VILNIUS UNIVERSITY
BUSINESS SCHOOL

**DEEP TECH ENTREPRENEURSHIP**

**Yuliana Okhrimenko**

**THE FINAL MASTER'S THESIS**

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|---|---|
| **CREATING OPPORTUNITIES FOR FOOD RETAIL INDUSTRY IN EU MARKET BY IMPROVING BARCODE TECHNOLOGY THROUGH DIGITAL LABELLING SYSTEM** | **MAISTO PREKYBOS SEKTORIAUS EU RINKOJE GALIMYBIŲ KŪRIMAS TOBULINANT BRŪKŠNINIO KODO TECHNOLOGIJĄ PER SKAITMENINĘ ŽENKLINIMO SISTEMĄ** |

Student: Yuliana Okhrimenko

Supervisor: Prof. Dr. Tadas Limba

Vilnius, 2025

# SUMMARY

VILNIUS UNIVERSITY BUSINESS SCHOOL

DEEP TECH ENTRPRENEURSHIP STUDY PROGRAM

YULIANA OKHRIMENKO

## CREATING OPPORTUNITIES FOR FOOD RETAIL INDUSTRY IN EU MARKET BY IMPROVING BARCODE TECHNOLOGY THROUGH DIGITAL LABELLING SYSTEM

Supervisor – Prof. Dr. Tadas Limba

Master's thesis was prepared in Vilnius, in 2024

Scope of Master's thesis – 100 pages.

Number of tables used – 7

Number of figures used – 27

Number of bibliography and references – 119

Master thesis analyses the theoretical concept of digitalized barcode implementation of the food retail industry in the European Union (EU) market and provides a business model for this technological upbringing. The case studies have been chosen from the different geographical parts of EU that show great level of digitalization and technology adoption: Sweden, Netherlands and France. In order to achieve accurate and coherent insights that will be greatly used for the model development, qualitative business and quantitative consumer analysis have been conducted.

The aim of the qualitative experts' survey is to develop a better understanding of businesses vision on the digitalization progress that has been made in their field of proficiency, establish main features and functions of technology implementation, current challenges, provided solutions and perspectives on the future development. The aim of the quantitative consumer survey is to analyse the current state of the market, identify patterns, consumer behaviour, their preferences, grocery habits and the level of acceptance of the existing technology.

There are four chapters to this thesis. In the first chapter, theoretical analysis of digitalized barcode system and customer behaviour is thoroughly analysed. Second chapter gathers real time examples of successful implementation cases of digitalization in the food retail stores and their impact on the retail industry and grasps upon the legal regulations in the EU connected to the topic. Third chapter gathers the collected qualitative and quantitative data and proceeds with the analysis for further business model creation. Lastly, fourth chapter digitalized barcode business model is proposed.

# SANTRAUKA

VILNIAUS UNIVERSITETO VERSLO MOKYKLA
GILUMINIŲ TECHNOLOGIJŲ VERSLUMO STUDIJŲ PROGRAMA
YULIANA OKHRIMENKO

## MAISTO PREKYBOS SEKTORIAUS EU RINKOJE GALIMYBIŲ KŪRIMAS TOBULINANT BRŪKŠNINIO KODO TECHNOLOGIJĄ PER SKAITMENINĘ ŽENKLINIMO SISTEMĄ

Vadovas – Prof. Dr. Tadas Limba
Magistro darbas parengtas Vilniuje, 2024
Magistro darbo apimtis – 100 puslapiai
Naudotų lentelių skaičius – 7
Naudotų paveikslėlių skaičius – 27
Bibliografijos ir šaltinių skaičius – 119

Magistro darbe analizuojama skaitmenizacijos brūkšninio kodo diegimo maisto prekybos sektoriuje Europos Sąjungos (ES) rinkoje teorinė koncepcija ir pateikiamas šio technologinio proveržio verslo modelis. Atvejo studijos atrinktos iš skirtingų ES geografinių dalių, pasižyminčių dideliu skaimenizacijos ir technologijų diegimo lygiu: Švedija, Nyderlandai ir Prancūzija. Siekiant gauti tikslių ir nuoseklių įžvalgų, kurios bus plačiai panaudotos kuriant modelį, buvo atlikta kokybinė verslo ir kiekybinė vartotojų analizė.

Kokybinio ekspertų apklausos tikslas – geriau suprasti verslo skaitmenizacijos progreso viziją jų veiklos srityje, nustatyti pagrindinius technologijų diegimo bruožus ir funkcijas, dabartinius iššūkius, siūlomus sprendimus ir ateities plėtros perspektyvas. Kiekybinės vartotojų apklausos tikslas – išanalizuoti dabartinę rinkos būklę, nustatyti tendencijas, vartotojų elgseną, jų pageidavimus, maisto prekių įsigijimo įpročius ir esamų technologijų priėmimo lygį.

Šis magistro darbas apima keturis skyrius. Pirmame skyriuje išsamiai analizuojama skaitmenizuotos brūkšninio kodo sistemos ir vartotojų elgsenos teorinė analizė. Antrame skyriuje pateikiami realaus laiko pavyzdžiai, kaip sėkmingai diegiamos skaitmenizacijos priemonės maisto prekybos parduotuvėse, jų poveikis prekybos sektoriui ir aptariami su tema susiję teisės aktai ES. Trečiame skyriuje pateikiami surinkti kokybiniai ir kiekybiniai duomenys ir atliekama analizė, siekiant sukurti verslo modelį. Galiausiai, ketvirtame skyriuje siūlomas digitalizuoto brūkšninio kodo verslo modelis.

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# LIST OF ABREVIATIONS

AI - Artificial Intelligence

AR - Augmented Reality

CRM - Customer Relationship Management

eWOM - Electronic Word of Mouth

ERP - Enterprise Resource Planning

ESL - Electronic Shelf Label

EU - European Union

GDPR - General Data Protection Regulation

IoT - Internet of Things

MAR - Mobile Augmented Reality

ML - Machine Learning

POS - Point of Sale

QR-code - Quick Response Code

SME - Small and Medium-sized Enterprise

SST - Self-Service Technology

VR - Virtual Reality

# INTRODUCTION

**Novelty and Relevance of the Topic.** We are living in an era where the majority of businesses are at the peak of its transition to more advanced and technological practices in order to hold the entrepreneurial lead, differentiate their brand and keep up with rising trends. Nowadays, the development of concepts and services that offer added value to consumers is becoming a crucial and cost-effective factor that can be achieved through information technology (Hänninen et al., 2018), which leads to a higher demand for novelty and work towards digitalization.

In the discussion (Porter & Heppelmann, 2014) on the topic of industrial digitization it was claimed that the rethinking of technology, skills, and processes throughout the entire value chain is required in order to evolve. The company needs to realistically see what capabilities it can develop as well as the direction of that development. This approach can lead to performing small and safe changes without risking the profit and reputation of an enterprise.

At the same time, food retail industry in the European Union (EU) market stands at the crossroad between innovative solutions and traditional ways of running a business. While big corporations are racing towards the progress, it can be challenging for SME (small and medium-sized enterprises) to keep up with changes while preforming the same level of operation.

That is where digital labelling technology can come along. It presents a ground-breaking opportunity to transform how product information is communicated and managed in the food retail sector. The innovation is to use existing barcode technology combined with an improved application interface to improve user experience and efficiency without the need to physically change the label.

The increasing need for improved consumer engagement and effective compliance with changing regulatory requirements highlights the topic's relevance. Businesses operating in the EU face challenges due to strict regulations related to product labelling, which require precise further analysis (Jayatilake et al., 2024). Traditional physical labels can be expensive and rigid, requiring regular updates and reprints. In order to overcome these obstacles, this study offers a solution that makes use of digital technology and the already-existing barcode infrastructure to enhance customer satisfaction, expedite information management, and save operating expenses.

**Scientific Issue.** Theoretical integration of digital technology with current barcode systems to produce a more dynamic and effective labelling solution is the central scientific question of this study. Although they are static in nature, traditional barcode systems have been the foundation of product tracking and identification. They are well researched but currently avoided making any advanced decisions since the appearance of QR-codes which only seem more advanced yet complicated and not

suitable for every situation. This study investigates bringing barcode scanning to a new level leveraging possible restrictions and the way of removing them by creating a barcode-interfacing application that offers interactive and thorough product information. It takes a multidisciplinary approach in order to analyse this technology, possibilities in implementation, and further improvements of retail operation, integrating marketing, consumer behaviour, information technology, and regulatory compliance concepts.

**The Object of the Research.** The main object of this study is the creation of a business model for the introduction of a digital labelling system in the field of food retail trade in the EU. This system involves the adaptation of existing barcodes into a digital format through a user-friendly application that provides detailed product information. An evaluation of how existing barcode systems can be integrated with digital technologies to provide real-time interactive product information.

**Goal of the Research.** The research seeks to demonstrate the potential benefits of digital labelling for both businesses and consumers, providing a model for future innovations in the food retail industry. Specifically, it aims to achieve following the tasks:

1. To analyse the theoretical concept of digital labels and consumer behaviour trends in the food retail industry.
2. To investigate into the real case studies from the countries within the EU.
3. To perform a quantitative study of consumers' current behaviour, trends, and preferences in the food retail industry.
4. To perform the qualitative study of experts regarding business' approach of adapting towards digital labels.
5. Based on the literature review and data analysis, to develop an application business model for digitalized barcodes.

The research idea is to demonstrate the potential benefits of digital labelling for both businesses and consumers, providing a model for future innovations in the food retail industry.

**Methods and Resources of Research.** To achieve the research goals, both qualitative and quantitative techniques will be used. A comprehensive literature review of digitalization (including digital labeling systems and barcode technology), consumer behavior, and regulatory requirements in the food retail industry is studied in order to examine current trends, technological developments, and areas for improvement. Interviews with experts in the field and customers, in addition to case studies on companies that have adopted digitalized technologies will offer qualitative insights into real-world difficulties and user preferences. Quantitative data on the system's impact and efficacy will be gathered through surveys given to consumers and food retail businesses; data analysis will assess performance,

satisfaction, and areas for improvement. To guarantee compliance and handle regulatory obstacles, an evaluation of EU regulations pertaining to data protection and product labeling will be conducted. Using these techniques the study seeks to fully assess how the digital labeling system can improve entrepreneurial leadership in the food retail sector.

**Research design.** There are four chapters in the research. Theoretical considerations regarding the adaptation of digital labelling systems to barcode technology are examined in the first chapter. This involves a review of the idea and development of digital labelling systems, identification of challenges related to barcode technology and a strategic assessment of market trends in the EU. This knowledge will become the basis for the next stages of the research.

In the second chapter of the study, market analysis is thoughtfully studied, which focuses on specific examples from the EU, including important markets such as France, the Netherlands and Sweden. Comparing digital labelling systems to traditional barcode technology, this section seeks to identify regional variations and parallels in the uptake and application of these technologies.

Expert interviews are used in the third chapter to acquire information about the evolution and implications of digital solutions. The perspectives of industry professionals regarding the potential benefits and difficulties of deploying digital labelling systems in various industries will be investigated in this qualitative study. This chapter also analyses the consumer view on the technology, their shopping habits and preferences.

The creation of a business model for the use of digital labelling systems as an improvement over barcode technology is the main topic of the fourth chapter. Best practices for companies hoping to take advantage of these innovations will be outlined in this model. In order to improve the integration of digital labelling systems into the current barcode technology frameworks in the EU market, the research concludes with findings and recommendations.

**Practical significance of the research.** This qualitative study emphasizes how crucial it is to comprehend how digital labelling systems are adapted in order to advance barcode technology. It seeks to provide a precise definition of the ideas underlying digital labelling as well as an outline of the qualitative standards necessary for its successful application. The research's conclusions and suggestions are useful because they provide information that will help digital labelling systems be applied more successfully and advance barcode technology in the EU market.

# THEORETICAL ASPECTS OF DIGITAL LABELING THROUGHOUT BARCODE TECHNOLOGY

Today, one of the main topics of interest in marketing is consumer purchasing behaviour. The term "consumer purchasing behaviour" describes how consumers make decisions from a variety of goods and services in order to fulfil their needs, save money, and be as satisfied as possible (Willman-Iivarinen, 2017).

It is one of the most important aspects of a business's success; for as long as an enterprise exists, customer feedback is collected and well-studied to conduct a comprehensive analysis for a future development and marketing plan. Decision-making is a complex and multi-stage process. The customer has a right to choose the best product for them to purchase considering a range of criteria, such as price, availability, design, sustainability, trust, trend and many more. Additionally, comes the complexity of demographics, attitudes, and preferences, ruled by cultural differences (Selma Ozdipciner et al., 2012).

Businesses try their best to accomplish consumers' satisfaction by inventing different approaches and services for a broader diversity of selection. Following the current trend in digitalization, there is a need for further research and investigation of ways to improve a well-known for everyone food retail sector. By its simplicity, we seem to think that there is nothing more to be done, everything is well-established and organized.

The first chapter is aiming to break this believe and examine a theoretical aspect of digital labelling system that can be implemented through a barcode scanning technique, analysing potential of well-established concept, finding bigger value in it as well as investigating on the market needs for future implementation and work for entrepreneurial innovation.

## 1.1 Consumer behaviour analysis in the food retail industry

Businesses in the food retail sector need to understand consumer behaviour in order to anticipate and meet the changing needs and preferences of their target market (Pantano & Priporas, 2016). Grewal et al. (2020) stress the value of researching customer behaviour, especially in light of new technologies that are changing drastically. In the retail industry, consumer behaviour refers to the study of people, groups, or organizations and the methods they employ to choose, safeguard, utilize, and discard goods, experiences, ideas, or services in order to meet needs, as well as the effects these methods have on the consumer and society (Haugtvedt et al., 2008). This includes how customers make decisions about

what to buy, how they interact with different retail channels, and what factors influence their decisions when it comes to food retail. One cannot stress the value of researching customer behaviour in the food retail industry. According to Pantano et al. (2020), knowing how customers behave enables retailers to:

- Recognize and address customer needs more skilfully
- Create specialized marketing plans
- Enhance product selection and store design
- Improve the entire experience of shopping
- Adjust to shifting consumer preferences and market conditions

The big influence of the COVID-19 pandemic has expedited the transition towards digital and omnichannel shopping experiences, making this particularly pertinent. Figure 1. is showing eight immediate effects on customer behaviour and consumption affected by Covid-19 (Sheth, 2020).


**Source:** Sheth, 2020

**Figure 1.** Immediate Impact of Covid-19 on Consumption Behavior.

To further explain the Figure 1. it is important to mention the following clarifications to the change in the consumer behaviour that includes:

1. *Hoarding:* A result of consumer anxiety, goods are being accumulated by consumers, creating shortages and grey markets. Further studies in psychology and economics are needed to understand this behaviour.
2. *Improvisation:* People are coming up with inventive ways to carry out customary events, like online marriage and funerals. This flexibility is applicable to online learning environments and telehealth.

3. *Pent-up Demand:* Discretionary item purchases are being delayed, which could contribute to future economic growth. The effect it has on consumer behaviour requires more investigation.
4. *Embracing Digital Technology:* New technologies have been quickly adopted, particularly social media and video conferencing. This shift's global impact calls for more research.
5. Store Comes: A number of products and services are now routinely delivered to homes, which may have an impact on impulsive purchases and consumption habits.
6. *Blurring of Work-Life Boundaries:* Managing several tasks at home has grown more difficult, necessitating the use of new time-management techniques.
7. *Reunions with Family and Friends:* As friends and family who live far away connect more frequently online, new sociological and cultural consumption patterns may result.
8. *Discovery of Talent:* Spending more time at home has encouraged people to experiment with new abilities and artistic endeavours, some of which may have commercial potential. (Sheth, 2020)

There has been a significant notice change in consumer behaviour resulting from the growth of e-commerce and mobile technology. Businesses need to concentrate on the incorporation of digital platforms into the shopping experience to emphasize purchase decisions that could result from it. The rise of omnichannel retailing has a positive effect on how consumers engage with food brands and make purchasing decisions. It allows them to effortlessly transition between online and offline channels. (Yrjölä et al., 2018)

Customers need a greater transparency and thorough product information. Grunert (2006) makes a note that in addition to a product's nutritional value, consumers are also interested in things like place of origin, manufacturing method, and environmental impact. Buyers' perceptions of "quality" have significantly evolved, and they are now more strongly linked to four quality attributes for food products: sensory, health, process, and convenience.

*Sensory* attribute refers to the three traditional measures of food quality—taste, appearance, and smell. Consumers attempt to predict the taste experience by utilizing a variety of market signals, such as brand, price, and quality labels.

*Health attributes.* Many health effects of food are of a rather abstract nature— like the risks of particular diseases being reduced by a certain percentage— and thus do not lead to consequences that are readily accessible to experience. The market for natural and organic products is expanding, as noted

by (Annunziata & Vecchio, 2016) in the Table 1, we can see an emphasis and clear interest for sustainable, healthier and moral products.

| *''It is important that the food I eat on a typical day…''* | *Not at all* | *Very important* |
|---|---|---|
| Is obtained in an environmentally friendly way | 6 | 30 |
| Is locally produced to support local farmers | 11 | 28 |
| Is produced in full respect of human rights | - | 41 |
| Is sold at a fair price for the producer | 9 | 28 |
| Is produced in a way that respect the biodiversity | 11 | 22 |
| Is made without exploiting women or children | - | 40 |
| Is grown using sustainable agricultural practices | 7 | 26 |
| Is respecting animals' rights | 15 | 16 |
| Is produced without the use of pesticides | 5 | 31 |
| Is packaged in an environmentally friendly way | 14 | 22 |
| Is produced reducing the amount of food waste | 12 | 20 |
| Is produced with low carbon emission | 16 | 18 |
| Is produced in an uncontaminated environment | - | 35 |
| Keeps me healthy | - | 46 |

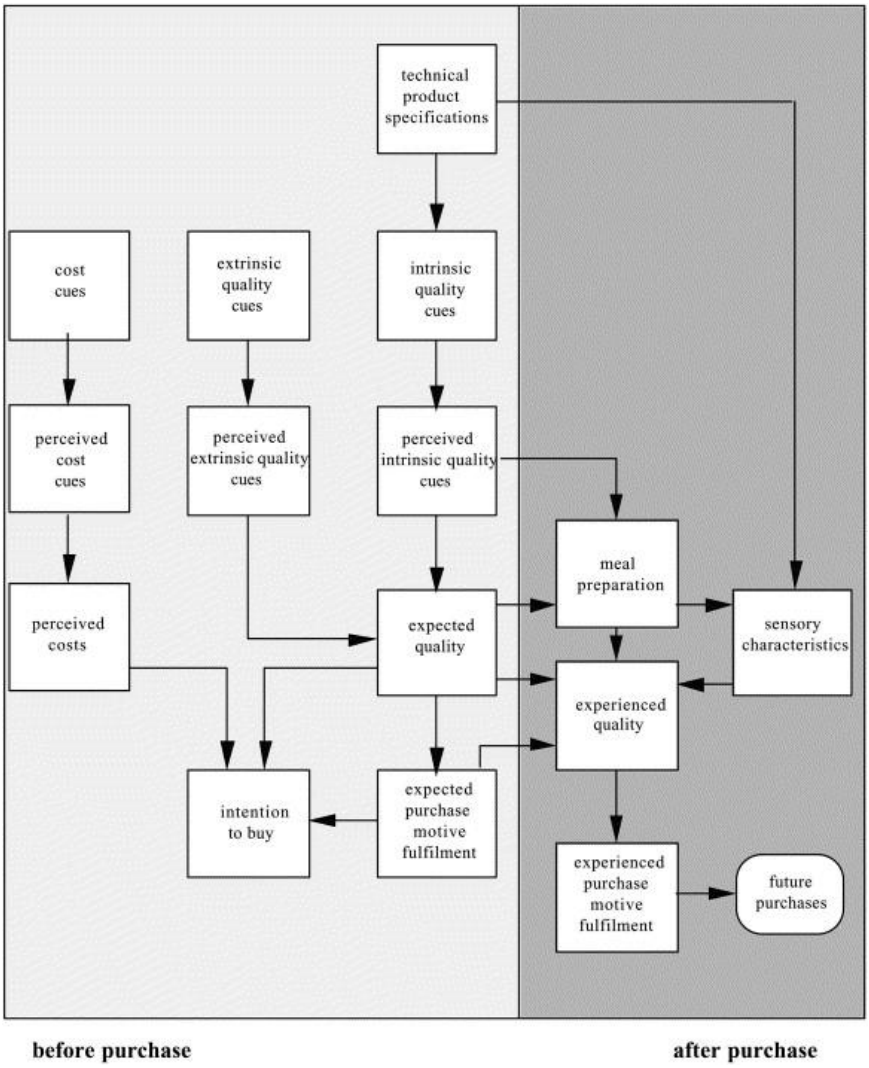
**Source:** Annunziata & Vecchio, 2016

**Table 1.** Food buying practices and consumption habits with regards to sustainability issues

Even when a *process's* methods have no discernible effect on the finished food product, consumers' interest in the production process is related to process attributes. This pattern corresponds with consumers' increasing attention to sustainability and ethical issues when purchasing food (Janssen & Hamm, 2012). Customers are willing to pay a premium for identically tasting and looking organic products, products that were produced with due consideration for the welfare of animals and/or the environment, and products that are assured to be free of genetically modified organisms.

*Convenience* is more broadly defined as alternatives to cooking meals at home, such as dining out (Darian & Cohen, 1995). Greater demand for convenience has frequently been linked to subjective perceptions of resource constraints held by households which account for the majority of the demand for convenience. A multidimensional service convenience scale was created and validated by Seiders et al. (2007), and it can provide light on the different aspects of convenience that matter to customers. Convenience and time-efficiency are important factors in determining customer behaviour, Bäckström and Johansson (2006) study on creating and consuming experiences in retail environments.

Overall, this can be concluded into the Total Food Quality Model, where previous attributes and characteristics are forming quality expectations (before the purchase) and quality experiences (after the purchase). Basic distinctions of the Total Food Quality Model are shown in Fig. 2.




**Source:** Grewal et al. (2009)

**Figure 2.** The Total Quality Model (from Grunert, 2002)

Grewal et al. (2009) assert that contemporary shoppers expect individualized shopping experiences that cater to their particular requirements and preferences. Payne & Frow (2005) talk about how retailers must use customer relationship management (CRM) techniques to offer more individualized services and get a better grasp of their clientele. Given that consumers in the food retail industry may have particular dietary requirements or preferences, this trend is especially pertinent to them.

Consumer behaviour in the retail food industry varies depending on the generational cohort. When comparing the online shopping habits of Generation X and Generation Y, Lissitsa & Kol (2016) find that younger consumers (Generation Y) are more likely to shop online than older consumers. Following up on this analysis of the relationship between generational differences, and status consumption, and brand preferences, it was investigated that younger consumers are generally more

influenced by social status and brand image when making purchasing decisions (Eastman & Liu, 2012). Not only that, but social media and online reviews have had a significant impact on consumer behaviour in the food retail industry. Cheung & Thadani (2012) provide evidence of the substantial influence that electronic word-of-mouth (eWOM) communication has on consumer decision-making through their integrative model and literature analysis. Building on this, they look into how consumers' intentions to make purchases can be influenced by the information they adopt via social media platforms.

**In conclusion,** consumer behaviour requires a diverse analysis due to its complexity and a variety of a landscape. It is critical to take into account any prospective future trends and projections that could influence it as the food retail sector develops further. Thus, it is a challenge for companies to ensure, their buyers are well studied and technology is ready to adjust for their needs.

### 1.2 The concept and evaluation for digital labelling system throughout barcode technology

A barcode is a graphic image that can hold data in unique patterns made up of squares that are vertically and horizontally spaced unevenly or with varying thicknesses. Put differently, it can be described as a shared identifier that has the ability to store barcode data or identification. Traditional barcode systems have long been used by the food retail sector for product tracking, identification, and checkout procedures. However, as consumer needs change and technology develops, there are more ways than ever to improve the efficiency and user experience of product labelling. One such invention is the idea of "digital labelling," which combines digital information systems and barcode technology to make shopping more dynamic and engaging.

The roots of digital labelling can be found in studies on how consumers interpret and react to nutritional information on food packaging. A thorough evaluation of European research was done by Grunert & Wills (2007), who emphasized the significance of understandable labeling so that consumers can make educated decisions. Adding to this, Clement, Kristensen, and Grønhaug (2013) investigated how package design elements affected visual attention and showed that the inclusion of digital components could greatly increase the salience and understanding of product information.

Another important consideration in the development of digital labeling systems is the multimodal nature of the shopping experience. Highlighting the changes in sensory dominance that take place at different phases of user-product interactions, Fenko, Schifferstein, and Hekkert (2010) hypothesized that digital improvements might give customers a more intuitive and engaging experience.

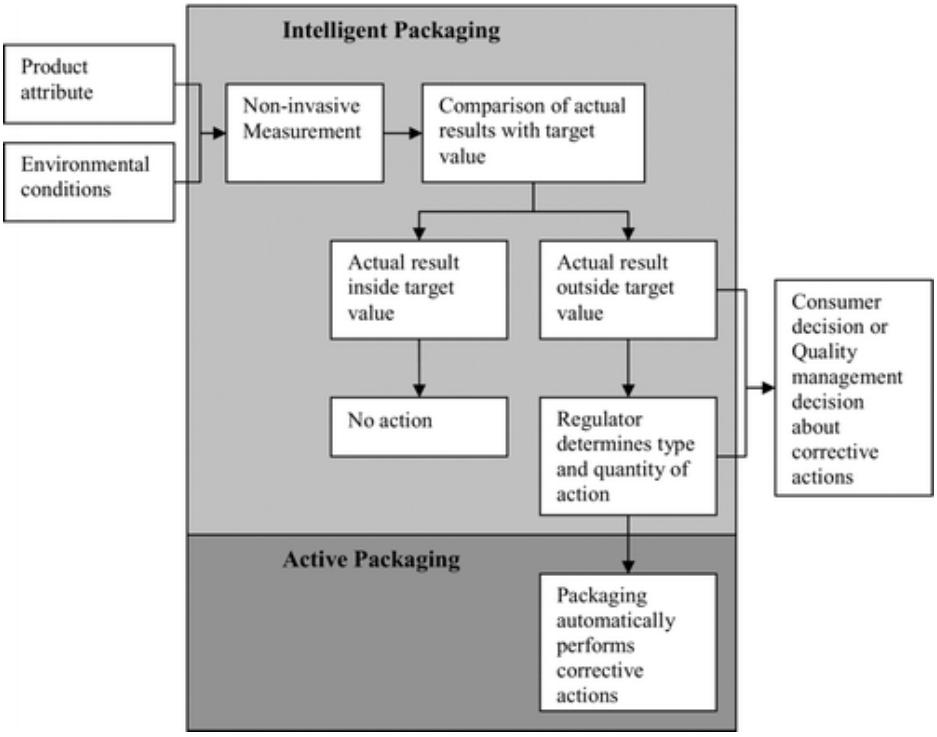
The integration of intelligent packaging solutions has gained increasing attention as the industry continues to change. In their review of recent developments in the industry, Vanderroost et al.

(2014) noted that digital labeling is a crucial element of the "next generation" of food packaging. Real-time updates, personalized data, and improved traceability are all possible with these smart systems, and they can all help to raise customer satisfaction and engagement levels. The enhancement of "Hazard Analysis and Critical Control Points" (HACCP) and "Quality Analysis and Critical Control Points" (QACCP) systems can also be facilitated by intelligent packaging (Heising et al., 2014). These systems are designed to:

1. promptly identify food hazards;

2. identify health hazards and develop plans and protocols to prevent, minimize, or eliminate their occurrence;

3. identify processes that significantly impact quality attributes and effectively improve the final food quality.




**Source:** Heising et al., 2014

**Figure 3.** Role of intelligent packaging (IP) and active packaging in quality control of food products after processing.

Figure 3 illustrates the use of the package for adaptive quality control: the active packaging component can automatically take corrective action when necessary, and the IP can monitor quality.

The capacity of digital labelling to offer a more thorough and customized product information experience is one of its main benefits. (Piqueras-Fiszman & Spence, 2015) investigated how consumer expectations and perceptions are shaped by product-extrinsic cues like packaging and

labelling. Retailers can meet the growing consumer demand for transparency and detailed information by incorporating digital elements to make product details more salient and easily accessible.

Digital labelling system implementation is not without its difficulties, though. It is essential to allign digital solutions with consumer behaviour and preferences for promoting adoption and engagement, retailers need to pay close attention to the needs, motivations, and technical proficiency of their target audience (Pöyry et al., 2013).

### 1.3 Qualitive criteria for development and issue setting

There are opportunities and challenges in developing digital labelling solutions as the food retail industry in the EU market keeps changing. Building on the conceptual framework and analysis of consumer behaviour that were previously covered, this section explores the qualitative requirements necessary for development and implementation that are successful. These standards address possible problems that might come up during the adoption process in addition to influencing the user experience.

A user-centered design methodology is the foundation of a successful digital labeling strategy. Every service or product should be created according to the needs and expectations (Norman, 2013). The importance of this underscores that the user interface and interaction must be simple, accessible, and responsive to consumer preferences and buying patterns. Retailers can create convenient, engaging and customer-centric solutions by putting the customer at the center of the design process.

A basic prerequisite for the widespread use of digital labeling systems is inclusivity. Making sure these technologies are usable by all customers, including those with special needs or impairments, is crucial as they become more ingrained in the retail environment. A thorough analysis of accessibility concerns in retail settings, home surroundings, and daily operations was carried out by (Bigham et al. (2010). Their research addresses obstacles pertaining to vision and highlights important opportunities as well as challenges for enhancing the inclusivity of these technologies. Developers need to think about the accessibility of supplementary features like text-to-speech capabilities, voice commands, and alternate input methods in addition to the core interface design. Retailers can develop digital labeling systems that meet the varied needs of their clientele and increase engagement and loyalty by giving inclusive design principles top priority.

The Belgian hypermarket company Carrefour is addressing this and experimenting with technology to enable visually impaired consumers to shop freely and without hindrances. Rompaey (2024) has researched that Carrefour has placed a tactile and audio map at the entrance of the store, which helps customers mentally map out the layout of each department. They have also positioned colorful,

intelligent QR codes on the floor, above aisles, and on shelves all over the store (Figure 4.). Customers can use the Navilens smartphone app to scan QR-codes up to 20 meters away, which will lead them securely and easily to the products they want. Price and ingredient details are among the extra information that can be retrieved by scanning the QR-codes.

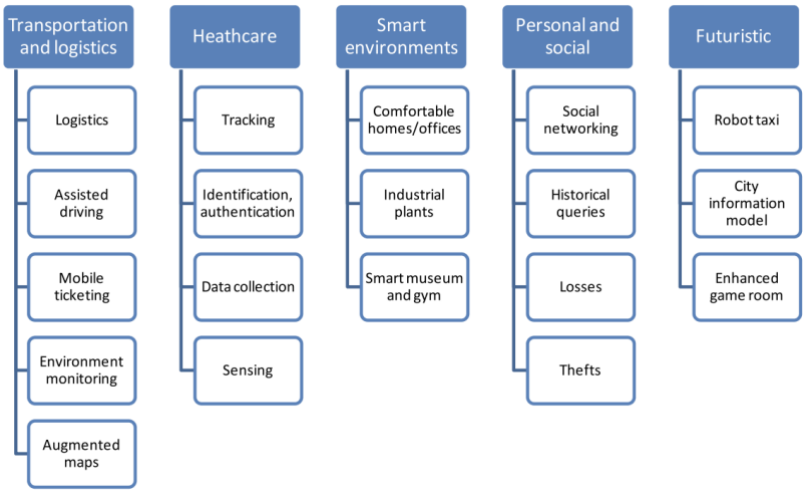

**Source:** Rompaey (2024)

**Figure 4.** Accessibility QR-code placed under a shelve of a fast-selling product

Multilingual support and localized content become essential features as digital labeling systems are implemented throughout the diverse EU market. Faisel et al. (2019) review of enterprise resource planning (ERP) systems offers important insights into the implementation of multilingual functionality and localization strategies in large-scale retail technologies, for example, options for easy language selection, the ability to dynamically adapt content based on the user's location, and the integration of automatic translation capabilities. More to that, localization goes beyond language support, it includes modifying product information, cultural allusions, and user interfaces to suit the particular tastes and demands of various EU markets. Retailers can develop digital labeling experiences that resonate with customers in their respective regions and build a stronger sense of familiarity and trust by attending to these localization needs.

Maintaining accurate and current product information can become another major challenge; consumer confidence and trust can be undermined by disparities between digital product details and physical labels, as shoppers demand accurate and timely information. Another good example of this challenge is a the health app Yuka, provided by Carrefour and reviewed by Rompaey (2021) in RetailDetail. Yuka opens the ability to scan barcodes to obtain a health score for food and personal hygiene items. Developers of this program want to improve consumer transparency by disclosing details about the ingredients, nutritional value, and allergies of over 1000 of their private-label products. This program guarantees consistent, automated, and up-to-date data sharing between consumer apps such as Yuka and brands. This allows brands to have more control over real-time information sharing.

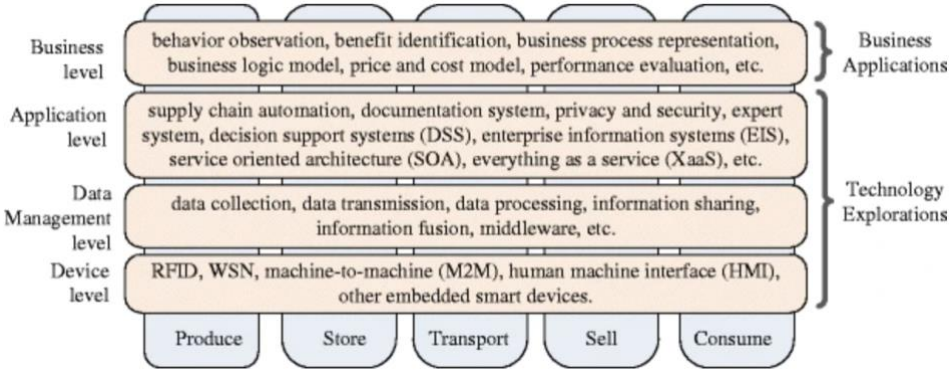
Digital labeling systems in the food retail sector face both opportunities and challenges from the integration of Internet of Things (IoT) technologies. In their groundbreaking paper, "The Internet of Things: A survey," which was published in Computer Networks, Atzori et al. (2010) gives a thorough rundown of IoT technologies and possible uses. They draw attention to the ways that IoT can facilitate real-time data collection and analysis, which can be used in different fields and industries (Figure 5.), which theoretically means it can be used in digital labelling too.




**Source:** Atzori et al. (2010)

**Figure 5.** Applications domains and relevant major scenarios.

Building on this framework, Pang et al. (2015) specifically look at the use of IoT in retail environments in their article " Value-centric design of the internet-of-things solution for food supply chain: Value creation, sensor portfolio and information fusion" published in the International Journal of Information Systems Frontiers. Provided by the same author exploration and application space of IoT is introduced in Figure 6.



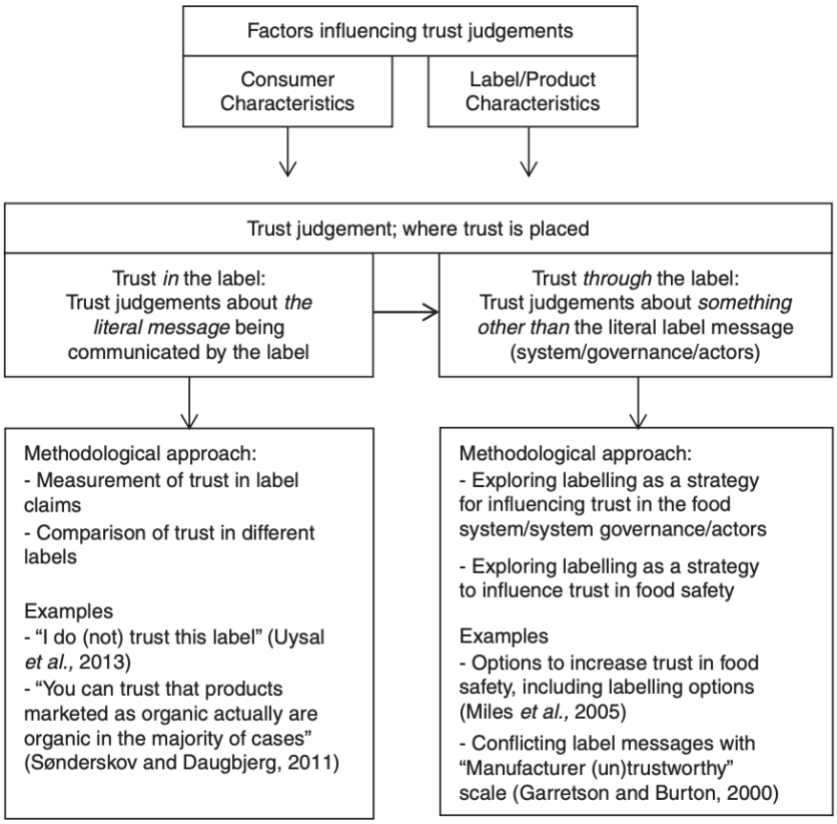

**Source:** Pang et al. (2015)

**Figure 6.** Exploration and application space of IoT

IoT sensors have the potential to automate the process of updating product information in the context of digital labeling; in some way, they can guarantee that digital labels consistently display the most recent data. However, the design of Internet of Things solutions for FSCs presents numerous technical difficulties. Low power design, energy harvesting, dependable communication, signal fading, worldwide data roaming, backend system integration, standardization, etc., are a few of them.

Among all the technical difficulties that will be adjusted by the rising technological industrialization, there is another issue of the legal and regulatory landscape. The General Data Protection Regulation (GDPR) has important ramifications for digital labeling systems that gather and handle customer data in the European context. Retailers need to make sure that their digital labeling systems adhere to the GDPR's requirements for data protection and consumer privacy (Politou et al., 2018).

More to say, the European Union's regulatory structure concerning food labeling, specifically *The European Banking Union* (2015) concerning the dissemination of food information to consumers, offers advantages and disadvantages for digital labeling solutions. The significance of consumer education in comprehending food labels is highlighted by Tonkin et al. (2015). In the same discussion, this author presents different factors that mainly influence consumers' trust and judgment referring to product labelling shown in the Figure 7.




**Source:** Tonkin et al. (2015)

**Figure 7.** A conceptualization of trust judgements made around food labelling

Enhancing consumer comprehension of nutritional information is possible with digital labeling systems, but they need to be created in accordance with current laws. Tse et al. (2017) discuss how new technologies like blockchain can help ensure the integrity and traceability of product information in digital labeling systems, potentially assisting in regulatory compliance.

Another area for innovation in the food retail industry is the integration of digital labeling systems with cutting-edge technologies like artificial intelligence (AI) and machine learning (ML) (Shankar, 2018). The author emphasizes a great potential of AI and ML implementation in the following fields:

- Understanding/Anticipating Omnichannel and Mobile Shopping Behavior
- Personalization and Recommendation Systems
- Sales/Customer Relationship Management
- In-store Customer Experience Management
- Customer Service and Payment Management
- Media Optimization
- Inventory Optimization
- Logistics, Transportation, and Delivery Management
- Store Cleaning and Layout Management

For instance, consumer interactive products with AI capabilities, might be able to identify trends in consumer behavior and modify product information displays to emphasize features that are most important to particular customer groups. Increased customer satisfaction and loyalty can result from this degree of personalization, according to Kumar et al. (2019).

On the other hand, there are ethical discussions about the use of such cutting-edge technologies overall. Transparency, responsibility, and fairness are three values that (Floridi et al., 2018) contend should guide the use of AI in consumer-facing. Retailers need to make sure that their AI solutions don't unintentionally target particular consumer groups or use unethical methods to influence their purchases.

Looking ahead, virtual try-ons, immersive product information, and even interactive cooking demonstrations could be accessed by customers by using digital labels as markers for augmented reality applications. There are a lot of exciting possibilities for integrating digital labeling with new technologies like virtual reality (VR) and augmented reality (AR). Dacko (2017) investigated how AR

technologies could change the shopping experience by superimposing digital information on real retail, discussing possible positive (Table 2) and negative (Table 3) aspects.

| Retail consequence | Agreement indicated, % |
|---|---|
| Happier with items purchased | 48.8% |
| More likely to purchase from the retailer | 41.2% |
| More likely to tell others about the retailer | 41.1% |
| More likely to visit the retailer | 39.0% |
| More satisfied with the retailer | 37.2% |
| More loyal to the retailer | 29.2% |
| None of the above | 4.6% |

**Source:** Dacko (2017)

**Table 2.** MAR shopping apps' effects on user's retail preference and future retail patronage intent, in order of most to least frequently indicated agreement (n = 965)

Increased likelihood of making a purchase, word-of-mouth, in-store visits, and retail customer satisfaction are among the retailer-specific benefits that accompany the increased purchase satisfaction that results from using mobile augmented reality (MAR) shopping apps. Although it is less evident than the other effects, increased retail loyalty is also mentioned.

| Negative or drawback aspects of MAR shopping apps | Agreement indicated, % |
|---|---|
| I have to give too much personal information | 31.4% |
| Not integrated enough with all my shopping | 27.8% |
| Not fast enough to use regularly | 26.9% |
| Not reliable enough to use regularly | 21.6% |
| Time consuming to learn | 20.1% |
| Difficult to use | 9.5% |
| None of the above | 17.3% |

**Source:** Dacko (2017)

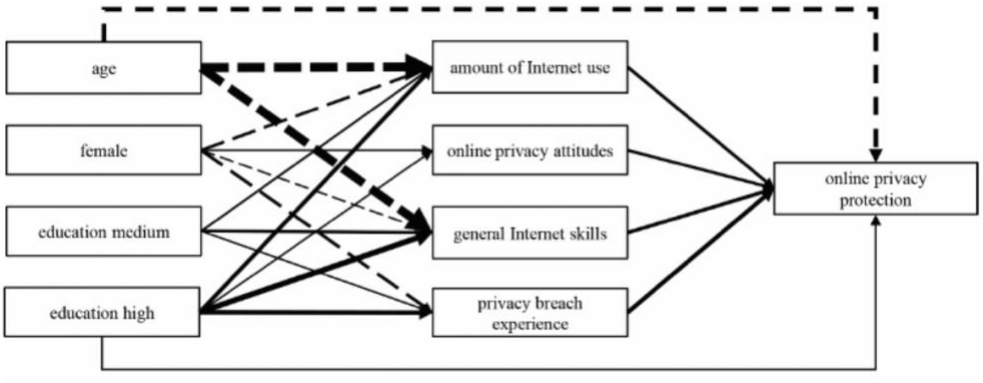
**Table 3.** User views on six possible negative or drawback aspects of MAR shopping apps, in order of most to least frequently indicated agreement (n = 965)

Although MAR shopping app users perceive numerous benefits from experiential shopping and that using these apps has multiple positive retail outcomes, it was anticipated that using these apps would have some disadvantages or limits on the user's ability to shop.

The results indicate that the requirement to give personal information to retailers is viewed as the primary negative, as expressed by 31.4% of MAR shopping app users, with other negatives being mentioned less frequently. Consumers are concerned about the sensitive information that is being collected, and according to Sicari et al. (2015), there is a big chance that the enormous volume of data that IoT devices and other apps gather will be abused internally and even more likely be vulnerable to breaches. However, 17.3% of users do not see any of the list's disadvantages or drawbacks. It is obvious

that there is room for wise retailers to pay even more attention to each of these areas in order to support better objectives and user experience evaluations.

Another area of concern regarding digital access and literacy is also brought up by the adoption of digital labeling systems. As noted by Büchi et al. (2021), there is a noticeable difference in digital skills and phone usage within the different demographic groups. It is highly important for retailers to guarantee that their digital solutions are easily navigable and accessible to all customers, irrespective of their level of digital literacy or technological proficiency. In Figure 8 (Büchi et al., 2021) ,we can see the digital proficiency level of the internet using different variables as follows: significant regression coefficients that are positive are indicated by solid lines, while those that are negative are indicated by dashed lines. The standardized regression estimate is used to scale line width, so thicker lines denote stronger effects. Although they were also modeled, covariances between the mediators and the exogenous variables are not displayed.




**Source:** Büchi et al., 2021

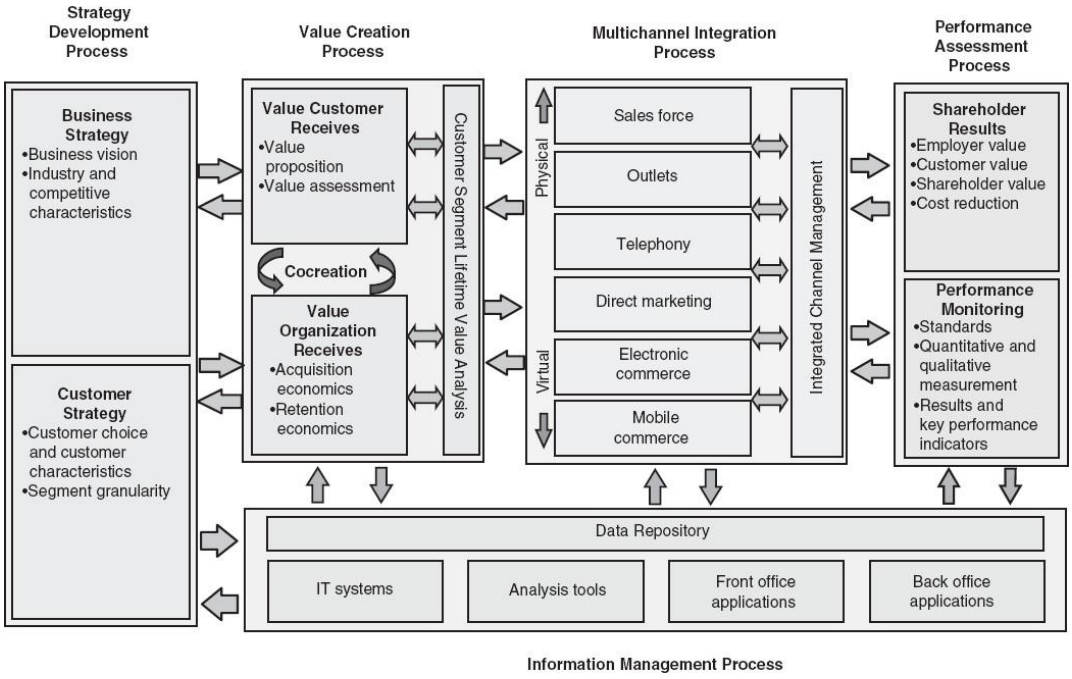
**Figure 8.** Path model

Not all customers have equal access to or familiarity with digital technologies, according to Helsper & Reisdorf (2017).For consumers who might have trouble using digital interfaces, retailers should think about offering alternatives or support.

***In conclusion,*** digital labeling in the EU food retail market has great potential to address many of the issues that the industry is currently facing. This is evident as we draw a close to our theoretical investigation of the topic. The food retail industry could undergo significant changes as a result of digitalization, one of which could be digital labeling. That could boost consumer trust and satisfaction, support sustainability goals, increase operational efficiency, etc.

### 1.4 Qualitative criteria for integration and entrepreneurial advantage

The idea of a smooth integration into current retail operations is fundamental to successful integration. It takes far more work to implement new technology into outdated systems than that. It necessitates a comprehensive strategy that takes into account the whole retail ecosystem. Payne & Frow (2005) highlight that a thorough comprehension of the intricacies of the retail environment as well as the technological aspects is necessary for the successful integration of new technologies in retailing. This knowledge is essential because digital labelling systems need to integrate with existing inventory software, Point of Sale (POS) systems, and management processes. In Figure 9, the authors stress the importance of a process-oriented, cross-functional approach that places customer relationship management (CRM) in a strategic context.




**Source:** Payne & Frow (2005)

**Figure 9.** A Conceptual Framework for CRM Strategy

Reviewing this conceptual framework, there are five main components:

1. *The strategy development process*, a thorough analysis of an organization's strategy and ends with improved business outcomes and increased share value, is depicted in this conceptual framework as an interactive set of strategic processes.
2. The strategy development process's outputs are transformed into programs that extract and deliver value through *the value creation process*. The process of creating value involves three main components: (1) identifying the value that the company can offer to its customers; (2)

identifying the value that the company can obtain from its customers; and (3) managing this value exchange, which entails a cocreation or coproduction process, to maximize the lifetime value of desirable customer segments.

3. In *the multichannel integration process*, choices are made regarding the best channel combinations to use, how to guarantee that customers have excellent experiences while interacting with those channels, and how to generate and display a single, cohesive view of the customer when they interact with multiple channels.
4. *The information management process* involves gathering, organizing, and utilizing customer data and information from all points of contact with the customer in order to produce customer insights and relevant marketing campaigns. The information management process comprises several essential components, including the data repository that serves as a corporate customer memory; IT systems that comprise the computer hardware, software, and middleware of the organization; analysis tools; and front and back office applications that facilitate various activities related to managing supplier relationships, internal operations, and customer interactions.
5. The crucial duty of ensuring that the organization's strategic goals for CRM are being met to a suitable and acceptable standard and that a foundation for future improvement is established is encompassed by *the performance assessment process*. This process can be divided into two primary parts: performance monitoring, which offers a more in-depth, micro view of metrics and key performance indicators, and shareholder results, which offer a macro view of the overall relationships that drive performance. (Payne & Frow, 2005)

Overall, customer experience, as well as an operational efficiency in the quickly changing retail landscape, can be greatly improved. According to Shankar et al. (2021), retailers who successfully incorporate digital solutions frequently observe increases in customer satisfaction, inventory accuracy, and overall profitability. In order for that to happen, they also suggest to categorize technology aligned with stakeholder type as follows:

- Customer-Facing/Shopper-Facing Technologies;
- Employee-Facing Technologies;
- Supplier-Facing Technologies. (Shankar et al., 2021)

The findings of Roy et al. (2017) study demonstrate that customers' appreciation of smart technology in retail establishments results in more positive attitudes toward these establishments, smart technology, and shopping experience overall.

A vital part of this process is the human element. Frontline staff members are crucial in technology-enabled service interactions (Nguyen & Ha, 2024). The importance of thorough staff training programs that cover more ground than just teaching the new system's technical aspects is highlighted. In addition to operating the technology, staff members need to be able to help customers use it effectively. Understanding the potential of digitalized solutions requires a lot of focus on technical proficiency and customer service skills. Instead of being seen as a one-time event, the training process should be taken as continuous work that can be improved and updated. Staff employees need to be kept up to date on new features and technological advancements so they can fully utilize the system.

The ability of retailers to more precisely target customers is becoming more valuable to suppliers as retail technologies advance in this area. As a result, suppliers who want access to specific customers can be paid more by retailers. For instance, suppliers who want to reach out to customers at the point of sale and provide an incentive to buy their brand may find a retailer with a sizable customer base and scan-and-go technology appealing. (Inman & Nikolova, 2017)

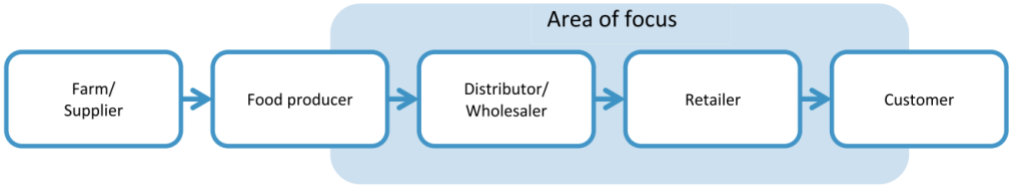
Throughout a successful implementation of those concepts, many entrepreneurial benefits can be received, like an oportunity for customization for example. As per Rust & Huang (2014) tailored marketing has the potential to greatly boost client loyalty and engagement. Which brings us to the digital solutions that could connect to consumers' smartphones to provide tailored product recommendations or promotions depending on dietary restrictions or previous purchase history. Potentially, digital labels could connect to consumers' smartphones to provide tailored product recommendations or promotions depending on dietary restrictions or previous purchase history.

Additionally, when gamification is implemented on a mobile platform, it can influence a number of significant retailing outcomes, including customer entertainment, accelerated repurchase, customer retention, and in-store engagement. Customers could participate in treasure hunts or educational games about product features thanks to interactive labels, which could lengthen store visits and increase sales. (Hofacker et al., 2016)

Digital labeling systems provide a number of other benefits for entrepreneurs; digitalization enables retailers to optimize their profitability by creating rapid and automated price adjustments based on variables like demand, inventory levels, and competitor pricing, per a study byFisher et al. (2017).

According to a *ReFED Report (2016*), a multi-stakeholder nonprofit organization dedicated to reducing food waste, improved inventory management systems, and creating new technological programs, one of which can be dynamic pricing models, be able to cut food waste in retail. This highlights the potential of digital solutions in addressing food waste.

A study by Buisman et al. (2019), which explores how dynamic pricing strategies made possible by electronic shelf labels reduces food waste in supermarkets, provides a more detailed reference to digital labeling and food waste. Although they don't give a precise percentage, they do stress that by promoting the purchase of soon-to-expire goods, such systems can greatly reduce waste. In the Figure 10. Main areas of focus is shown.




**Source:** Buisman et al. (2019)

**Figure 10.** Food waste area of focus in retail market

***To summarize,*** retail operations can have a great complatitive advantage by incorporating digital tools. Digital labels can revolutionize a number of areas of retail business by lowering operating costs, enabling dynamic pricing strategies to improving customer experience through personalization and gamification, customer interaction and data-driven decision making while providing answers to urgent world problems like food waste reduction.

However, the successful implementation, needs a well-calculated comprehensive strategy that takes into account both the human and technological aspects. Retailers also need to consider possible obstacles like upfront implementation costs, privacy issues with data, and the requirement for smooth integration with current systems.

The ones who can successfully use digital labeling technology stand to gain a substantial competitive edge. As a result, they are a useful tool for merchants looking to prosper in a market that is becoming more digital and customer-focused.

# QUALITATIVE CRITERIA FOR DIGITAL LABELING APPLICATION IN EU MARKET

The theory behind digital labeling systems and their possible effects on consumer behavior in the food retail sector was established in the previous chapter. This chapter expands on this understanding by exploring the qualitative standards and real-world implementation of digital labeling in the EU market. With big countries' diversity and unified regulatory framework, the EU offers a distinctive environment for the uptake of cutting-edge retail technologies. The goal of this chapter is to present a thorough analysis of the adoption of digital labeling in Sweden, France, and the Netherlands—three important EU member countries. These nations were chosen due to their varied market traits, technological preparedness, and differing degrees of adoption of digital labeling. We can learn a lot about the elements that affect successful implementation and potential obstacles by looking at these different markets.

According to Hagberg et al. (2016), the digitalization of retail is a complicated process that involves adjustments to many aspects of retail practice rather than just a technological change. The analysis will concentrate on a number of important areas, such as how digital labeling is currently being received by consumers, retailer adoption rates, and the effects on customer satisfaction and operational efficiency in each nation. This chapter will also examine the legal and regulatory environment in the EU that surrounds digital labeling because these elements are vital in determining how new retail technologies are implemented and adopted.

## 2.1 Analysis of digitalization implementation in Sweden

This subsection consentrates on the case studies of digital tools implementation in the Swedish retail, which are well known for its technological strength and early adoption of digital innovation all across the globe.

To understand the implementation of digital labeling in Sweden, it is important to first examine the country's retail landscape. The market shares are divided between 4 major retailers: ICA (50%), Axfood (21%), Coop (17%) and Lidl (6%). Detailed market segmentation among the biggest retailers and others can be seen in Figure 11. (*The Swedish Food Retail Market*, n.d., 2023). While ICA, Axfood, and Lidl are privately owned retail chains, Coop was created under Kooperativa Förbundet (KF), the national body of consumer co-creatives. In 2020, around 3,7 million buyers were members of this

initiative, with the total of a 800 stores, owned and operated by local consumer organizations or franchises (Grashuis & Hakelius, 2023a).


**Source:** The Swedish Food Retail Market, n.d., 2023

**Figure 11.** Food retail market segments 2022

Observing the price difference, appearing between private firms and consumer co-creatives, there is an 11% - 15% on average difference when talking about prices of store brands and name brands, making it cheaper for the customers to purchase at the "consumer operated store" (Grashuis & Hakelius, 2023a).

Moving forward to advanced retailing, Sweden was one of the earliest adopters of electronic shelf labelling (ESL), basing a company named "Pricer", leading in the Swedish market. ICA retailer chain is greatly equipped with ESL by Pricer in almost every store it runs. According to the information reported on the website, they have issued and represented around 110 million EL (Soutjis et al., 2017). A number of factors contributed to Sweden's ESL implementation's success:

- *Technical infrastructure:* The smooth integration of ESL systems into current retail operations was made possible by Sweden's strong digital infrastructure.
- *Consumers acceptance:* A well-implemented system, allowed consumers to notice little to no change in their purchasing process.
- *Operational efficiency:* The potential for cost savings and increased pricing accuracy.

Building on the successful ESL, retailers have started to adopt to a more autonomic procedures for a self-service customer experience, that can drastically transition the whole industry. Retail Business Services' CIO, Rom Kosla, has established specialized teams within his company to make sure that innovation is maintained throughout daily operations. One such group is known as the Propulsion Lab, and it is made up of seasoned engineers and system architects who collaborate with university interns to innovate around the newest technological trends.

According to Rom Kosla, making time for innovation produces outcomes. For instance, my employees were able to expedite the release of new technology as pilots because they had ample time to work with ESL, figure out how to power them, and stay up to date with accurate data (*Tio Hinder För It-Innovation – Och Hur Du Kommer Förbi Dem*, n.d.).

Originally, customer experience was limited and co-dependent on the in-store workers, putting a lot of pressure on employees, increasing their scope of responsibility, and decreasing the quality. Nowadays, with the introduction of self-service technologies (SST), the service systems give clients the opportunity to jointly design positive and memorable experiences that add value to the company's operations. Therefore, in accordance with value propositions, service systems enable and facilitate the successful realization of customer experiences (Hansen, 2019). Experience drivers generate the need for technological and organizational support, foster interpersonal relationships, and encourage information-seeking (Åkesson et al., 2014). In the same study, based on the research of consumers engaging with the self-service system in IKEA store, top five reported SSTs are the following:

- an online planner, a kitchen planner, and a guide for designing a new kitchen at home before going to the store;
- the website or app for creating shopping lists;
- information kiosks that let consumers search for information, plan, and calculate within the store;
- customers to scan their own items at the expedited checkout;
- stock availability checkers that can be used prior to a store visit.

Based on the statistics provided in the article (barkoder.com & EOOD, n.d.), between 2010 and 2016, the percentage of Swedish grocery stores that offered self-scanning and self-checkout technologies nearly doubled to 25%, reflecting the country's rapid adoption of these technologies. This pattern is indicative of a larger global movement toward increased consumer autonomy and retail automation. These systems give customers more flexibility and speedier checkout times, especially during peak hours, by enabling them to scan and pay for items without assistance from staff. Overall, the potential advantages of the technology for retailers, include lower operating costs and fewer staffing requirements, which would free up staff members for other customer service-related tasks.

Although previous research has frequently demonstrated that mobile phones play a minor role in shopping, recent surveys and studies indicate that they are increasingly being incorporated into regular shopping habits (Holmes et al., 2014). The percentage of Swedish consumers who have access to smartphones has increased from 36% in 2011 to 77% in 2015 (*ReFED_Report_2016.Pdf*, n.d.).

According to Taher et al. (2021), the majority of their research group was shopping with their phones in the Swedish supermarkets. Their observation witnessed that most of the time, buyers were comparing prices and checking available in-store offers, searching for a recipe on the browser, or simply entertaining themselves by talking with someone over the phone or listening to music. The same study analyses the use of in-store handheld scanners, which are used by 23.5% of shoppers mostly to control the price and set budget limitations.

So as highlighted by Fuentes et al. (2017), digitization is not a natural phenomenon. It is a procedure that must be carried out practically and materially. Retails capes should be viewed as performative relational spaces in addition to being functional service providers or locations of the production of cultural resources. They should be viewed as websites that are recreated in the context of shopping and retail.

Being a tech hub, Stockholm, the capital of Sweden, has embraced digitalization to the fullest extent possible; 70% of people shop online, cashless transactions are common, and taxes can be paid with a smartphone (Stafrén, n.d. 2016).

In the article (Så Lyfter Svenska Molntjänster Matbutiker – ”de Ligger Långt Fram”, n.d.) the topic of cloud integration is discussed. Pricer, Whywaste, and Visual Art, three Swedish suppliers, are working together to develop a joint store cloud. Digital signage, food waste reduction, and electronic shelf pricing are all combined in this integration. Among the received benefits they have:

- enhanced effectiveness in inventory control and pricing;
- notable decrease in food waste (possibly cut in half in a single store);
- improved consumer satisfaction with lucid digital displays;
- improved data analysis and store process optimization.

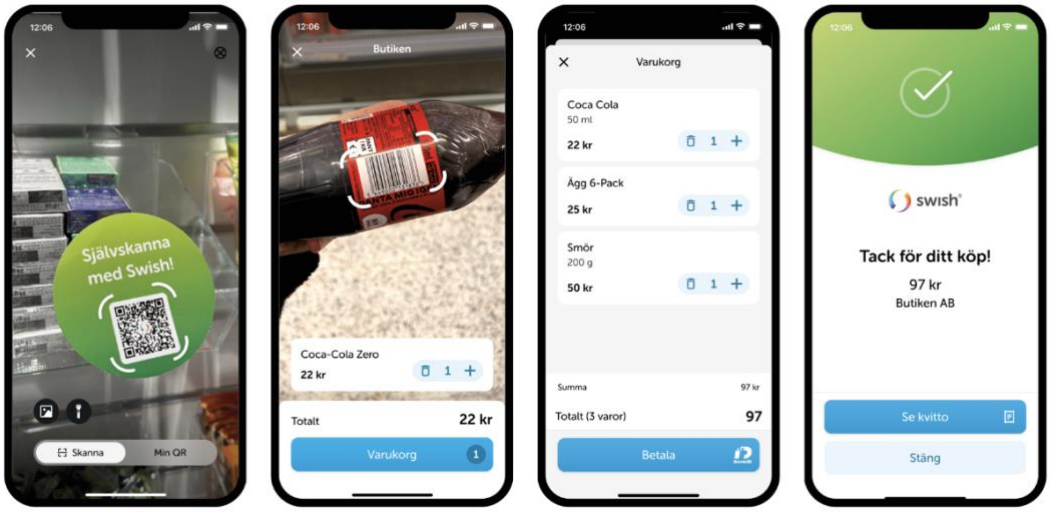
Having a strong working modem on their hands, they are looking ahead for a better solution to come, considering three main aspects for development: more advanced AI-driven forecast tools, better trend analysis and further automation and efficiency improvement.

Coming back to the digital labelling, a world-leading Swish, a fintech business from Sweden known for its new, revolutionizing way of conducting transactions, surprised the retail world by adding a new feature to its trusted brand. In-app upgrade allows users to purchase small amounts of items with no hassle from the lines to a cashier station, quick and easy, simply by scanning a barcode. As shown in Figure 12, in just 4 steps, you can arrange your grocery trip:

1. While entering a store, scan a store-owned QR-code;
2. Scan your belongings;

3. Review the shopping cart and use Swish to make the payment!
4. Access to the receipt available in the app. (*Swish - Självskanna Med Swish*, n.d.)

It is important to mention, that this self-scanning experience is only possible for a limited amount of stores, in-contracted with Swish, as well as the capacity of the app is narrowed to a few items-purchase. Giving this company a way to grow for the future development.




**Source:** Swish - Självskanna Med Swish, n.d.

**Figure 12.** A 4 step self-scan guide

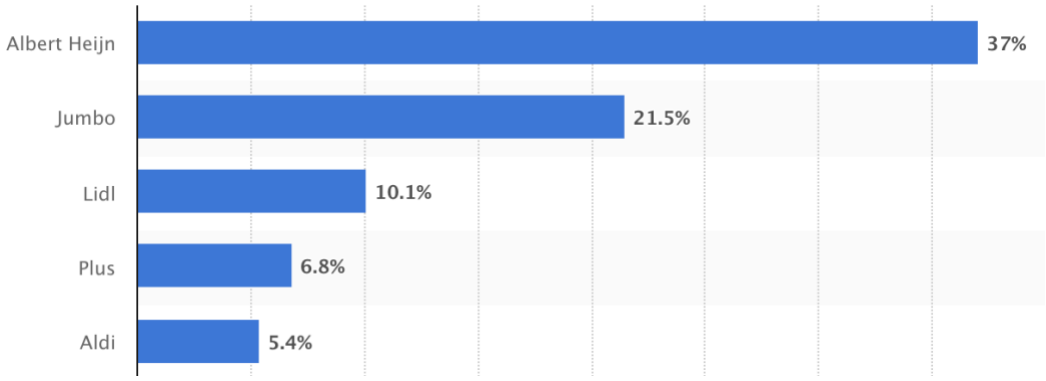
Another example of digitalization among the Swedish retail sphere shown by Swedish start-up Lifvs to create unmanned digital supermarkets and transform rural areas. Lifvs serves communities looking for easily accessible grocery options, with a total of 19 locations in isolated areas where traditional local shops have diminished. Those stores that can provide the service without the employees, at its' most is using artificial intelligence. Customers can enter, scan their purchases, and finish the transaction all online, promoting convenience in places that traditional retail frequently overlooks. The success of Lifvs is a great illustration of how technology can help rural communities overcome their problems while changing the retail environment to satisfy contemporary customer needs (Orange, 2020).

***In conclusion,*** with the three leading retailers—ICA, Axfood, and Coop—holding close to 90% of the market share, the Swedish food retail industry is considered mature. The grocery market is expected to grow at a rate of 4.99% between 2024 and 2029, with a potential market size of about $48.05 billion by that year. This prediction points to the sector's stability and possible growth (ADA Insights, 2024). The Swedish market is diverse in digitalization approaches and ways of running a business, concentrating on consumers' opinions, preferences, and comfort.

## 2.2 Analysis of digitalization implementation in Netherlands

The retail food industry in the Netherlands is very competitive and well-developed, with a strong focus on innovation and a high level of concentration. The report by Deloitte (2020), investigates retailers' dedication to innovation in digital transformation and sustainable practices for different types of industries, including retail, and their adaptability and resilience in the face of economic challenges. The results demonstrate how Dutch retailers are successfully positioning themselves in a cutthroat international market by progressively incorporating technology to improve customer experiences and optimize operations. Action Nederland BV became 6$^{th}$ in the growing rate with the compound annual growth rate (CAGR) of 29.6%, later in the list goes Ahold Delhaize (multinational retail and wholesale holding company) with CAGR of 14%.

In the figure 13 (*Netherlands*, n.d.), we can see the market share of biggest retail chains in Netherlands, where only three of them: Albert Heifin (part of Ahold Delhaize group), Jumbo and Plus (Dutch co-operative supermarket chain with 260 total stores in the country) are country based and created chains.




**Source:** Netherlands, n.d.

**Figure 13.** Market share of Top 5 supermarkets in Netherland for 2022

As compared in the previous subsection, it is important to analyze pricing for the goods for brand stores items and co-operative stores, to better understand market specifics. In the Netherlands, the firm and the consumer co-operative have less obvious pricing strategies. In six of the eleven categories, selected for the study of Grashuis and Hakelius (2023), the company offers store brands at lower prices. In one category, the consumer co-operative is less expensive, and at the 5% confidence level, there is no discernible difference between the remaining four categories. The consumer co-operative's name brands cost roughly 5% more than other brands in the market basket. Since the consumer co-operative is only

2% less expensive on average, greater parity is seen on the name brand side. However, the company's prices are not substantially different in four of the eleven categories, and it is substantially less expensive in two of them.

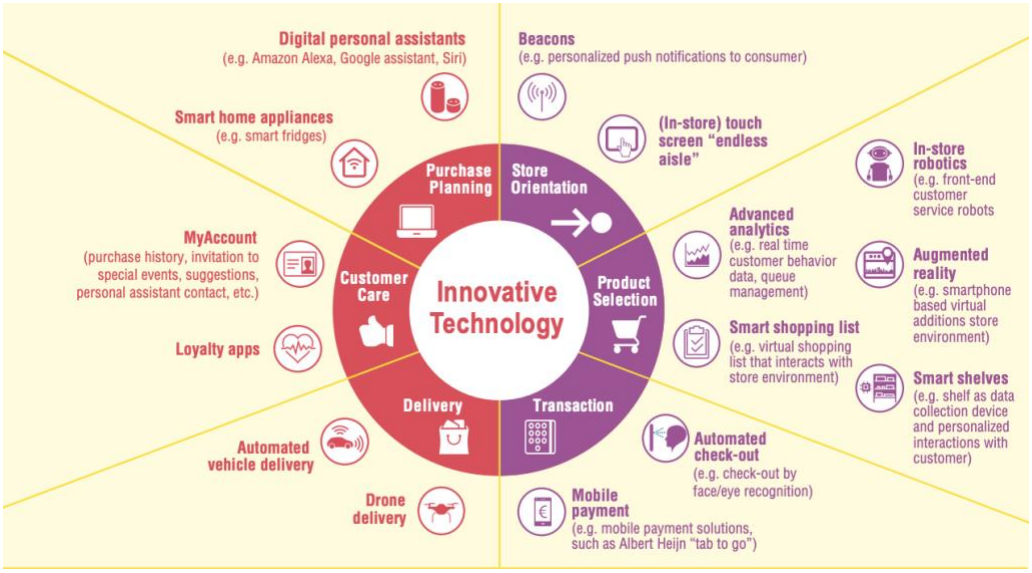
In contrast to consumer co-operatives, businesses in the Netherlands are not only refraining from monopolistic pricing practices but are also competing at lower price points, meaning they are constantly looking for a way to put themselves as a market lead in other spheres, including sustainability and digitalization. Combining the beneficial effects of competition on innovation and innovation on productivity implies that competition has an indirect effect on productivity growth through innovation. In the long run, competition's initial impact on productivity is more pronounced since it fosters innovation (Creusen et al., 2008). The research also finds out that businesses with a larger market share in the Dutch retail industry invest comparatively more in innovation than do businesses with a smaller market share.

The Netherlands, along with the United Kingdom, Denmark, Switzerland, Germany, and Sweden, became an online seller with one of the highest proportions of online shoppers, regardless of age, in 2021, which, in long-term dynamics also means the higher level of innovation (Roszko-Wójtowicz et al., 2024). Proving a point, in the Ahold Delhaize Annual Report (2020), it was conducted that the company received 57.4% increase in net consumer online sales compared with 2019.

The same report suggests the importance of enhancement of customer relations, building better leading local food value. List of values includes:

- Providing inspiring, healthy, and affordable food options for all;
- Creating a seamless digitally enabled experience;
- Making shopping easier for everyone;
- Personalizing shopping through tech-enabled loyalty programs;
- Increasing standards for product integrity;
- Attracting, developing, and retaining the best talent to serve customers;
- Saving for customers;
- Data privacy.

Utilizing cutting-edge technologies will become more crucial for gathering data in an offline setting and for enhancing the in-store experiences of customers. Full-service grocery stores will have to make sure that their future locations are "smart" and capable of assisting customers with every step of the buying process. Figure 14 illustrates technologies that are affecting and reshaping current Dutch retail market (Berger, 2019).




**Source:** Berger, 2019

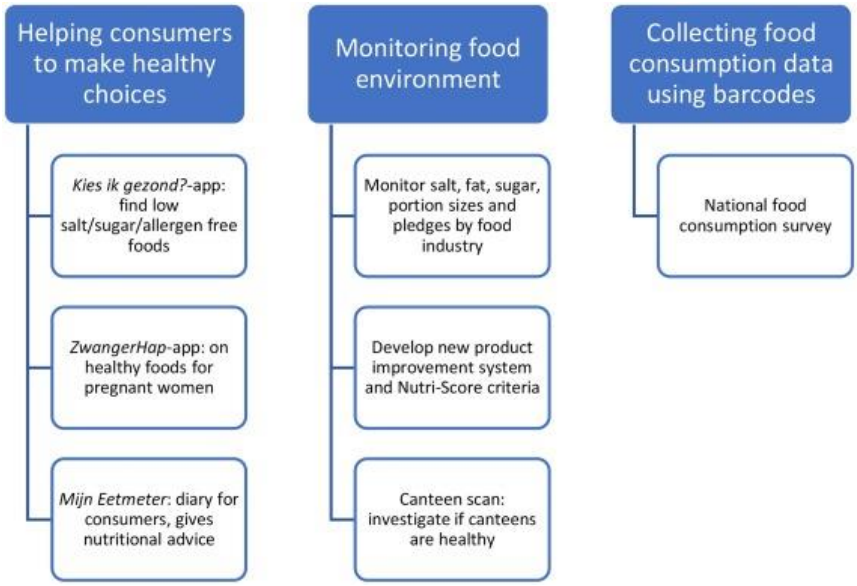
**Figure 14.** Innovative technologies impacting the grocery sector

Speaking of an introduced digitalized solution, Dirk, a retail chain, created a system that entails spending less time in line and bringing your groceries home sooner. One convenient tool they use that lets you scan items as you browse the store is a handheld scanner (see Figure 15). You can pick up a handheld scanner at the entrance before entering through the gates. This makes it simple to scan product barcodes while you are shopping, as it displays the total cost and the number of products you have already scanned. At the checkout, you can scan the barcode above the cash. This allows you to pay by transferring the data from the handheld scanner to the register (*Scan&Go*, n.d.).


**Source:** Scan&Go, n.d.

**Figure 15.** Illustration of handheld product scanner for Scan&Go

Related to the topic of digital labelling, it is important to mention that since 2007, the LEDA (short for LEvensmiddelenDAtabank = food databank) database in the Netherlands has gathered food label data for about 100,000 branded foods. Every day, data is uploaded from five main providers. The Netherlands Nutrition Centre uses label data for consumer education, and the National Institute for Public Health and the Environment uses it for research to help shape policy (Figure 16). Approximately 75% of the Dutch retail food market is covered by the database. Using mobile apps or website data scraping, initiatives like Open FoodFacts, FoodRepo, FoodSwitch, QuestionMark, and foodDB gather branded data through crowd-sourcing and make it accessible online for consumer information or research (Westenbrink et al., 2021).




**Source:** Westenbrink et al., 2021

**Figure 16.** Current use cases with branded food data in LEDA.

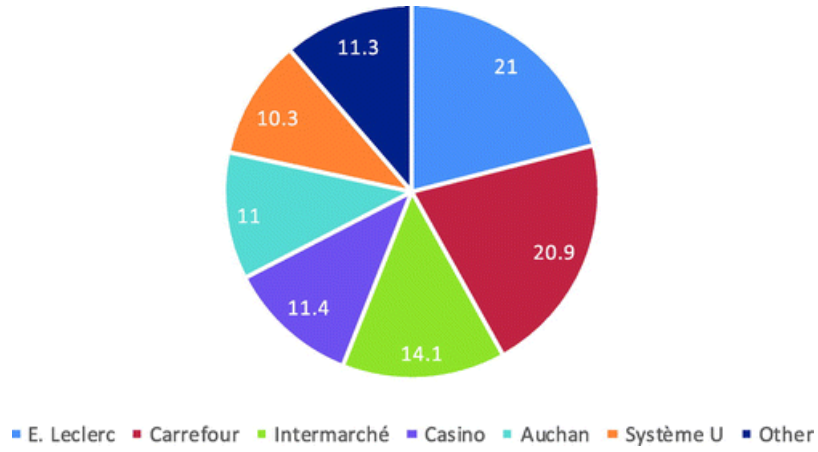
***In general,*** the Netherlands is clearly at the forefront of digital innovation in retail, constantly working to improve customer relations, data privacy, and overall shopping experiences, even though the amount of information available may be more limited given the size of the nation. Starting from 2019, during the pandemic, local retailers have shown remarkable forward-thinking strategies in the face of economic challenges and the rapid shift to online shopping. It puts Dutch retailers in a strong position in the cutthroat global market and establishes a standard for digital integration in the retail food sector.

## 2.3 Analysis of digitalization implementation in France

One of the biggest economies in Europe, the distinctive fusion of contemporary supermarket chains and traditional markets defines France's retail food sector. In recent years, the industry has undergone rapid change as a result of shifting consumer preferences and advances in technology. Supermarkets, hypermarkets, and convenience stores make up the French retail scene, which is increasingly focused on digital transformation to adapt to shifting consumer needs.

82% of French consumers purchase locally produced food items, and 59% do so at least once a week. Supermarkets continue to be the primary location for purchasing local goods, but markets, convenience stores, and specialty shops are also very well-liked. Previously underutilized digital channels are now being used by more consumers to purchase local goods. Local food shopping experiences were disrupted by the implementation of containment periods (in France, as in most other countries), leading to a significant uptake of pickup stores and home delivery (Michaud-Trévinal et al., 2022).

To that comes French retail which is extremely concentrated, whereas small, independent retailers continue to dominate the market in other EU counties like Italy. With 20% of the market each, Carrefour and E. Leclerc are the two retailers that dominate the market in 2017. Nearly 90% of all food sales in France are made by the six biggest retailers, as shown in Figure 17 (Dewitte et al., 2018).




**Source:** Dewitte et al., 2018

**Figure 17.** Market Shares of Major French Retailers

E. Leclerc is a co-operative supermarket chain that is proud of its uniqueness. The organization brings together more than 600 independent store owners and business owners who share similar values and collaborate to create their own success (Osaxis, n.d.). At the same time, Carrefour is pioneering in the large food retail business, having their origin from France; nowadays they have 14,000

stores in more than 40 countries, 5,274 of which are in the homeland (Group | Carrefour Group, n.d.). You can easily notice that all of the leading supermarkets are locally based and created.

In the study of shopping patterns, Recchia et al. (2024) concluded that the majority of households (49%) shopped at supermarkets as they were less likely to reside close to a convenience store. Another bug percentage of households (18%) were more likely to have a market in their activity space and shopped primarily at organic stores, markets, specialty shops, and producers. 12% of households were less likely to see a producer in their activity space and mostly shopped at discount stores. Another 12% of households shopped at convenience stores or online. Lastly, go households (9%) were more likely to live close to a specialty food store and spent a lot of money at greengrocers and other specialty food stores.

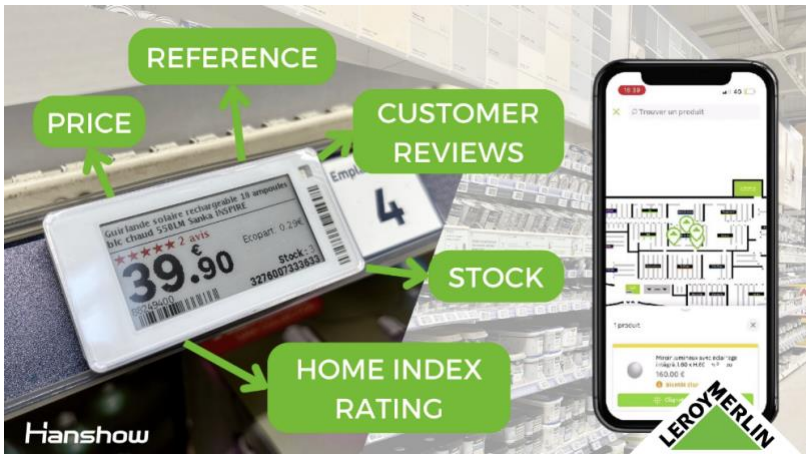
Discovering a topic of price change for consumers in food retail, Léonard et al. (2019) analyzed data from barcode information sent to the French National Statistical Institute (Insee) which essentially aims to determine changes in price levels over time. Geographically, the findings show clear regional trends: a sizable central-west region of France has price levels that are roughly 3% lower than those in Île-de-France; a category that comprises the more rural parts of central France, northern France, and Aquitaine, where industrial food prices are typically 2% lower than those in Île-de-France; and the more industrial and urban parts of eastern and southern France have food price levels that are 1% lower than those in Île-de-France. Last but not least, Corsica costs 2% more than the Île-de-France region.

E-commerce has grown significantly in France, albeit more slowly than in some other European nations. A study estimates that France's e-commerce market was worth €112 billion in 2020, ranking second in Europe after the UK (“European E-Commerce Report 2021,” n.d.). This growth was accelerated by the COVID-19 pandemic; in 2020, online sales increased by 8.5% over the year before. French retailers have been making significant investments in digital transformation to compete with Amazon and other e-commerce giants and adapt to shifting consumer demands. Many demographic groups, including suburban and rural households, now engage in e-commerce (Rothweiler, n.d.). With pickup points (PP) making up around 71% of package deliveries, this has resulted in a notable demand for dedicated delivery services (*France*, n.d.).

However, the adoption of e-commerce did not perform without challenges. Sun (2011) points out the issue of trust coming from an absence of face-to-face interactions and the inability of customers to thoroughly inspect goods and services before making a purchase. When asked why they had never made an online purchase, 31.5% of French non-users cited "distrust in the Internet" as the primary explanation.

Many French retailers have looked to ESL as a way to close the gap between online and offline experiences. ESLs are digital displays that take the place of conventional paper price tags, improving accuracy and enabling real-time price updates. As an example, Leroy Merlin, a French DIY company known worldwide, decided to enhance operational efficiency, liberating employee productivity, aiming to provide customers with superior service. Customers frequently need to speak with store employees in-store and give thorough explanations of their problems and situations because of the peculiarities of the do-it-yourself industry. Associates frequently have to help customers with product-related issues after offering solutions. Together with comparatively high labor costs, this process takes up a significant portion of associates' daily working hours and lowers the store's overall operational efficiency. To solve those issues, Hanshow's ESL solutions were installed in 144 stores in France (*Hanshow*, n.d. 2024). Key features include:

- *Stock-to-Light:* This feature improves product placement accuracy by using a flashing light to guide associates to the appropriate product location on the shelf.
- *Improving Customer Navigation:* In-store geolocation is made possible by Hanshow's ESL solution (Stellar Pro) and the Leroy Merlin mobile app, which enhances the shopping experience by offering individualized assistance.
- *User Experience Improvement:* Provides access to the Home Index for evaluating the impact of products, adds customer reviews and thorough product descriptions, and keeps prices consistent both online and offline.
- *Retail Efficiency:* By reducing salesperson pickup times and removing price disparities, better inventory control and order preparation raise customer satisfaction (Figure 18).




**Source:** Hanshow, n.d. 2024

**Figure 18.** Real life example of installed Hanshow's ESL solution

France also did not miss a chance in implementing a new trend of sufficient and convenient for customer self-checkout stations. The percentage of hypermarkets with self-service checkouts rose from 81% in 2018 to 88% in 2021. This comprises 95% of Hyper U's, 92% of Carrefour's, and 99% of Auchan's hypermarkets. At the same time, there are some who prefer a slower process with an engaging component, so hypermarkets found a compromise solution to this: installing both self-service and cashier-involved stations for buyers to choose from (Green Seed Group, 2022).

Similar to self-checkout, French shoppers are empowered by Click&Collect. Customers can purchase goods online and pick them up in person at a store or other designated pickup location by using the Click&Collect option. This strategy has become very popular with consumers: Click&Collect improves customer satisfaction by providing quicker fulfillment and economical options for merchants. From the standpoint of the retailer, this service is more cost-effective than home delivery because it allows for improved inventory management, minimizes delivery points, and lowers fuel expenses (*JLL*, 2018).

More to that, French retailers are pushing the boundaries of retail innovation beyond click-and-collect services. Casino Group's "Le 4 Casino," a Parisian concept store that skillfully combines traditional retail with digital technology. This cutting-edge store provides a carefully chosen assortment of organic goods, gourmet foods, and unique items in addition to digital services that allow for 24/7 shopping without the need for physical checkouts. Modern technology like augmented reality screens and a "Picking Wall" that lets customers place orders from Casino's online store for same-day delivery are features of the store. "Le 4 Casino" also connects e-commerce and physical retail by combining a C-discount showroom with a co-working space (Casino Groupe, 2018). The French retail industry's efforts to develop immersive, technologically advanced shopping experiences that satisfy changing consumer tastes while preserving the personalized touch that French consumers cherish are best represented by this concept store.

At the same time, The General Directorate for Enterprises does not forget and does not keep SMEs aside from the inovation. The study was conducted to measure the progress minor businesses made over the years, which shows:

- With the exception of social networks, 66% of the businesses polled have a website that showcases their operations (prior to the COVID crisis, this percentage was 37);
- 43% of employees have access to an online platform for exchanging documents (prior to the pandemic, they were 17%;
- 29% of them use paid online referencing (before that, they were 15%;

- 33% use professional collaboration tools (before they were 21%;
- 20% of them had their own website for online sales.
- However, when using digital technology, 44% of businesses say they are worried about losing or having their data compromised (previously this amount was 36%) (France Num, n.d. 2021).

***To conclude,*** French retail marks a dramatic change due to its historical background that emphasizes custom and individualized attention. French retailers are adopting digitalized tools to meet consumer demands, that has formed an expansion of e-commerce and use of in-store technologies like scan-and-go systems and ESLs. It's obvious that the most prosperous French retailers in the future will be those who can successfully combine digital innovation with the nation's long history of retailing. French retail has the potential to develop distinctive and captivating shopping experiences that combine the best of both worlds by utilizing technology to complement rather than replace traditional strengths.

## 2.4 The legal regulation aspect of digital labelling in EU

This subsection analyses the legal framework that can both support and pressure innovative digital labelling innovation that was presented in the earlier sections. Existing legislations practiced in the EU are rather limited due to the quick changes in the business, making it nearly to impossible to constantly update the framework to a current scene. More to that, a digitalized barcode system could potentially open many doors for businesses that aim for transparency, sustainability, and consumer empowerment, they would represent a drastic shift in how product information is expressed to customers. It is important to mention that to guarantee its' efficient and moral application, this technological breakthrough calls for a strong legal framework. As known, EU's approach has been known for its' gradual evolution, so there will be no place for just a single, all-covering directive. The difficulties of regulating a quickly developing technological field while adhering to accepted consumer protection principles are reflected in this steady development.

Regulation (EU) No 1169/2011 on the provision of food information to consumers largely governs the legal framework for food labelling in the EU (*The European Banking Union*, 2015b). Its main goals are to guarantee consumers' right to information and the free flow of legally produced and marketed foods throughout the European Union (Żakowska-Biemans et al., 2019).

Among the main clauses of Regulation (EU) No 1169/2011 are:

1. Name and address of the food business operator, country of origin for specific foods, instructions for use, alcoholic strength for beverages with more than 1.2% alcohol, net quantity, date of minimum durability or "use by" date, storage conditions.
2. The rule stipulates that required information must be easily readable, indelible, and have a minimum font size.
3. Allergens should be clearly highlighted in the list of ingredients.
4. Pre-packaged food should have energy and nutrition value on the label such as fats, saturated fats, carbohydrates, sugars, protein, and salt displayed (*The European Banking Union*, 2015b).

In addition to that any claim made on a food's label, presentation, or advertising in the EU must be accurate, clear, and supported by scientific evidence, according to Regulation (EC) No 1924/2006 on nutrition and health claims made on foods (Hieke et al., 2016).

Regulation (EC) No 178/2002, which establishes the fundamental rules and specifications of food law, is one of the regulations that assure the safety of information on food labels. The European Food Safety Authority (EFSA) and protocols for food safety issues are established by this regulation (Frewer et al., 2016). The law stipulates that food labelling, advertising, and presentation must not deceive consumers, especially regarding the food's nature, identity, properties, composition, quantity, durability, origin or provenance, or manufacturing or production method.

Several additional legislative domains are relevant when contemplating the implementation of digital labelling in food retail, which cover:

- E-commerce and distance selling;
- Data protection;
- Accessibility;
- Unfair Commercial Practices;

Particular guidelines for distance contracts, including those made electronically, are provided by Directive 2011/83/EU on consumer rights. Before making a purchase, consumers are guaranteed to receive crucial information, such as the primary features of the products or services, thanks to this directive. This would require that, in the case of digital food labelling, consumers have access to all required information that is normally found on physical labels before the distance contract's expiration (Dumortier, 2022).

Digital labelling systems that gather or handle personal data are significantly impacted by the GDPR (EU) 2016/679. For example, a digital labelling solution must adhere to GDPR principles,

which include data minimization, purpose limitation, and the need for explicit consent for processing sensitive health data, if it uses consumer data to provide personalized nutrition information or allergen alerts (Paul Voigt, n.d. 2016).

The European Accessibility Act (Directive (EU) 2019/882) on the accessibility requirements for products and services, attempts to make goods and services more accessible to people with disabilities (Harris, n.d.). This requirement may affect digital labelling solutions towards the development of a users-friendly experience for consumers with cognitive and visual impairments. Entrepreneurs that would apply digitalized labeling would have included features like text-to-speech capabilities, font size adjustments, and high contrast options.

Big impact is also coming from Directive 2005/29/EC, which addresses unfair business-to-consumer commercial practices in the internal market. In commercial communications, including digital ones, this directive forbids deceptive acts and omissions. This would entail making sure that all digitally supplied information is correct, comprehensive, and not displayed in a way that might deceive customers in the context of digital food labelling (Trzaskowski, 2018).

If digital labelling systems use any kind of electronic seals or signatures to verify the authenticity or integrity of the digital data, Regulation (EU) No 910/2014 on electronic identification and trust services for electronic transactions in the internal market (eIDAS Regulation) may be pertinent (Cuijpers & Schroers, 2014). This may be especially crucial for guaranteeing the reliability of digital labels, particularly for goods bearing protected geographical indications or protected designations of origin.

What is more, there are a few recently developed policies that would contribute to legitimizing and improving future innovation:

1. The goal of the Farm to Fork Strategy, which is a component of the European Green Deal, is to create food systems that are equitable, wholesome, and ecologically sustainable. Plans to develop a sustainable food labelling framework and standardize required front-of-pack nutrition labelling are included (Schebesta & Candel, 2020). By giving customers access to more thorough and readily updated information, digital labelling may be essential to accomplishing these goals.
2. Adopted in 2020, the Circular Economy Action Plan seeks to standardize sustainable products throughout the European Union, like the initiatives for digital product passports and a shared European dataspace for intelligent circular applications are among them (Neligan et al., 2023).

3. Artificial Intelligence Act (proposed): Digital labelling systems that use AI to personalize information or make recommendations based on customer data may be impacted by the proposed regulation on artificial intelligence. These systems would have to adhere to the proposal's risk-based approach and transparency standards (Veale & Borgesius, 2021).
4. The recently enacted Digital Services Act and Digital Markets Act were created to make the internet a safer and more accessible place (Larouche & de Streel, 2021). They primarily focus on online platforms which are an indispensable part in scanning digital labels connected to mobile applications or e-commerce platforms.

***In conclusion,*** the move to digital labelling requires careful consideration of several legal areas, even though the current EU legislative framework offers a strong foundation for food labelling. A comprehensive strategy that will cover fields from e-commerce, data protection, artificial intelligence and accessibility will be required in order for digitalized solutions to be legally accepted in the market. New laws that specifically address the opportunities and difficulties posed by digital food labelling are probably going to be created as the EU develops its sustainability and digital strategies.

# QUALITATIVE CRITERIA FOR DIGITAL LABELING EVALUATION OF APLICATION POSSIBILITIES

## 3.1 Research methodology

**Issue of the research.** Digital labelling in food retail offers a ground-breaking chance to revolutionize the management and communication of product information. Nevertheless, little is known about how the idea is being applied and how it affects consumer behaviour and corporate operations in the EU market. By investigating the potential of digital labelling systems to improve consumer experience and operational efficiency in food retail, this study seeks to close this gap.

**The object of the research.** The implementation and effect of digital labelling system in the EU food retail sector, with an emphasis on business and consumer acceptance.

**Goal of the research.** To evaluate, from a business and consumer standpoint, the viability and possible advantages of introducing a digital labelling system in EU food retail to further develop a business model.

**Tasks of the research:**

- To assess consumer acceptance and preparedness for digital labelling systems in the retail food industry.
- To evaluate food retail companies' readiness and ability to implement digital labelling technologies.
- To determine the possible obstacles and facilitators to the EU market's adoption of digital labelling.
- To examine how digital labelling affects customer behaviour and corporate operations.

**The research method.** A mixed-methods approach will be used in this study, combining quantitative and qualitative data collection methods. There will be two phases to the research:

1. Consumer Survey: To understand about digitalized experience, satisfaction level, brand recognition, preferences in quantitative online survey will be conducted for consumers in the EU food retail scene.
2. Business Interview: To determine the preparedness, difficulties, and perceived advantages of deploying digital labelling systems, concentrating on mostly qualitative data, a thorough interview or questionnaire form of food retail companies in the EU will be carried out.

The consumer survey has an introduction part for participants to familiarize with the topic of the research as well as its final goal, questions were designed to be objective and short. To make the analysis simple, a combination of closed-ended and Likert scale questions were used. The survey was designed to follow a logical flow as it moved from broad to more focused subjects. In order to prevent invalid data demographic questions were added at the end. To find and address any possible problems or potential issues, the survey was pilot tested before being distributed.

As well as consumer survey, business interview has an introduction part in the questionnaire form and specific instructions for a few questions in the list to ensure a better understanding and collect more accurate responses. The aim for this is to gather insights on digitalized labelling and their thoughts on the topic. Submitted answers should be considered as a personal opinion and expertise.

### 3.1.1 Organisation of the consumer-oriented research

The study's consumer-focused section used a quantitative research approach to collect information from a sizable sample of EU consumers about their opinions and experiences with digital grocery shopping tools. When gathering numerical data from a large population in order to spot trends and draw generalizations, quantitative research is especially helpful (Creswell, 2014).

An online survey served as the main instrument for gathering data for this study. The purpose of the survey was to gather information on how customers used digital grocery shopping tools and how they felt about the digitalization of retail.

The survey was carried out between December 1st and December 15th 2024, for a total of two weeks. The survey was extensively disseminated via a variety of online platforms, such as consumer forums and social media sites, in order to guarantee a large enough sample size for significant statistical analysis. Adult EU citizens with prior grocery shopping experience made up the target population. There were 103 responses in all. The final sample size used for analysis was 98 after data cleaning eliminated responses from respondents outside the EU and incomplete responses.

The survey consists of 15 questions: one Linkert-scale question and close-ended questions. The logic of those questions is structured in a total of 4 sections, which all serve a specific task:

1. Demographic Profile;
2. Shopping Habits;
3. Attitudes;
4. Brand Recognition and Future Adoption.

**In the first section,** demographic information is collected. A total of 4 questions were addressed to gain basic information about respondents age range, gender, country of residence and phone usage literacy. The purpose of questions in this section was to create a strong demographic profile between groups.

**In the second section,** consumers current shopping habits and engagement with digital tools are researched. A total of 6 questions addressing frequency of store visits, usage of grocery store mobile app, most frequent in-store mobile features that are used, usage of other in-store digital tools and membership for digital loyalty programs.

**In the third section,** a 5-point Linkert scale model has been used. It explores feelings and perceptions on the following statements:

1. "I am comfortable using in-store digital tools";
2. "Digital tools simplify my shopping experience";
3. "I am saving money while using digital tools";
4. "I would prefer a digitalized experience over traditional shopping";
5. "If more digitalized tools appear, I would most likely use them";
6. "Access to digitalized product information is important for me";
7. "I am comfortable sharing personal data with retail brands for a more personalized shopping experience".

This section follows up with a question about data privacy to confirm what data is acceptable for participants to share (f. e. purchase history, location, dietary preferences etc.).

**In the fourth section,** consists of 3 mandatory and 1 optional question that are oriented for analysing brand recognition and readiness for accepting new technology.

### 3.1.2 Organisation of the business-oriented research

Large sample sizes are frequently needed for quantitative research, but smaller, carefully chosen samples can still provide insightful information for qualitative research. The research phenomenon, strategy, informativeness of the data, and method of collection all influence the sample size in qualitative research (Malterud et al., 2016). As pointed out by Bigham et al. (2012) it is uncertain to answer the question of "how many respondents is needed in order to provide a qualitative research". The answer would be "It depends" as every research is individual and vary by the methodological questions, objectives, questions complexity etc. In the case of this thesis, ten experts were selected to take part in the business-oriented research.

Experts were chosen based on their expertise in retail digitalization, specifically targeting individuals in management or strategic roles within food retail companies across the EU. This purposive sampling method is widely used in qualitative research to ensure participants possess the necessary knowledge and experience (Etikan et al., 2016). Potential participants were identified through industry networks and professional platforms. Once suitable experts were selected, they were approached individually and provided with a detailed explanation of the research objective and purpose: to gain insights into the business perspective on retail digitalization, with a particular focus on digital labeling systems and their effects on operational processes and customer experience.

The survey took place over the period from December 1st, 2024 to December 15th, 2024. To address potential non-responses, the questionnaire was distributed to 25 experts. As expected, 13 of them did not provide any response and 3 has provided insufficient data without complementing most of the questions, so they were expelled from final data analysis. Overall, we have conducted 10 successful responses from experts that will be further analysed and studied.

The questionnaire comprised nine questions: one Likert scale question, one multiple-choice question, and seven open-ended questions.

**In the first question** (Linkert scale), participants were asked to evaluate four statements related to the qualitative dimensions of retail digitalization, in particular, enhancing customer experience, improving operational efficiency, maintaining competitiveness, and optimizing inventory management.

**In the second question**, participants were invited to articulate, in their own words, their perspectives on the quality of digitalization within the retail sector.

**In the third question** (closed question), participants were asked to mark the three most important factors evaluating the quality of digital solutions in retail or write an additional one.

**In the fourth question,** participants were asked to name specific features or functionalities that they believe are essential for high-quality digital solutions in retail.

**In the fifth question,** participants were asked to name the main challenges or problems they face in developing and implementing digital solutions in their retail operations.

**In the sixth question,** participants were asked to provide solutions that based on their opinion will be able to solve those problems that they have stated in the previous question.

**In the seventh question,** participants were asked to provide an example of a retailer (worldwide) that they believe demonstrates high-quality implementation of digital technologies as well as elaborate on their decision.

**In the eighth question,** participants were asked to provide an example of a retailer in their country that they believe demonstrates high-quality implementation of digital technologies as well as elaborate their decision.

**In the ninth question,** participants were asked to envision the future of digitalization in retail over the next 5-10 years and evaluate the level of impact it might bring.

The questionnaire was sent over an e-mail and via the LinkedIn chat with the basic description of the project and explanation of tasks and eventual value from filling in this form.

### 3.1.3 Characteristics of experts survey respondents

Since the goal of this research is to evaluate food retail companies' readiness, ability to implement digital labelling technologies and to determine the possible obstacles and facilitators to the EU market's adoption, experts were chosen from a different field, activity level, country and position.

Experts, performing in this survey include:

- Expert A – Training and Development Specialist. Field of activity – retail staff education.
- Expert B – Store Manager. Field of activity – supermarket.
- Expert C – Customer Service Manager. Field of activity – hypermarket.
- Expert D – Operations Supervisors. Field of activity – convenience store chain.
- Expert E – Marketing Manager. Field of activity – eco-friendly retail solutions.
- Expert F – Store Manager. Field of activity – candy store.
- Expert G – Business Owner. Field of activity – small retail store in rural area.
- Expert H – District Manager. Field of activity – grocery retail.
- Expert I – Assistant Manager for Retail Audit. Field of activity – hypermarket.
- Expert J – IT Manager. Field of activity – convenience store chain.

## 3.2 Data analysis

This section provides a framework for understanding the research findings. These results are then presented in the following two subsequent sections: Consumer data analysis and Business data analysis. Combining both quantitative and qualitative data to provide an insightful understanding of

consumer attitudes and behaviors towards digital technologies used in the retail industry, as well as the prospects and barriers businesses face during adoption these technologies.

### 3.2.1 Consumer data analysis

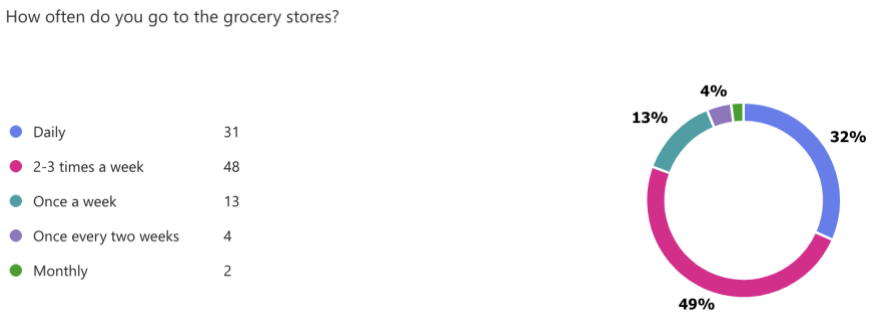
The quantitative information gleaned from the consumer survey is thoroughly examined in this section. The purpose of the survey was to learn more about consumer preferences, attitudes, and behaviors related to digital tools in the EU food retail industry. In order to provide thorough interpretations of the results and investigate correlations between different factors, this analysis will look at each survey question separately. As mentioned earlier, the survey was divided into four main sections.

**Demographic Profile section** explores 98 participants, predominantly female (67%), while 26% identify as men and the remaining 7% prefer not to say. More than a half of all respondents (52%) are aged between 18-25 years. The distribution across other age categories: 34% are aged 26-35, 7% are in the age range 36-45 and the remaining 7% fell into a 55+ category, which suggest a possible bias towards a younger female generation.

The respondents' country of residence is largely concentrated in Lithuania (37%) and Latvia (18%), further comes Germany (9%), France (4%), Italy, Spain, Belgium and Poland have each 3% of all the responses. The remaining countries such as Portugal, Bulgaria, Netherlands, Hungary, Austria, Greece, Romania, Czech Republic, Denmark, Norway, Slovakia have an overall 20% of the votes. This geographic diversity offers important insights into cross-national differences in consumer behaviour and attitudes toward digital retail technologies, even though it is not entirely representative of the EU as a whole.

The high degree of smartphone usage proficiency reported by respondents is a significant finding of the demographic data. The majority (76%) assessed their level of proficiency as "Very Advanced" or "Above Average," indicating a cohort that is proficient with technology and offering context for understanding their acceptance and use of digital tools both in-store and online.

**Shopping Habits section** starts with the first question: "How often do you go to the grocery stores?", it demonstrates the importance of grocery shopping in consumers life as 32% are doing this daily and 49% are going there 2-3 times a week (Figure 19). This indicates a high degree of grocery shopping engagement, indicating frequent interactions with retailers and, consequently, a potentially open audience for the adoption of new digital tools.

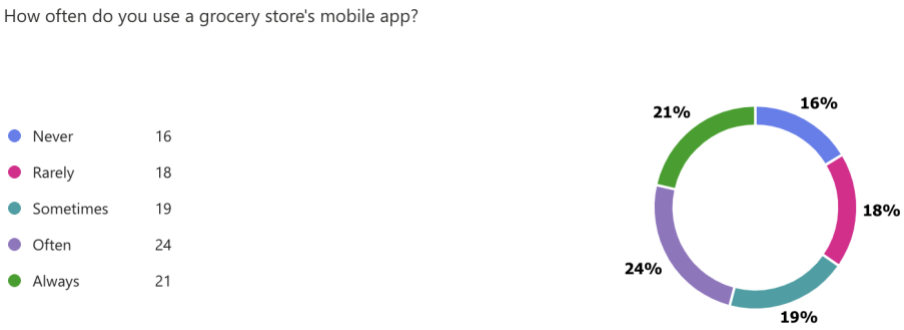



**Source:** complied by the author

**Figure 19.** How often do you go to the grocery store?

Right after, in the second question, respondents were asked to confirm if they were a part of supermarket chain loyalty program. Out of all, 78% are responding positively. This points to a clear advantage for loyalty programs and highlights how well they work to increase customer retention and engagement. By applying digital solutions into ongoing loyalty initiatives can significantly increase brand loyalty and consumer engagement.

The third question of this section concentrates on the usage frequency of store mobile-apps. The majority of respondents (45%) said they used the mobile app "Always" or “Often” but a sizable portion (34%) said they used it "Rarely" or "Never" (Figure 20). This notable variation in app usage indicates that there are different consumer segments according to how they use technology, indicating that personal preferences and current levels of digital literacy must be taken into account when implementing new digital technologies like digital labelling.




**Source:** complied by the author

**Figure 20.** How often do you use a grocery store's mobile app?

Following up on the previous data, the fourth question investigates mobile app features that attract customers the most as well as are most comfortable and useful for them while shopping. Digital coupons and earning bonuses, each individually, were mentioned by over 25% of respondents when asked which app features they use most. This means that features that offer convenience and financial

incentives are highly valued, unlike the appeal of purely informational features. Given the importance of cost-effective incentives, digital signage strategies should prioritize consumer and cost savings.

In the fifth question, the same logic was repeated. Consumers were asked. While a significant proportion (29%) said they use these tools "always" and 24% mentioned “often”, an almost equally large proportion (13%) said they "never" or "rarely" (18%). Such division raises the possibility that the factors influencing in-store adoption of digital tools may differ from those influencing mobile app adoption. They will require a more nuanced approach to implementing digital signage technologies in real-world retail environments.

Following up, question six clarifies the most recognized and commonly used digital tool out of a list of 3: navigation screens, barcode scanners, and self-checkout machines. According to the data, respondents clearly prefer self-checkouts (59%) and barcode scanners (21%), with a smaller enthusiasm for navigation screens (14%), while the rest of them chose “none” (6%). The growing trend of consumer efficiency and autonomy in the retail industry is highlighted by this preference for self-service options. Retailers looking to implement digital signage systems must ensure they retain this efficiency feature and work in tandem with their current self-service infrastructure.

The responses to the Likert scale questions (Statements 1–7) in your consumer survey are interpreted in depth in **the Attitudes section**. A 5-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree) was used in these questions to gauge consumer attitudes and opinions of a range of digital tools used in food retail, the results of which will also be shown in a graphical detail (Figure 21). Every question is looked at separately, offering a thorough analysis of the answers and emphasizing important discoveries.


**Source:** complied by the author

**Figure 21.** Linkert-scale summary for consumers questionnaire

Statement 1: "I am comfortable using in-store digital tools."

This question assessed customers' level of comfort with digital tools in the store (self-service checkout, barcode scanners, interactive displays, etc.). The results indicate a very favorable sentiment towards this aspect of the digitalization of food retailing. Most respondents said they were comfortable using the digital tools already available in the store; this is a good sign that they are ready to integrate and use more digital technologies.

Statement 2: "Digital tools simplify my shopping experience."

This statement explores how customers feel about the effectiveness and usability of digital tools during the purchase process. We can notice a high degree of agreement, digital tools are believed to be a significant improvment to an overall customer experience. This is especially important when implementing digital signage, as a user-friendly and intuitive design is crucial.

Statement 3: "I am saving money while using digital tools."

This question assessed the expected cost savings associated with the use of digital tools. A high level of agreement indicates that customers are aware of the potential financial benefits of using digital tools, such as loyalty programs or digital coupons, that directly influence their purchasing decisions. As the end user directly benefits from any cost savings, this supports digital labeling significantly.

Statement 4: "I would prefer a digitalized product experience over traditional shopping."

The purpose of this question was to find out whether respondents prefer online shopping over conventional methods. The majority has chosen to "agree" or "strongly agree" with this statement, indicating a preference for digital interaction. Given its intrinsic connection to digitally enhanced product information, this insight is useful for predicting the success and adoption of digital labeling.

Statement 5: "If more digitalized product information is important for me.”

The level of agreement shown by the consumers demonstrates that they value access to comprehensive product information. It shows the importance of providing accurate, complete, and easily accessible product information through digital channels. The rationale for using digital labeling is directly supported by this conclusion.

Statement 6: "Access to digitalized product information is important for me."

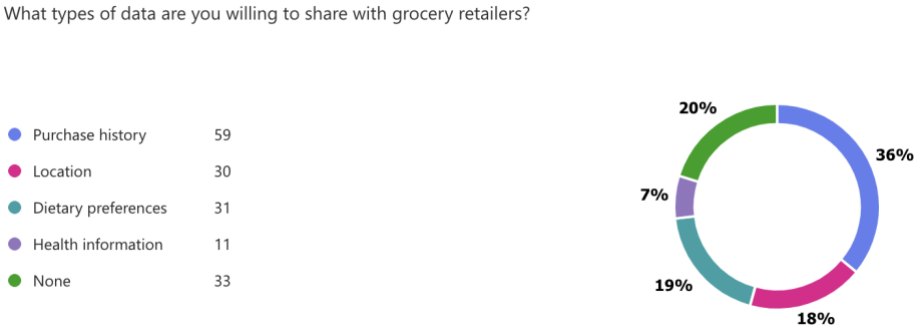
This statement assesses the importance respondents place on having comprehensive product information available. The highights a strong desire for complete and easily accessible product information which underscore the importance of a digital labeling strategy that should make such information available.

Statement 7: "I am comfortable sharing personal data with retail brands for a more personalized shopping experience."

This statement measures how comfortable customers are with disclosing personal information in exchange in order to acheive a more personalized experience. The finding pointed out the division between the ones who express concern about data sharing and the ones who are fine with that as a trade-off for a better customer experience. This highlights the importance of this aspect that should be followed by the data protection requirement to ensure consumers' trust and the analytical part.

***To conclude,*** based on the Likert scale data, collected opinions about digital tools in food retail when it comes to convenience, efficiency and potential savings are gretly positive. However, the data also reveal serious privacy concerns, highlighting the need for robust data security protocols and open data handling procedures. As long as these data privacy issues are addressed and an accessible system is created and implemented, the results clearly demonstrate the potential of digital labeling. When extrapolating these results, it is important to take into account the gender and geographic biases of the sample. The validity and generalizability of these findings will be strengthened by future studies using a larger, more representative sample.

Lastly, **the Brand Recognition and Future Adoption section** starts with the first question that investigates in detail types of data that consumers are willing to share. While a slightly smaller percentage (18%) felt comfortable sharing location data, fewer respondents (7%) were inclined to share health information, and a majority (36%) indicated a willingness to share shopping history and dietary preferences (19%). A significant percentage (20%) refused to disclose any information (Figure 22). This demonstrates how many consumers are still seriously concerned about data privacy, which underscores the significance of data privacy and the need for transparent data handling practices in digital retail. In the future, those customers may completely avoid using digitalized tools because of that issue.




**Source:** complied by the author

**Figure 22.** What type of data are you willing to share?

The second question concentrates on the brand recognition amount of the one who have previously used their digital solutions. A significant percentage (34%) of consumers responded positively, another 28% chose "maybe" and the rest (39%) has informed that they are not recalling brands by their digital efforts. It shows that although digital tools can be a valuable force towards brand recognitions, it will not work in all cases. Further research and a multi-factor approach will be needed.

The third question was optional to answer in this survey. And more than a half of respondents (52%) were willing to provide the local retail brands that to their opinion emphasize the technology or provide memorable digital customer experience (Table 4).

| **Country** | **Example** |
|---|---|
| Lithuania | Maxima, Iki, Rimi, Barbora, Lidl, Wolt Market |
| Germany | Lidl, Aldi, Edeka, Rewe, Kaufland, Fressnapf, Too Good To Go, Okay, Collect & Go |
| Poland | Lidl, Rimi, Biedronka, Lewiatan, Zabka |
| Spain | Lidl, Rimi, Carrefour, Mercadona, Dia |
| Portugal | Lidl, Continente, Pingo Doce |
| Latvia | Rimi, Maxima, Barbora, Drogas |
| Czech Republic | Albert, Coop, Rohlik |
| Netherlands | Albert Heijn, Jumbo, Plus |
| Romania | Profi, Auchan, Penny, Rom Food |
| Norway | Meny, Coop, Rema |
| Slovakia | Coop |
| Belgium | Carrefour, Okay, Collect & Go, Cai |
| Italy | Coop |
| Greece | Kritikos |

**Source:** complied by the author

**Table 4.** Memorable local retailer brand

As we can see, the table appears to have brands that are international (Lidl), implying steady brand awareness and possibly satisfying online experiences throughout the EU; the regionally specific brands (Iki, Barbora, Rewe) which demonstrate the variety of the EU's grocery retail market, and online-only stores/apps (Wolt, Too Good To Go) that draws attention to how offline and online channels are integrated into customer experiences.

The fourth question summarizes the whole survey by acknowledging consumers readiness for trying new solutions. The vast majority of respondents (95%), who indicated that they are ready to implement new digital solutions, emphasize the potential market for digital signage systems. This positive sentiment points to a potentially responsive customer base, especially when coupled with the previously mentioned benefits of cost-effective and convenient options.

***In summary,*** according to an analysis of consumer data, the EU food retail industry is generally positive about digital tools, especially those that emphasize convenience, savings, and a personalized experience. However, there are still serious data privacy concerns that require caution when implementing data-driven digital solutions such as digital labeling. The need for regional adaptation to meet local preferences and market contexts is also supported by the geographic diversity of responses.

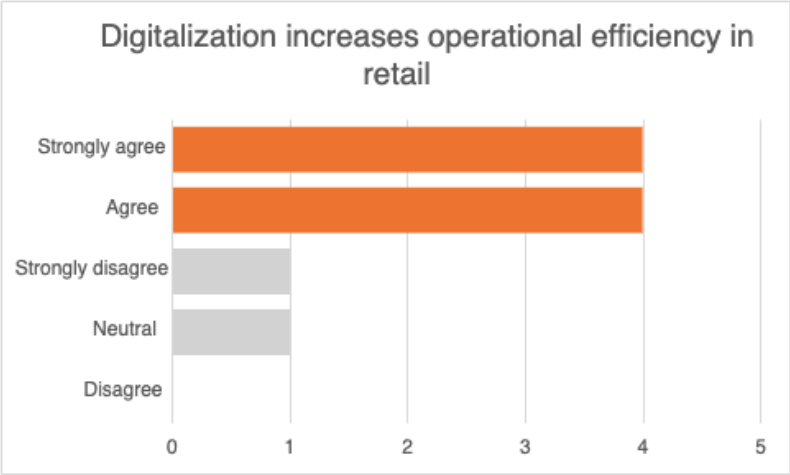
### 3.2.2 Business data analysis

In this section, we analyse the qualitative data from interviews and experts' surveys which expertice in food retail industry in one way or another. The purpose of the survey was to collect the personal opinions and expertise of respondents, finding patterns in the responses, and gaining important insights for future business model creation. Although the data analysis is mostly qualitative method based, there will be two questions where experts are asked to agree or disagree with the following statements (Linkert scale) and to choose an answer out of the list of options to see their preferences in certain areas.

**First part of the first question:** *Digital technologies* improve customer experience in retail stores.

Digital technologies were proposed as the main qualitative objective of this research, which could improve customer engagement, experience, and interaction in both physical and online stores. The process of looking for, selecting, and buying goods and services has changed as a result of this digital revolution, as have consumer expectations (Sharma, 2024). Digital-oriented approach can be an advantage if it simplifies consumers experience, prioritizing their needs and solving excising issues.

The opinion of the experts, who were involved in the survey show clear preference towards the digitalization when it comes to customer experience (Figure 23).




**Source:** complied by the author

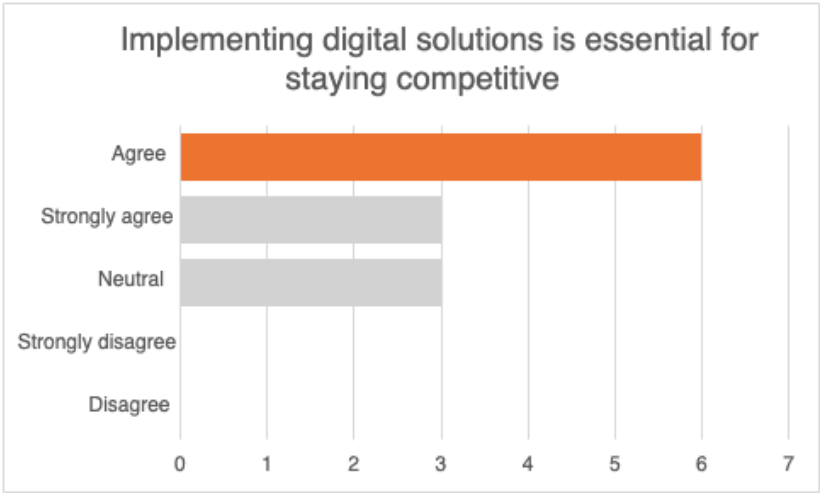
**Figure 23.** Digitalization increases operational efficiency in retail

This figure shows that four experts strongly agree (Expert A, H, I and J), four experts as well agree (Expert B, C, D and G), one (Expert E) decided to be neutral about the topic and one (Expert F) strongly disagrees that digital technologies improve customer experience in retail industry. Overall, the majority of experts express positively about the digitalization in their field of expertise.

**Second part of the first question:** *Digitalization* increases operational efficiency in retail.

A promising operational technique for resolving many of the ongoing retail issues of today is digital products (Gustafsson et al., 2019). Because digital products allow for instant delivery, remove physical inventory constraints, and offer customizable experiences, they provide a revolutionary solution to many of today's retail problems.

The results of the survey are showing a somewhat positive approach to an operation efficiency increase through digitalization (Figure 24).




**Source:** complied by the author

**Figure 24.** "Implementing digital solutions is essential for staying competitive"

Three of all experts (Expert A, B and D), have chosen “Strongly agree” option, four (Expert E, H, I and J) are generally agreeing with the statement. Three more experts (Expert C, F and G) decided to stay neutral. Overall, seven out of ten experts are speaking positively about the digitalization for increasing operational efficiency.

**Third part of the first question:** *Implementing digital solutions* is essential for staying competitive in retail.

It is critical that businesses to learn to capitalize on the opportunities presented by digitalization. Companies that choose not to stay up with innovation risk being at a serious competitive disadvantage, for instance, companies that do not provide electronic payment solutions frequently lose clients (Varga & Csiszárik-Kocsir, 2024).

In this case, the responses of the survey are diverse and are distributed as shown in the Figure 25.

As a result, three experts (Expert A, H and I) strongly agree, three experts (Expert B, D and E) agree with the statement, two of the respondents (Expert F and J) remain neutral and two remaining ones (Expert C and G) disagree with implementing digital solutions in order to stay competitive in the market.

**Fourth part of the first question:** *Digital technologies* help in better inventory management.

Businesses everywhere look for methods to boost supply chain performance in order to lower operating expenses, boost profits, hold onto and grow their market share, and become more customer-responsive. Businesses that want to enhance the performance of their current supply chains must rely on technology to meet customer demands at a higher level (Attaran, 2020).

As per the experts’ point of view, the opinions were distributed mostly positively. The majority of experts are strongly agreed or agreed to the statement. Three experts (Expert A, E and G) strongly agree and four experts (Expert D, H, I and J) agree that inventory management can be improved by accessing a digitalized approach. The remaining respondents (Expert B, C and F) decided to stay neutral.

***In conclusion,*** the Linkert-scale findings of experts’ opinions on the specific statement that evaluate factors of influence of digital technologies in the retail scene have shown an mostly positive attitude towards implementing digitalization the business industry. Overall, four of the qualitive criteria statements should be further researched, discussed and analyzed in order to provide a more accurate statistic.

**Second question:** In your own words, how would you describe the quality of digitalization in retail?

- Expert A claims that *"It's a faster response to market trends and consumer demands providing much more efficiency".*
- Expert B says: *"It depends, some are great, some are still clunky as they are on the early stages of implementing and as we know it can't come without problems".*
- Expert C states that *"It is inconsistent at the moment, some are okay, some are poorly designed or poorly integrated. Currently it is not working well especially among the older generation".*
- Expert D: *"It enhances the existing strategies in regards of customer attraction".*
- Expert E: *"It's the fact of making it easier and more efficient for a range of customers, if not all customers".*
- Expert F: *"It makes it more difficult since not all people have access to internet and smart phone".*
- Expert G: *"Complex and not tailored for small businesses".*
- Expert H says that the quality of digitalization is *"on a high level right now, fast growing, evolving and becoming a competitive advantage in a lot of cases".*
- Expert I describes it as *"Generally high in online stores, apps and delivery services".*
- Expert J sees it as *"Currently growing".*

***To summarize,*** according to the second question's answers, experts demonstrate their evaluation of quality of digitalization of retail in the current retail market. Since the responses are open-ended, they can be divided in one or few following categories at once:

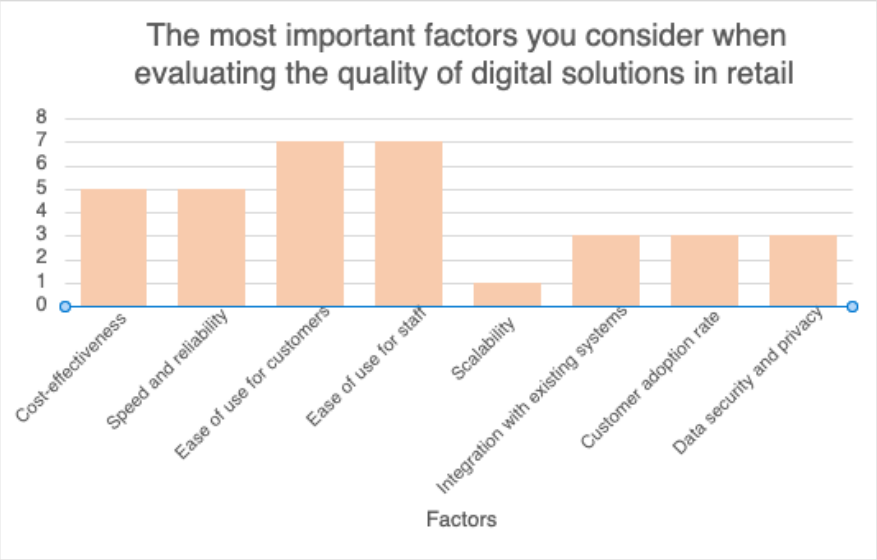
- Great developed, serving the needs for the consumer and business (Expert A, D, E, H and I);
- Currently growing, showing the level of adoption to a market needs (Expert A, B, H and J);
- Inconsistent or is still in the early stage of development (Expert B and C);
- Undeveloped, does not provide the solution to the current market needs (Expert C, F and G).

The major part of respondents shows positive perception on the quality of digitalization in the current market, expressing it as well developed or progressing in the right direction to demonstrate a

great potential in the future. However, a few of experts are skeptical to the innovation as it does not serve the needs for smaller businesses or is still too complex to implement.

**Third question:** From the list below, please select the most important factors you consider when evaluating the quality of digital solutions in retail.

In this question, experts have been asked to mark, in their opinion, factors that determine the factors that would be the most important when choosing if a certain technology should be implemented in the business operation. Their opinions diverged as shown in the Figure 25.




**Source:** complied by the author

**Figure 25.** Factors in consideration of digital technology

This figure shows a pattern in experts' preferences when talking about which factors to consider the most important ones. Seven out of ten experts have marked "Ease of use for customers" (Expert A, B, C, D, G, H and I) and "Ease of use for staff" (Expert B, C, D, E, F, H and J) as the major factor, showing the preference for a comfortable experience and adoption for consumers and workers. Half of the respondents marked "Cost effectiveness" (Expert A, C, E, G and H) and "Speed and reliability" (Expert A, C, D, E and F). Expert also highly value the efficiency of work that will be done through digital solutions as well as ways that will reduce costs or will profit them in some way.

"Integration with exciting systems" (Expert B, I and J), "Customer adoption rate" (Expert C, G and I) and "Data security and privacy" (Expert F, H and J) were each chosen three times. As per the response chart, we can see that "Scalability" is considered the least important factor in the experts' opinion. Only one expert (Expert B) think that change in performance capacity is important to them.

***In conclusion,*** those responses reveal clear priorities for deploying digital solutions in retail that are bringing value. Ease of use for both customers and employees is the most important factor. This

emphasizes how important intuitive designs and user-friendly interfaces are for digital retail solutions. Half of the respondents also emphasized cost-effectiveness and speed/reliability, suggesting a balanced strategy that takes into account both performance quality and financial ramifications. It shows an incredible interest for digital implementation, acknowledging those solutions that will prioritize data security, integrate seamlessly with current systems, and are not only economical and efficient.

**Fourth question:** Based on your experience, what specific features or functionalities do you believe are essential for high-quality digital solutions in retail?

- Expert A: *"Making things easy and effective is the main functionality here, by adding value about giving customers access to features such as product details, reviews and recommendations".*
- Expert B: *"Reliability and user friendliness. If the system is hard to work with for staff or hard to use/adapt to for customers it is not worth it".*
- Expert C: *"Simplicity is the most important, both for the customer and for tech staff to be able to maintain it in the effective way".*
- Expert D did not provide an answer to this question.
- Expert E: *"It has to be accessible, available, and easy to use".*
- Expert F: *"It needs to be available for the staff more than customers".*
- Expert G: *"User friendly website and app, reliable delivery service".*
- Expert H thinks that *"data security, ux/ui and technical support"* are essential for high-quality digital solutions.
- Expert I: *"Real time order tracking, variety of online payment options, clear communication with the customer, simple to understand and navigate design".*
- Expert J: *"Flawless system, organized infrastructure".*

Following up on the previous question, experts were asked to specify the exact features or functionalities that, in their opinion are the most important one for an implementation of a successful high-tech solution in retail. Although all of the responses are different, they all can be divided in few categories as per the common themes:

- Simplicity and user experience (Expert A, B, C, E, G and I). Usually, when talking about a feature that will characterize the product, respondents were referring to effective and easy functionality, that provides an access to product information, reviews and recommendations, simplicity of the design, flawless navigation and great user-experience.

- Performance and reliability (Expert B, G and J). Experts have mentioned, that flawless system with organized infrastructure and reliability both for regular use and delivery is important for them to see in their product.
- Accessibility (Expert E and F). It was an important note from experts, that the system should be accessible, so to speak, the product should be as usable as possible for everyone, regardless of their cognitive of physical abilities. This concept touches both the consumers and stuff.

**Fifth question:** What are the main challenges or problems you face in developing and implementing digital solutions in your retail operations?

- Expert A: *"The biggest challenge comes during the integration of new technologies into existing systems, because it needs to be done without disrupting operations or customer experiences currently in action. Another Challenge is the organization itself that -in most cases-part of it lacks the technological expertise to carry out this complex process".*
- Expert B: *"Cost of implementation, ongoing maintenance, technical errors and data safety".*
- Expert C: *"High implementation, expensive IT stuff, poor implementation to existing working systems and big customers resistance".*
- Expert D *"The accessibility for third parties".*
- Expert E: *"it's the user experience. It has to be a smooth and easy to use user experience to ensure customer satisfaction and interaction too".*
- Expert F: *"That I need to hire more qualified working staff that can deal with systems and computer.".*
- Expert G: *"Cost is the main barrier".*
- Expert H *"budgeting, ensuring security and system integration".*
- Expert I: *"Maintaining system reliability, avoiding technical errors or delays in requests, ensuring timely delivery".*
- Expert J: *"Consumer trust in data handling, cost of adoption, those solutions are for corporations only, so no diversity".*

This question grasps on the challenges that ten respondents have noticed while implementing digitalized solutions to their business. In combination with the next question, we are able

to analyze how, as per their expertise, they see the theoretical or practical solution to that landscape of those challenges. In order for us to have a clearer view, those hurdles will be structured into six different categories:

- *System integration* was mentioned four times in this question (Expert A, C, D and H). Mostly, experts were complaining about the difficulties in integration with an existing mechanism of work as well as difficulties for the third parties to accept the technology and adapt to it.
- *Cost and budgeting* were the one named the most throughout the answers to this question (Expert B, C, G, H and J). Respondents have reported high cost of implementation and ongoing maintenance as the main barrier for the implementation of digital solutions. Expert G, as an owner of a small food store have mentioned it as "the main barrier", which clearly shows that at the current state digitalization is not available nor affordable for small businesses.
- *Data security* was noted tree times (Expert B, H and J), mainly referred to data safety and lack of trust among consumers that have to accept businesses handling their data.
- The challenge of *adoption* was as well notion tree times (C, E and I). Respondents have noticed customer resistance in using new technologies, especially among the older generation, and overcomplicated or confusing user flow in customer experience journey.
- *Technical challenges*, mentioned only twice (Expert B and I) still showcase an existing problem in maintaining system reliability and finding technical errors in the product.
- *Human resources* issue was noticed just twice as well (Expert A and F). The main issue lies in lack of technological expertise within the organization and the need for constant outsource of workers.

***In conclusion,*** the answers from the experts point to a number of interrelated difficulties in putting digital solutions into practice in the retail industry, with system integration, financial concerns, and data security standing out as the main issues. The complexity of digital transformation in the retail industry is further highlighted by problems with user adoption, technical dependability, and the requirement for specialized human resources, especially for smaller companies with limited funding.

**Sixth question:** Based on the challenges mentioned in the previous question, what opportunities or solutions do you see to address these problems?

- Expert A: *"A unified system that connects inventory, sales, customer data will be needed in this case, since the main point is to have the new implemented technologies simulated temporarily with the current ones for digital transformation to be successful. Providing trainings to the staff making them ready to provide better experience".*
- Expert B: *"Plan rollouts for the new system and action plans for avoiding complications".*
- Expert C: *"Educate the stuff for teaching older consumers to use the technology in the store as they are barely using their smartphones, find more affordable solutions, take time for smoother implementations".*
- Expert D *"Don't use open-source software".*
- Expert E: *"The key is to take into consideration that customers are not all from the same category, age, etc., so we need to not make more complicated for them, we need to give the simplest option that can work for -almost- everyone".*
- Expert F: *"Hiring More efficient staff, trying to train the current workers".*
- Expert G: *"Partnership with companies that offer affordable solutions".*
- Expert H *"calculating the expenses properly, finding cheaper solutions with startups, ensuring good workers that will be able to create a product aligning with the existing operations".*
- Expert I: *"Investing in robust infrastructure, organizing better logistic, optimizing communication with customers".*
- Expert J: *"Governmental initiatives".*

Those responses reveal an approach to addressing the challenges, mentioned in the responses to a previous question. It was decided to categorize those solutions for a better representation in the Table 5.

| **Challenge** | **Proposed solution(s)** | **Expert(s)** |
|---|---|---|
| System integration | Time allocation for smoother operations, careful planning, temporary simulations of new technologies with current ones | A, B, C, H |
| Cost and budgeting | Considering government initiatives, partnership with startups and companies that provide cheaper solutions, calculating expenses. | C, G, H, J |
| Data security | - | - |

| | | |
|---|---|---|
| Adoption | Investing in better design flow, providing simple options that work for a bigger number of consumers, educating staff to teach older consumers, communication optimization. | C, E, I |
| Technical challenges | Avoiding open-source software, investing in robust infrastructure. | D, I |
| Human resources | Providing staff training, hiring more qualified specialists. | A, F, H |

**Source:** complied by the author

**Table 5.** Challenges and solutions proposed by experts

The solutions put forth by the experts emphasize the necessity of a thorough, multifaceted strategy to address the difficulties posed by retail's digital transformation. Those experts mark the significance of comprehensive planning and execution, covering everything from organizational and customer-centric strategies like employee training and user-friendly design to technical and operational factors like system integration and infrastructure investment. In order to successfully execute digital solutions and pave the way for a smooth and long-lasting digital transformation, retailers must carefully balance cost, technological prowess, human resources, and the various needs of their clientele.

**Seventh question:** Can you provide an example of a retailer (worldwide) that you believe demonstrates high-quality implementation of digital technologies? Why do you consider this a good example?

In order to lead the digital transformation, it is important to understand how businesses successfully integrate digital technologies, implementing flawless digital solutions can significantly impact a retailer's overall competitiveness, customer experience and operational efficiency. The way businesses operate and deliver value to their customers is changing dramatically as digital technologies permeate every aspect of their operations (Verhoef et al., 2021). Finding and studying real-life examples (Table 6) of retailers who are successfully using digital technologies can provide insight into the sector.

| No | Expert | Example | Comments |
|---|---|---|---|
| 1 | Expert A | Nike House | *"Their idea was simple but yet very effective; it allows customers to reserve shoes online to try on in-store. Customers can arrive through a specific entrance to find a locker with their name on, which can then be unlocked via their smartphone to try the shoes they picked up online".* |
| 2 | Expert B | FamiSuper | *"They had AI-powered smart trolleys. Once again, this is about convenience for the customer and for simplifying* |

| | | | |
|---|---|---|---|
| | | | *overloads for stuff, as always, they have put themselves on the lead of the innovation.".* |
| 3 | Expert C | - | - |
| 4 | Expert D | Nike | *"Their campaigns".* |
| 5 | Expert E | Walmart | *"by introducing Alphabots for online order delivery that can keep a huge number of different items at a time. For faster packing and delivery of online orders, the Alphabot works perfectly".* |
| 6 | Expert F | Carrefour | *"It has big stores and big prepared staff".* |
| 7 | Expert G | - | - |
| 8 | Expert H | Marks & Spencer | *"They have queue boosters that are basically stuff with digital checkouts".* |
| 9 | Expert I | Tesco | *"Brick and click business model, solid IT infrastructure, great online shop, scan as you shop, smart cameras and badges, EPL".* |
| 10 | Expert J | Amazon | - |

**Source:** complied by the author

**Table 6.** Worldwide retailer example that demonstrates high quality solutions

***To sum up,*** an interesting variety of worldwide examples has been shown as well as a brief but detailed explanation from experts, why they think a specific business shows an advantage or is memorable among others. It is always good to learn from the best, and exploring digital tools appearance from those brands might bring valuable insights for the EU scene.

**Eighth question:** Can you provide an example of a retailer in your country that you believe demonstrates high-quality implementation of digital technologies? Why do you consider this a good example?

As the challenges and solutions can be directly relevant to the local market, analyzing successful examples of digital transformation in a retailer's country can provide particularly insightful insights (Table 7).

| No | Expert | Example | Comments |
|---|---|---|---|
| 1 | Expert A | Zara | *"They use RFI to manage the inventory of all its products in real-time. This allows to accurately specify the location and sales status of products, making it possible to predict* |

| | | | |
|---|---|---|---|
| | | | *consumer purchasing behavior and trends and quickly develop products, best-selling for each store and adjust the inventory based on that information".* |
| 2 | Expert B | Coop | *"Scan and pay; a very convenient system that allows you to scan the back of the label and pay directly".* |
| 3 | Expert C | - | - |
| 4 | Expert D | Traffi | - |
| 5 | Expert E | K-Group | *"Digital marketing displays, it helps enhance customer experience by bringing new inspiration and current information to the customer in a timely manner".* |
| 6 | Expert F | BIM | *"It has only the necessary digitalised system for staff to use and stamps all the advertisement for clients for free".* |
| 7 | Expert G | - | - |
| 8 | Expert H | Rewe | *"They have created "Das Fulfillment Center 2.0" that is basically a huge high-tech building that simplifies the delivery for all the workers by shuffling food automatically in the correct places and categories".* |
| 9 | Expert I | Sonae | *"Great user experience to their online platforms, optimized e-commerce".* |
| 10 | Expert J | Ikea | - |

**Source:** complied by the author

**Table 7.** Local retailer example that demonstrates high quality solutions

Experts cited a number of examples where retailers have effectively implemented first-class digital technologies to improve customer satisfaction and operational efficiency. These include Rewe's automated fulfillment center, Coop's convenient Scan and Pay system and Zara's real-time inventory tracking using RFID. Additional examples demonstrate the integration of e-commerce platforms, optimized internal systems and digital marketing displays. Taken together, these case studies show how retailers in different markets are using a variety of digital solutions to transform their operations and provide better customer service.

**Ninth question:** How do you envision the future of digitalization in retail over the next 5-10 years? What technologies or trends do you think will be most impactful?

This question was asked purely for the observation purposes. The idea was to gather experts opinion in future of the industry they are working in to see any patterns or differences in thinking.

- Expert A thinks that *"AI will play a larger role, with AI-powered assistants and automation becoming commonplace, the digital divide in retail may narrow as technology becomes more accessible and affordable, but also new disparities could emerge".*
- Expert B is sure that *"AI will be everywhere with increasing highlight to online solutions".*
- Expert C: *"Slow, but steady adoption to the technology. In the future consumers will use online services more often and working stuff will be slightly reduced".*
- Expert D has responded simply: *"AI"*.
- Expert E thinks *"it might take longer but I see it in the process automation through robotics. Robots will just pick, pack, and ship products with unmatched efficiency".*
- Expert F did not provide any response.
- Expert G: *"All the small businesses will have apps for their stores, coupons and an option for a delivery".*
- Expert H: *"increased automation, enhanced personalized experience for even in-store visits, improved mobile payment system".*
- Expert I: *"AI, focus on sustainability, reduced packaging waste, personalized experience, VR".*
- Expert J: *"AR, VR and AI will be in the majority of big stores".*

Experts predict a digital future for retail that will be marked by the expansion of artificial intelligence and automation, the development of omnichannel and mobile solutions, and an emphasis on personalization and immersion. Many expect significant growth in AI-based technologies, from virtual assistants to robotic process automation, potentially leading to increased efficiency but also raising concerns about the digital divide. As customers increasingly rely on digital channels, experts also predict a future with pervasive mobile apps, online services and delivery options even for smaller businesses.

They also point out that a more immersive shopping experience can be created by integrating advanced technologies such as AR and VR and improving personalization. Some also envision a focus on sustainability through digital solutions aimed at improving logistics and reducing packaging waste.

***All things considered,*** respondents describe a retail environment that is becoming increasingly digital, automated and personalized, offering both opportunities, and challenges for companies and customers.

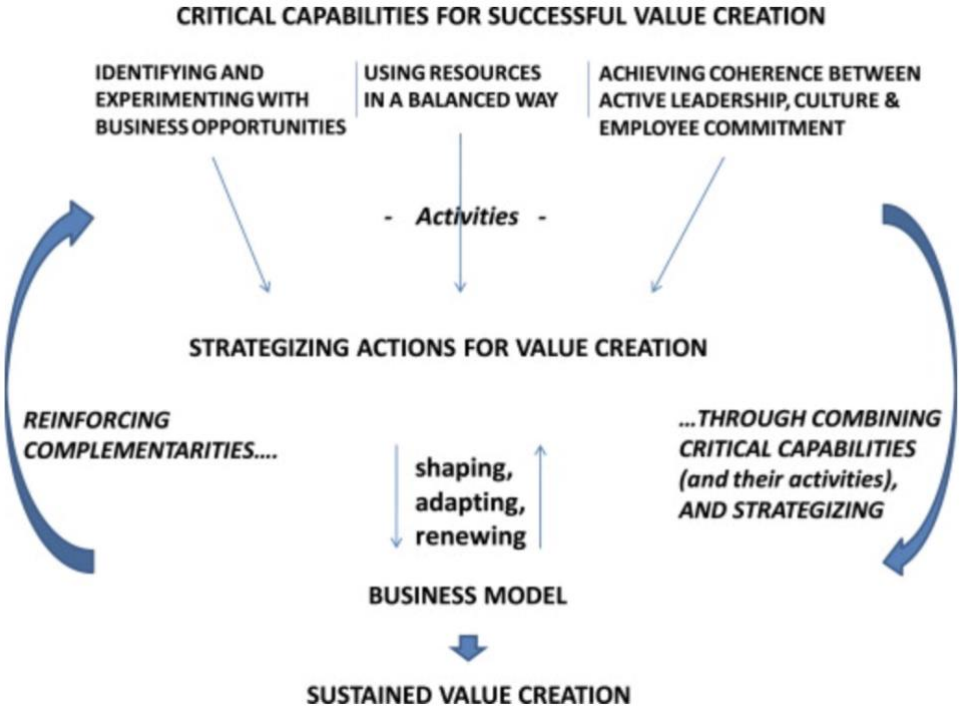
***Summarizing the results of the business data analysis,*** the collected data gave important insights into the present and future directions of digitalization in the retail industry.

# DESIGNING BUSINESS MODEL FOR DIGITALIZED BARCODE APPLICATION

## 4.1 Design methodology

As confirmed by the experts and consumers, qualitative and quantitative criteria are sufficient for future implementation in the business scene; it is beneficial to design a business model for digitalized barcode applications within the EU food retail industry. Business model development is a critical choice for entrepreneurs starting new companies and a vital if the potentially more challenging, task for managers tasked with updating an outdated model to prepare their company for the future (Zott & Amit, 2010).

Specifically, it has been noted that in order for businesses to stay relevant in the emerging digital economy, they must develop strong dynamic capabilities to quickly develop, implement, and transform business models (Achtenhagen et al., 2013). The same author has suggested the framework for achieving business model change for sustained value creation (Figure 1).




**Source:** Achtenhagen et al., 2013

**Figure 26.** An integrative framework for achieving business model change for sustained value creation

A focus on organic growth combined with strategic acquisitions, simultaneous expansion in multiple dimensions, and a combination of profitability and high quality are the three strategic actions

associated with value creation. They are driven by three categories of critical capabilities: a focus on testing and exploiting new business opportunities, a methodical approach to resource allocation, and achieving a balance between clear and active leadership, a strong organizational culture, and employee commitment. In fact, different sets of actions combine to form these important abilities (Achtenhagen et al., 2013).

By highlighting the necessity of taking into account actions taken for the focal firm but outside its borders by partners, suppliers, or customers, some academics have specifically drawn attention to the boundary-spanning nature of business models. This enables the focal firm to leverage outside ideas and technologies through "open business models" and rely on the resources and skills of third parties. Thus, the business model can be enhanced by taking an "activity system" such as novelty-centered features, lock-in strategy, complementary value, and efficiency improvement into account (Zott & Amit, 2010).

## 4.2 Business model analysis

The business model (Figure 27) for digitalized barcode application was created on the established qualitative and quantitative criteria developed on the basis of:

- Theoretical aspects of digitalized labeling (Chapter 1)
- Qualitative aspects of digitalized labeling in the EU market (Chapter 2)
- Quantitative analysis of consumer segment of the food retail (Section 3.2.1)
- Qualitative analysis of business segment of the food retail (Section 3.2.2)

The business model contains key components: value proposition, key activities and recourses, customer segments and customer relationships, channels and revenue stream, cost structure, and key partners, as well as additional components: novelty-centered features, lock-in strategy, and efficiency improvement.

***Value proposition*** is the core of the business model, and it covers both retailers and consumers. This model revolutionizes the way product information is accessed and used in retail stores, introducing a new interactive digital barcode system that replaces conventional barcodes. Offering a customized, interactive shopping experience, this system is designed to significantly increase customer engagement. At the same time, it provides retailers with a complete digital upgrade solution that improves inventory control, accelerates processes, and provides deep customer data. In the fast-changing technology landscape, a locked-down ecosystem design ensures retailers control over their operations

and data while taking advantage of digital features. This strategy reduces the risk of third-party dependency and possible exit from the network.

***Key activities*** concentrate on the continuous development and refinement of digital barcode implementation software systems. This involves developing user-friendly interfaces for both consumers and retailers in addition to creating the digital barcode system itself. The model recognizes the challenges of integrating new technologies into existing retail infrastructure and emphasizes the importance of installation and integration services. Updating the system, improving features based on user data and industry trends, and providing extensive training and support for retailers and their employees are examples of ongoing activities.

***Key recourses*** include the technology itself, a network of experienced installation and support professionals, data analytics and artificial intelligence capabilities, and strategic alliances with retail technology providers are important assets.

***Customer segment*** covers medium to large size businesses in food retail sector including grocery stores, supermarkets, department stores, and specialty retailers. Because of this focus, customized solutions that cater to the unique requirements and difficulties of every retail category can be developed.

***Customer relationship*** is processed through personalized onboarding and integration, it ensures that each retailer receives a personalized approach. Regular system upgrades, continuous support, and a team-based approach to creating original retail solutions are all highly valued. This tactic builds long-lasting relationships in addition to increasing customer satisfaction.

***Channels*** include a direct sales team, participation in industry trade shows and conferences, online marketing efforts and a referral program. Such a multi-channel strategy guarantees wide market coverage and ensures targeted interaction with potential customers.

***Revenue stream*** includes a variety of sources of income that bring profit which include cost of initial system setup and installation, ongoing monthly or annual subscription fees, fees for premium features and add-ons, and the sale of analytics and data analysis packages. This revenue stream model promotes continuous engagement and system renewal, aligning it with a long-term value proposition.

***Cost structure*** reflects the technology-intensive nature of the solution. In order to maintain the competitiveness of the system, large expenditures on research and development are required. Hardware and software manufacturing, installation and maintenance costs, marketing and sales initiatives, and extensive customer support and training initiatives are additional significant cost centers.

***Key partnerships*** include partnering with cloud service providers for powerful data processing and storage capabilities, payment processors for seamless transaction integration, retail analytics companies for enhanced data analysis, and hardware manufacturers.

***Novelty-centered features*** designed to captivate consumers and provide benefits for retailers, which include:

1. *Interactive product information*. Through the use of smartphone technology, consumers can scan codes for detailed product information, reviews and comparisons. AR capabilities enhance this function by allowing customers to see products in use, improving the decision-making process and reducing the uncertainty of the purchase.
2. *Personalized recommendations.* The system provides personalized product recommendations and discounts based on each customer's unique shopping history by connecting scanned barcodes to customer profiles. In addition to enhancing the customer experience, this personalization raises the possibility of repeat business and fosters customer loyalty.
3. *Gamification elements.* The shopping experience is made more entertaining by the addition of challenges, streak or achievements section. Increased engagement and store exploration are encouraged by this gamification technique, which may result in longer dwell times and higher sales.
4. *Dynamic pricing.* Retailers can implement instant sales and dynamic pricing strategies with unprecedented flexibility by displaying real-time price updates. This function allows you to quickly react to changes in the market and the activity of competitors.
5. *Inventory management.* The system provides automatic reordering and real-time inventory tracking. This feature optimizes inventory levels and reduces associated costs, significantly reducing the likelihood of shortage and overstock scenarios.
6. *Customer flow analysis.* Heatmaps and customer journey data are generated by the system, offering invaluable insights to maximize sales opportunities through product placement and store layout optimization.
7. *Contactless checkouts.* The ability for shoppers to pay with their smartphones and scan digitalized barcode codes reduces checkout lines, improves the overall shopping experience, and can even increase throughput during peak hours.

***Lock-in strategy*** is included to ensure a committed partnership with retailers, which includes:

1. *Technology integration.* Due to its deep integration with retailers' current systems, digitalized barcode implementation creates a high switching cost and a dependence on technology.
2. *Customization.* Solutions are customized according to the unique requirements of each seller, which further increases the value of the system for a particular company and deters potential competitors.
3. *Long-term contracts.* This model encourages retailers to adhere to and expand their use of the digitalized barcode system over time, preferring long-term contractual arrangements with tiered pricing benefits.
4. *Continuous innovation.* Features are regularly updated and improved to keep the system at the forefront of retail technology and consistently outperform available alternatives.

***Efficiency improvements*** are implemented to the model for reducing transaction costs and streamline the operations, including:

1. *Labor cost reduction.* Automated inventory control and price adjustments greatly reduce the need for human intervention.
2. *Error minimalization.* The digital nature of the system improves accuracy and customer satisfaction by reducing errors in pricing and product information.
3. *Checkout optimization.* Waiting times are reduced with an expedited checkout process, which increases customer satisfaction and can increase throughput.
4. *Inventory optimization.* Inventory and transportation costs are reduced by optimizing inventory levels with real-time tracking and advanced analytics.

***Overall,*** this business model aims to provide a revolutionary strategic plan for digitalized barcode implementation, that is enhancing customer engagement, creating a locked-in ecosystem for retailers, ultimately driving the efficiency, profitability and competitive advantage in the increasingly digitalized retail market.

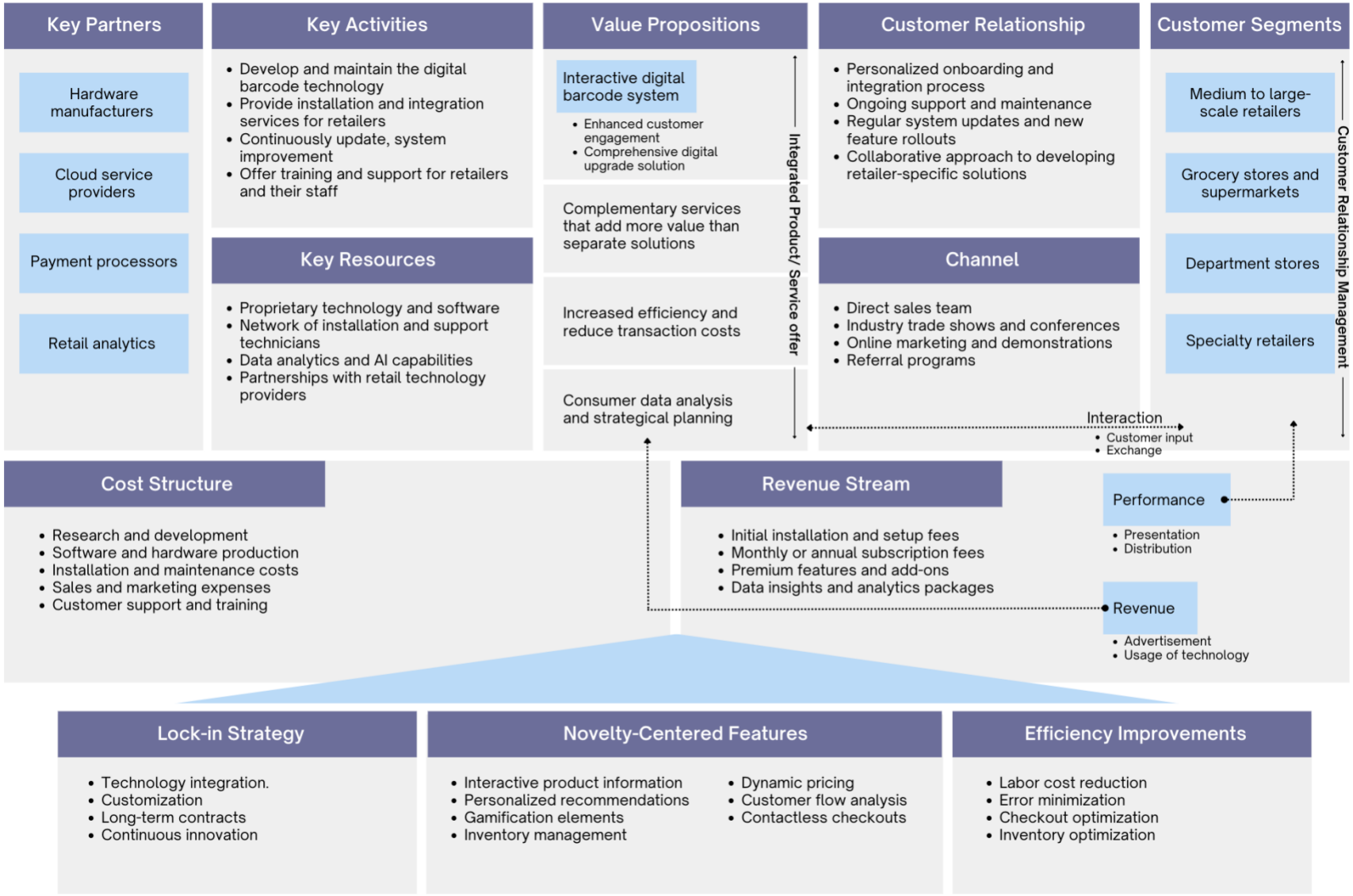



**Figure 27.** Digitalized Barcode Implementation Business Model, complied by the author

# CONCLUSIONS AND RECOMMENDATIONS

1. The theoretical part of this study concentrates on the concept of the evaluation of digitalized barcode implementation and consumer behavior in the food retail sector. It is important to mention that the concept of a digitalized barcode is not well-defined in the literature. Overall, the concept of digitalized barcode scanning is a part of creating a business model that mainly concentrates on consumers and businesses, as per the qualitative and quantitative research. In order to achieve positive effects, outcomes, and implementation of business models, qualitative criteria should be implemented. The evaluation of digitalized barcode systems from the viewpoints of both customers and businesses emphasizes the necessity of a well-rounded implementation strategy.

2. Analyzing the experiences of emerging markets in the EU countries that have been chosen: Sweden, Netherlands, and France. Followed countries led to success due to their innovative implementation, progress monitoring, investment into modern solutions, careful calculation of customer needs, and region-specific differences. Additionally, through the qualitative research, more cases, both locally from the EU and worldwide, of successful digital tools implementation were analyzed for a better, broader understanding of region-specific parameters or demographic upbringings.

3. Based on the quantitative study of the consumer's behavior, preferences, and values, a better understanding was gained for the creation of the digitalized barcode integration system business model. For a more individualized approach, this business model should be adopted based on the needs of the customer. Important evaluation criteria for digitalized barcode systems include design, customer satisfaction, loyalty, and integration with online distribution channels. A complex, integrated approach is required for optimal implementation; no single criterion can be isolated as being the most important. Goal-setting, resource allocation, measurement challenges, perception problems, information overload, sustaining customer interest, mobile compatibility, differentiation, and cultivating customer loyalty are some of the main challenges.

4. Based on the qualitative study of business experts in the industry of food retail, retailers are in need for holistic approach to minimizing cost structure, attracting customers, enhancing excising operations and holding a technological lead. All of that should be provided by the implementation of the digitalized barcode system business model into their existing one, by either enhancing it or exchanging it completely.

5. The process of deploying digitalized barcodes is well-described by a suggested business model, which begins with a short-term explanation and establishment of each key parameter and having

additional elements to show extra value to the retailers. The application model places equal emphasis on business-focused ROI generation and customer-oriented qualitative criterion implementation. The long-term objective of implementing digital barcodes is to produce a positive return on investment. This suggests a continuous process of assessment and enhancement to sustain efficacy in a retail environment that is changing quickly.

## Recommendations

1. To ensure common understanding and application in the food retail sector, work towards the development of a standardized definition of digitized barcode systems.

2. Put digitalized barcode systems into place with a thorough plan that strikes a balance between client demands and corporate goals. Design, client happiness, loyalty, and integration with online distribution channels should all be taken into account in this strategy.

3. Create the digitized barcode system with a strong emphasis on the values, preferences, and behavior of the consumer as determined by quantitative research.

4. When implementing, concentrate on proactively addressing common issues such as goal setting, resource allocation, measurement, and customer retention

5. Instead of focusing on short-term goals, focus your attention on achieving a positive return on investment (ROI) in the long term by combining creative solutions with quality criteria.

6. To maintain the effectiveness of your digitized barcode system in the rapidly changing retail environment, set up a system of continuous evaluation and improvement.

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# LIST OF ANNEXES

**Annex 1.** The questionnaire for consumer survey

Dear Participants, you are invited to take part in the survey on digital experiences in European food retail. This study aims to understand how digital technologies provided by supermarkets affect grocery shopping experiences, influencing brand recognition and satisfaction. Your answers will give us important information about how digital innovations affect the retail food industry.

The data collected in the presented survey will be securely retained until the project is completed in January 2025. The information used in the report will be anonymous and will not be shared with any third-party organizations. You have the right to withdraw from the survey at any stage and request the deletion and exclusion from the project.

The survey should take approximately 5-10 minutes to complete. Thank you for your time and interest!

**1. Your age**

**2. Your gender**

**3. Country of residence within the EU**

**4. How would you describe your smartphone usage proficiency?**

**5. How often do you go to the grocery stores?**

a) Daily

b) 2-3 times a week

c) Once a week

d) Once every two weeks

e) Monthly

**6. How often do you use a grocery store's mobile app?**

a) Never

b) Rarely

c) Sometimes

d) Often

e) Always

**7. Which features of grocery store apps do you use most frequently?**

a) Shopping lists

b) Digital coupons

c) Earning bonuses

d) Product scanning

e) Store navigation

f) Meal planning

g) Nutritional information

h) Order tracking

**8. How often do you use other in-store digital tools (navigation screens, barcode scanners, self-checkout machines) when grocery shopping?**

a) Never

b) Rarely

c) Sometimes

d) Often

e) Always

**9. Which digital tools do you use most frequently?**

a) Navigation screens

b) Barcode scanners

c) Self-checkout machines

**10. Are you a member of any digital loyalty programs for grocery stores?**

a) Yes

b) No

**11. How much do you agree with the following statements? (Linkert-scale)**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| I am comfortable using in-store digital tools | ◯ | ◯ | ◯ | ◯ | ◯ |
| Digital tools simplify my shopping experience | ◯ | ◯ | ◯ | ◯ | ◯ |
| I am saving money while using digital tools | ◯ | ◯ | ◯ | ◯ | ◯ |
| I would prefer a digitalized experience over traditional shopping | ◯ | ◯ | ◯ | ◯ | ◯ |
| If more digitalized tools appear, I would most likely use them | ◯ | ◯ | ◯ | ◯ | ◯ |
| Access to digitalized product information is important for me | ◯ | ◯ | ◯ | ◯ | ◯ |
| I am comfortable sharing personal data with retail brands for a more personalized shopping experience | ◯ | ◯ | ◯ | ◯ | ◯ |

**12. What types of data are you willing to share with grocery retailers?**

a) Purchase history

b) Location

c) Dietary preferences

d) Health information

e) None

**13. Are you more likely to remember a brand after interacting with its digital platforms?**

a) Yes

b) No

c) Maybe

**14. Can you name three grocery brands that offer good digital shopping experiences?**

**15. Would you consider trying new solutions in the future?**

a) Yes

b) No

c) Maybe

**Annex 2.** The questionnaire for business survey

Dear Participant, as an expert in retail management, your insights are invaluable to our research. This study aims to understand the business perspective on how digital technologies (electronic shelf labels, self-scanners, discount apps, etc.) are affecting operational processes and customer experiences in food retail. The findings from this study will contribute to a better understanding of the current state and future directions of retail digitalization in the EU, potentially informing industry practices and policy decisions.

The data collected in the presented survey will be securely retained until the project is completed in January 2025. The information used in the report will be anonymous and will not be shared with any third-party organizations. You have the right to withdraw from the survey at any stage and request the deletion and exclusion from the project.

Your participation would involve completing a brief questionnaire consisting of nine questions. The survey should take approximately 10 minutes to complete. Thank you for your time and interest!

**1. Please evaluate the following statements about the qualitative criteria of retail digitalization according to the evaluation scale:**

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| Digital technologies improve customer experience in retail stores | ◯ | ◯ | ◯ | ◯ | ◯ |
| Digitalization increases operational efficiency in retail | ◯ | ◯ | ◯ | ◯ | ◯ |
| Implementing digital solutions is essential for staying competitive in retail | ◯ | ◯ | ◯ | ◯ | ◯ |
| Digital technologies help in better inventory management | ◯ | ◯ | ◯ | ◯ | ◯ |

**2. In your own words, how would you describe the quality of digitalization in retail?**

**3. From the list below, please select the three most important factors you consider when evaluating the quality of digital solutions in retail:**

a) Ease of use for customers

b) Ease of use for staff

c) Integration with existing systems

d) Cost-effectiveness

e) Data security and privacy

f) Speed and reliability

g) Scalability

h) Customer adoption rate

**4. Based on your experience, what specific features or functionalities do you believe are essential for high-quality digital solutions in retail?**

**5. What are the main challenges or problems you face in developing and implementing digital solutions in your retail operations?**

**6. Based on the challenges mentioned in the previous question, what opportunities or solutions do you see to address these problems?**

**7. Can you provide an example of a retailer (worldwide) that you believe demonstrates high-quality implementation of digital technologies? Why do you consider this a good example?**

**8. Can you provide an example of a retailer in your country that you believe demonstrates high-quality implementation of digital technologies? Why do you consider this a good example?**

**9. How do you envision the future of digitalization in retail over the next 5-10 years? What technologies or trends do you think will be most impactful?**