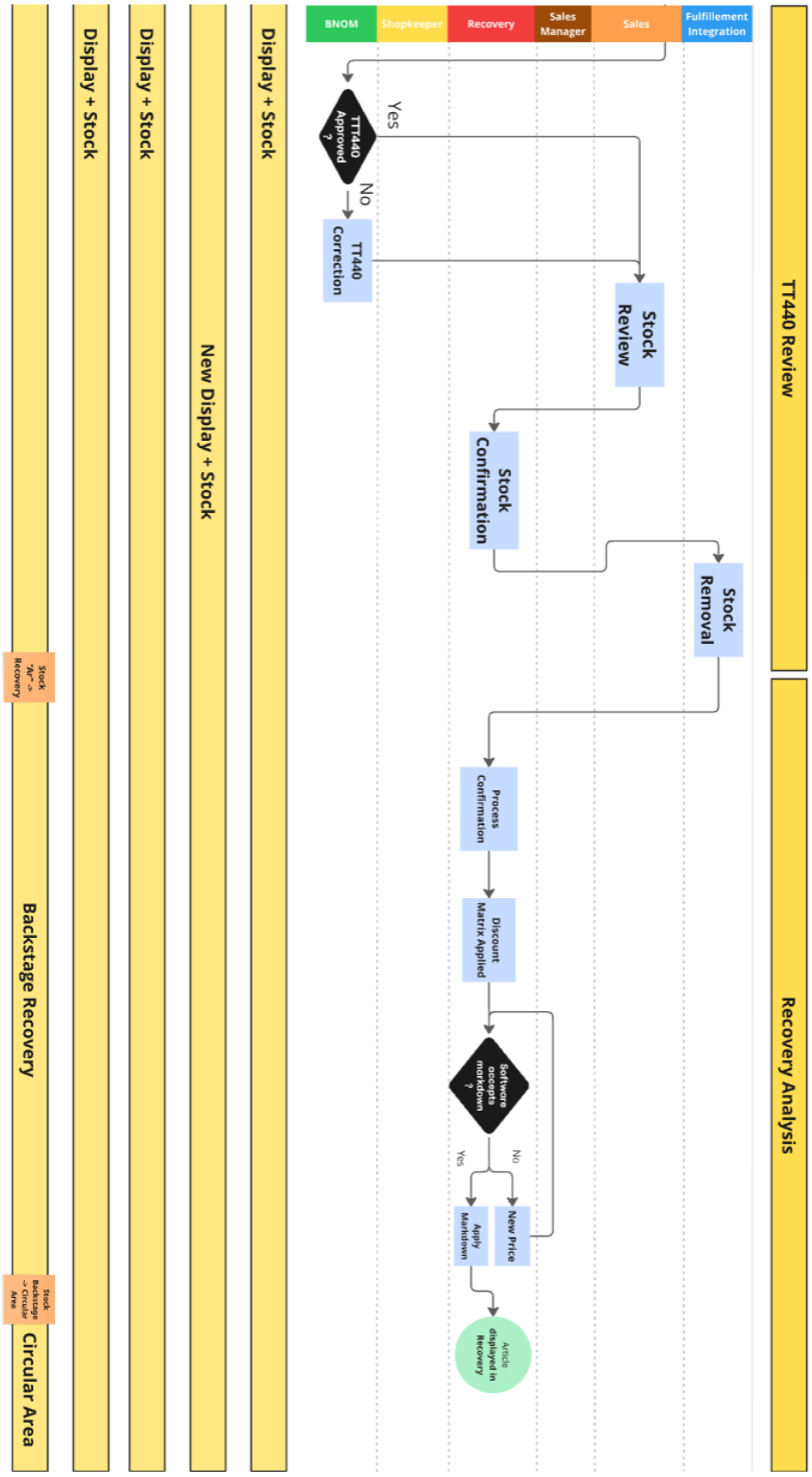


Figure E.2: UTG Management Process Rebuilt Swimlane Part 2 of 2

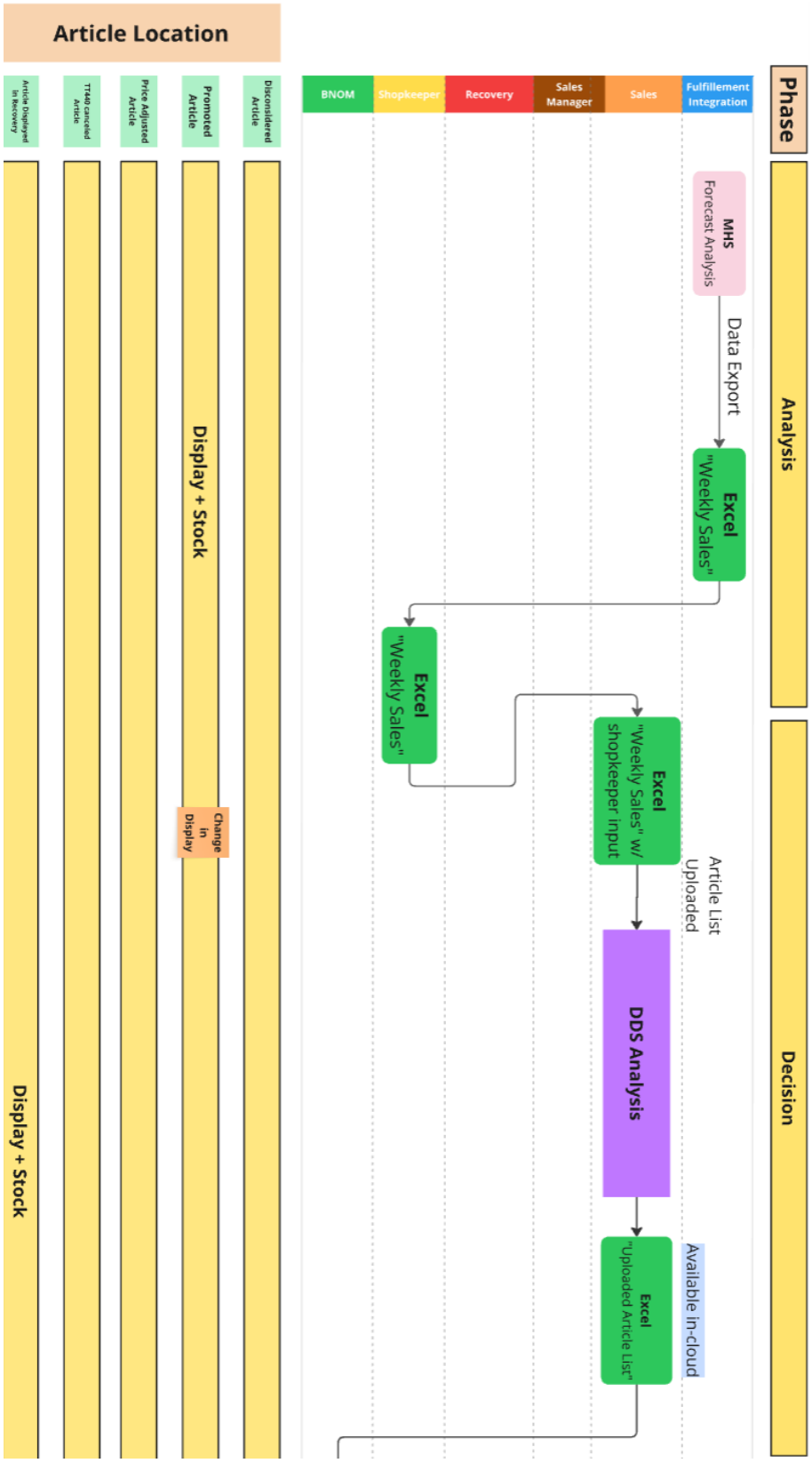


Figure E.3: UTG Management Data Flow Rebuilt Swimlane Part 1 of 2

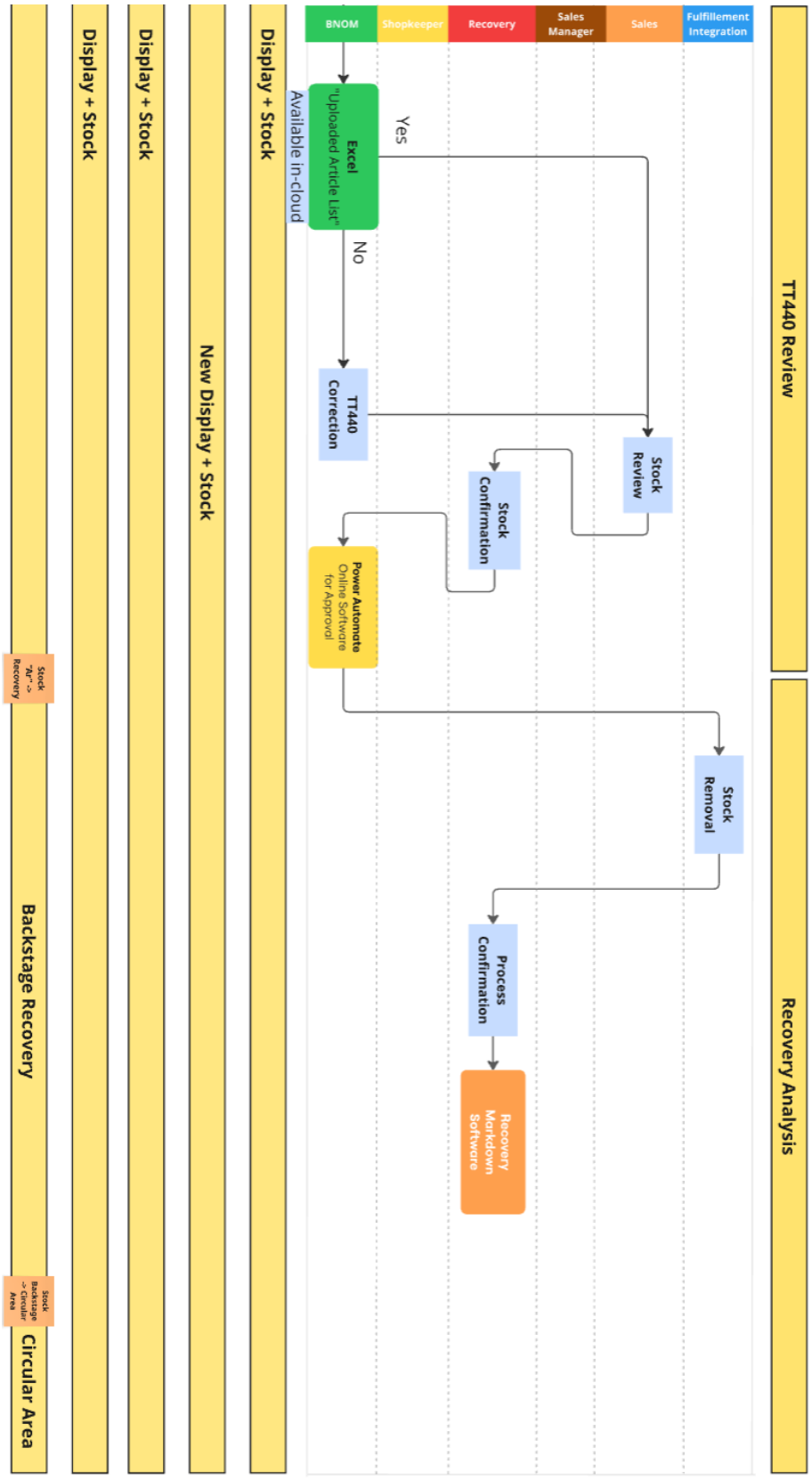


Figure E.4: UTG Management Data Flow Rebuilt Swimlane Part 2 of 2

Appendix F

Decision Support System

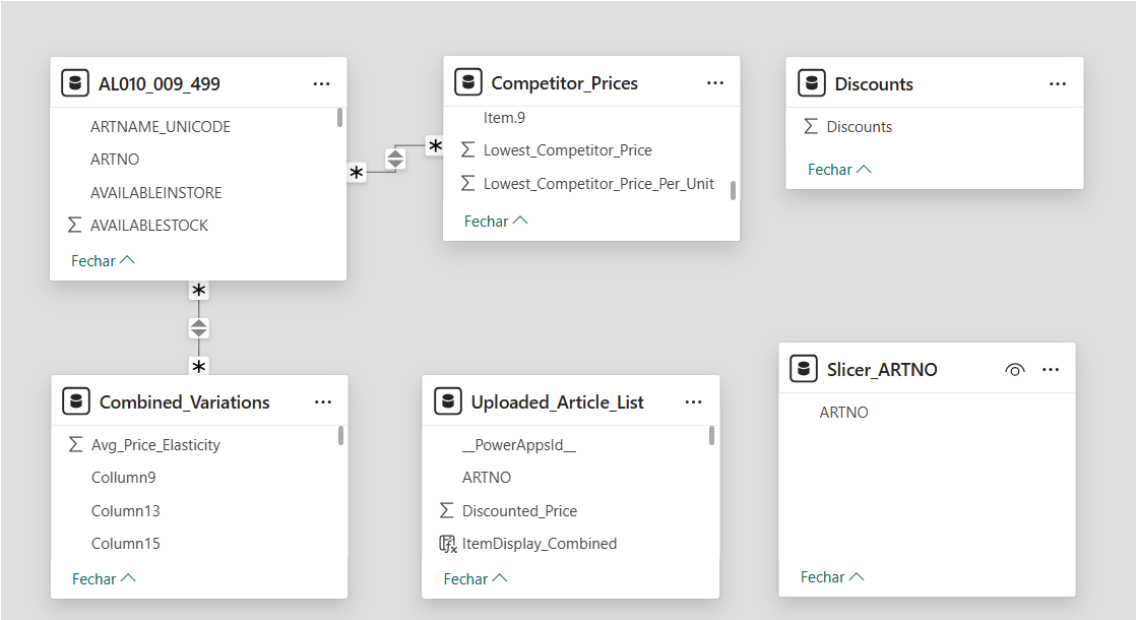


Figure F.1: Tables present in the DSS Power BI - Part 1 of 2

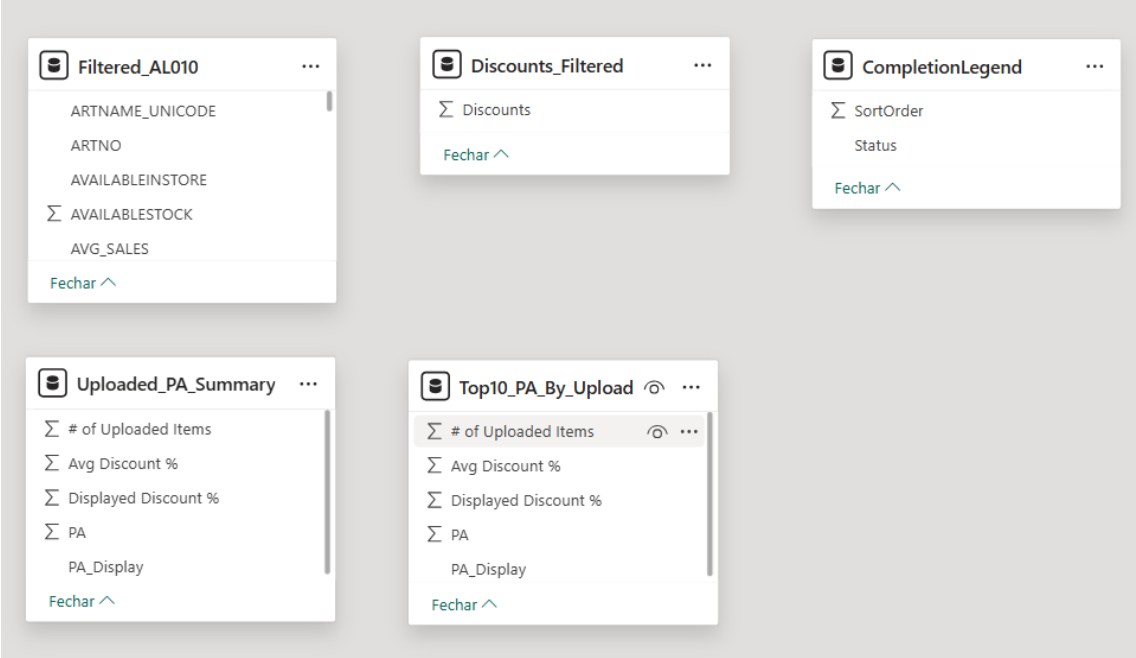


Figure F.2: Tables present in the DSS PowerBI - Part 2 of 2

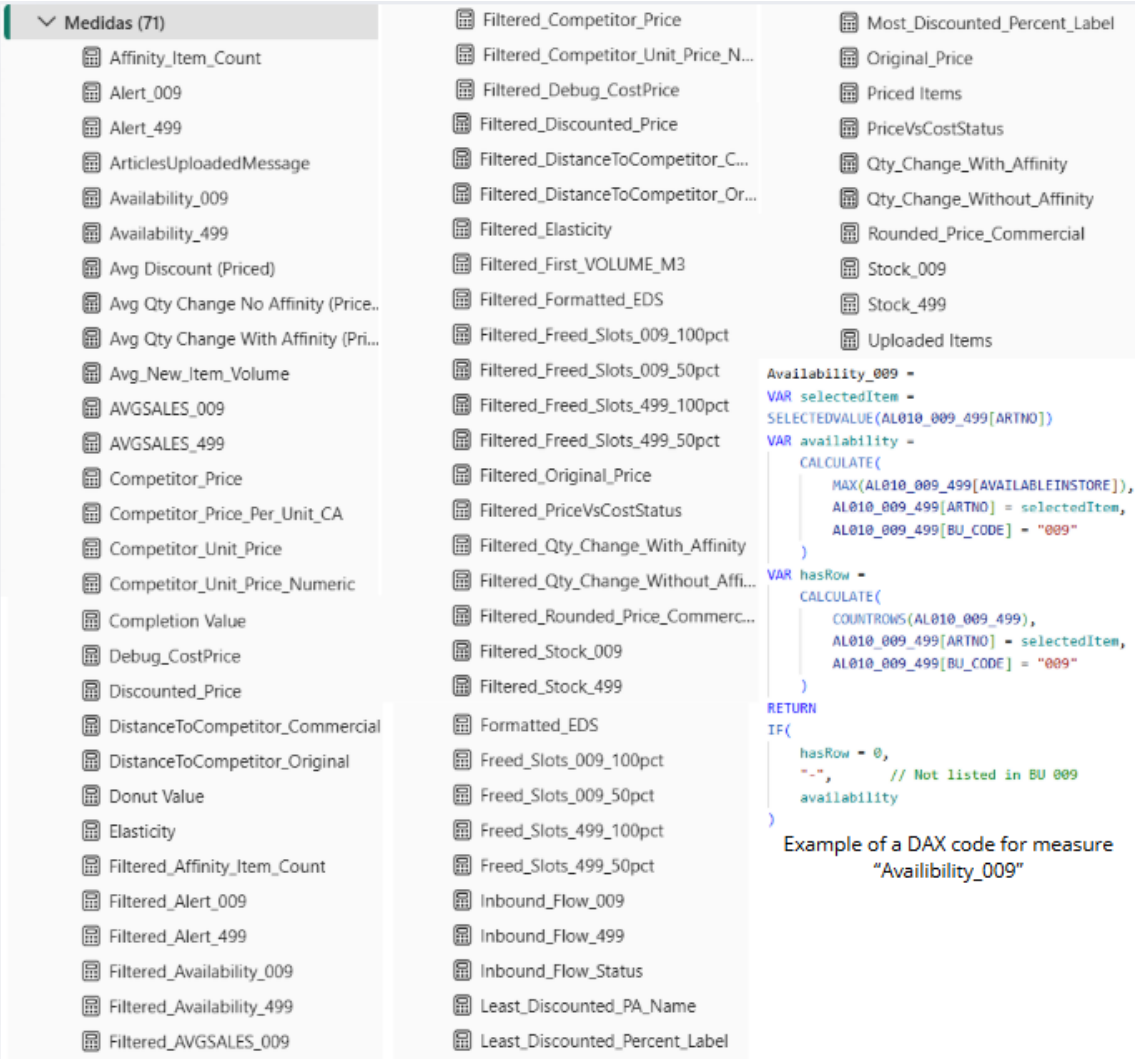


Figure F.3: DSS DAX Measures and DAX code example

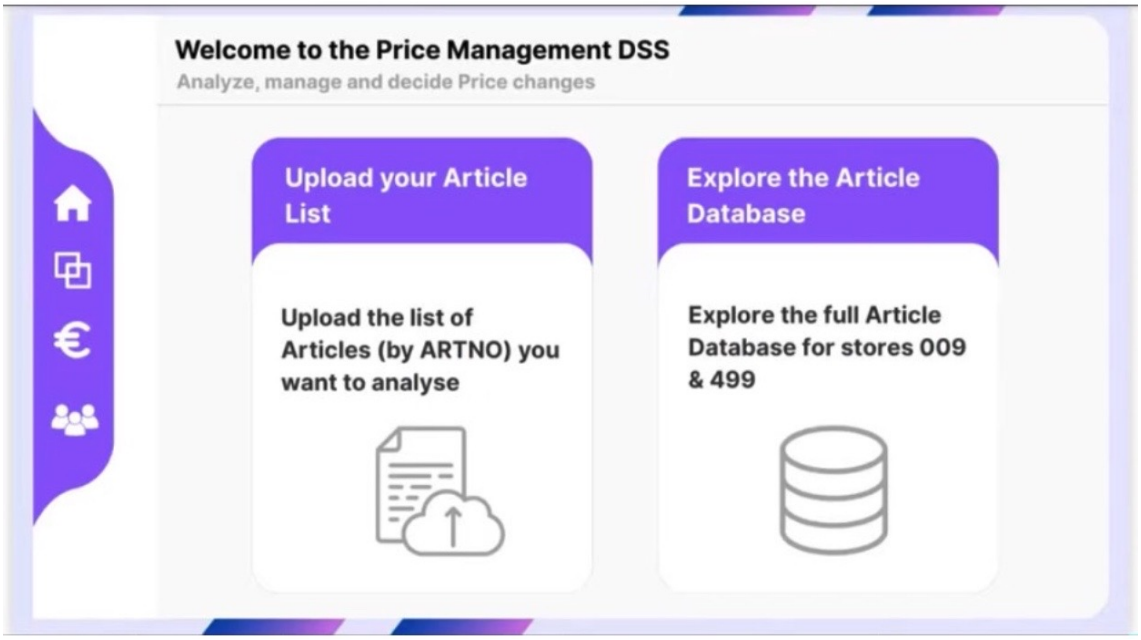


Figure F.4: DSS Home Page

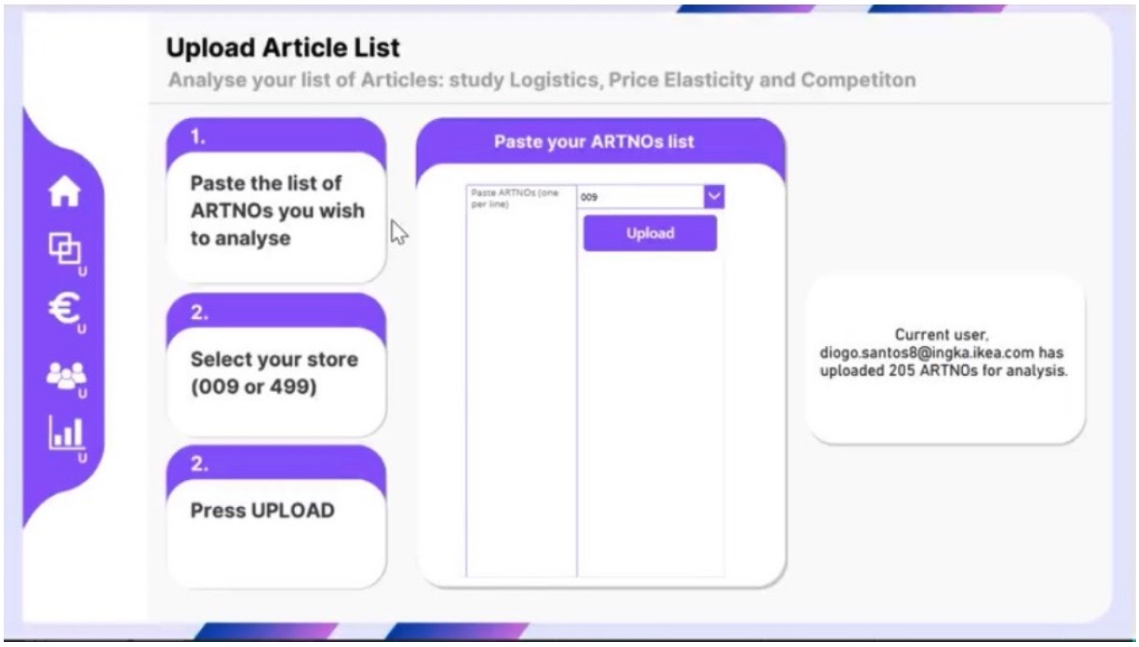


Figure F.5: DSS Upload Page

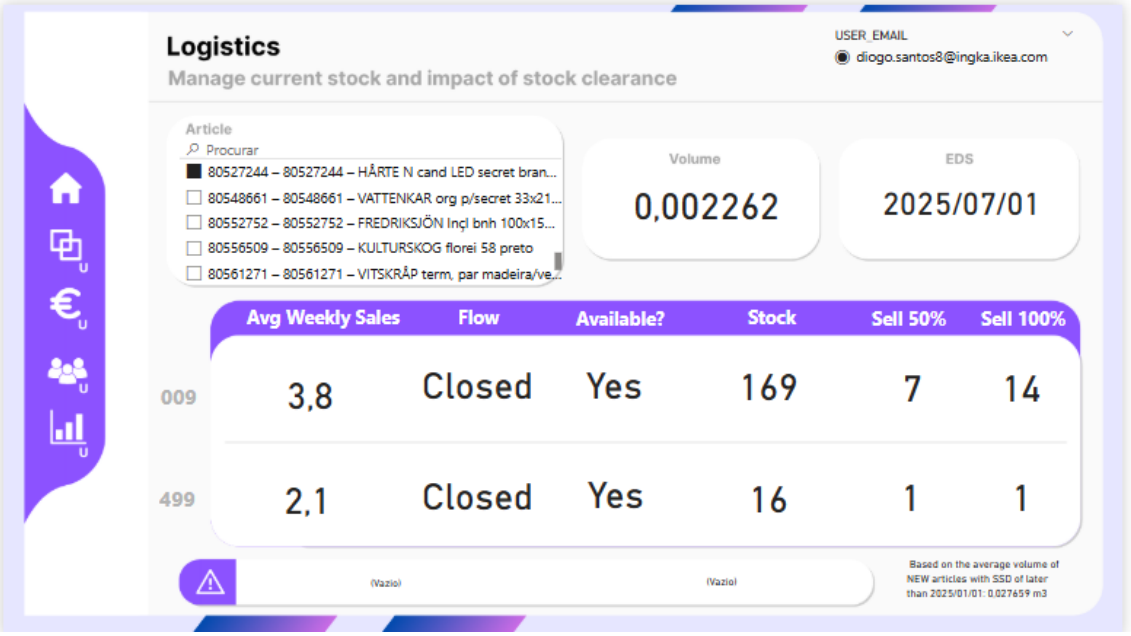


Figure F.6: DSS Logistics Page

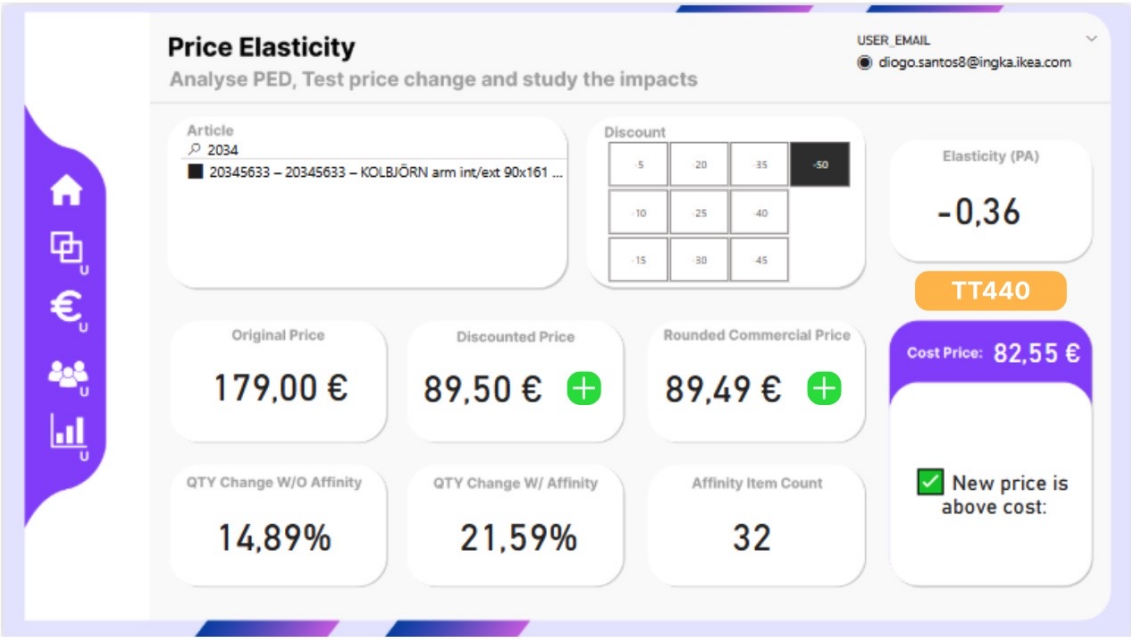


Figure F.7: DSS Price Elasticity Page

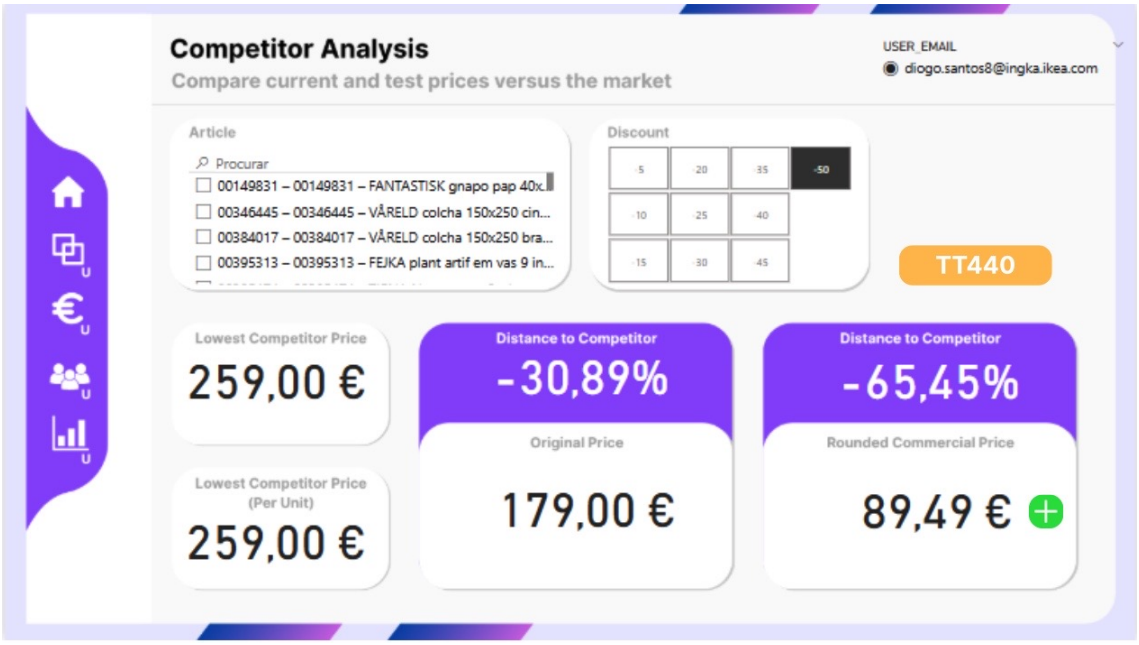


Figure F.8: DSS Competitor Analysis Page

Appendix G

Recovery Section

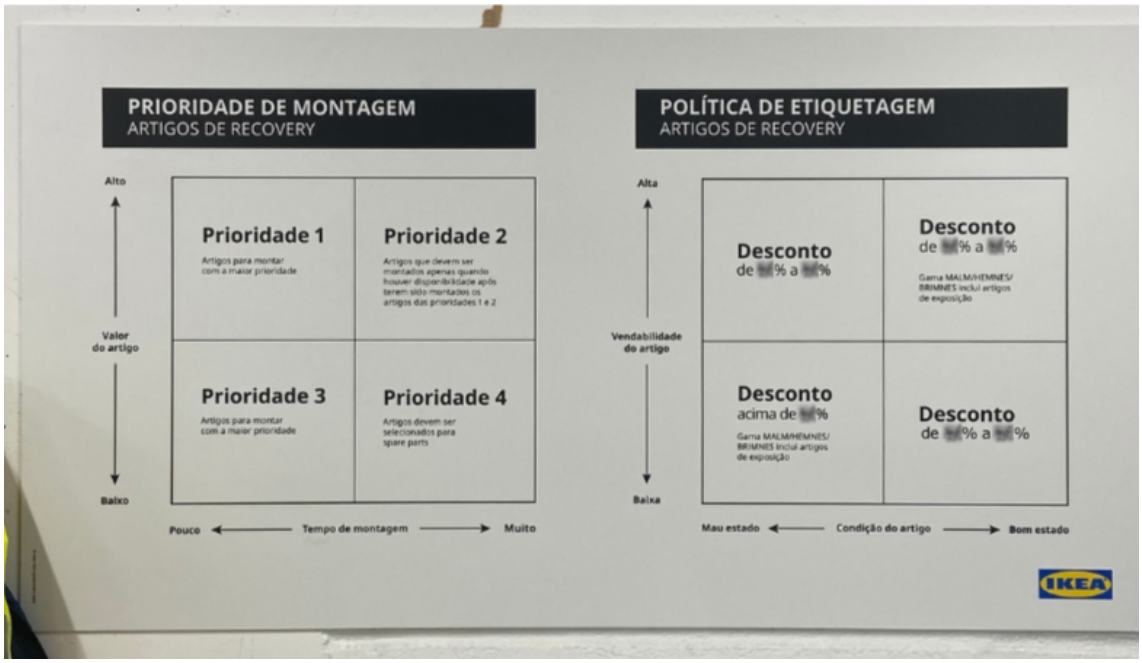


Figure G.1: Discount Matrix used in the Recovery Section



Figure G.2: Recovery label placement guidelines



Figure G.3: TT440 tags to apply in showroom articles