Strategic Assortment Decisions in Omnichannel Retailing:

The Design and Evaluation of an Omnichannel Assortment Ontology for Consumer Confusion

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Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Gültekin Cakir

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Abstract

Consumer confusion is a phenomenon observed in retail settings where consumers feel irritation or frustration during the shopping journey. Consumers can be overwhelmed by assortment size, complex product variety, brand similarities, information inconsistencies or by intense stimuli from store atmospherics inducing information overload, leading to adverse reactions. Oftentimes, these experiences result in various negative short- and long-term consequences such as helplessness, purchase abandonment, dissatisfaction, or loss of trust or loyalty, thus representing a crucial challenge for retailers to prevent or mitigate. Consumer confusion has been studied extensively in a single-channel context, for instance, by investigating information overload phenomena in online shopping situations or examining increased choice sets resulting from large assortment sizes in physical stores. However, although *omnichannel retailing* has become the current state-of-the-art in the retail industry today, consumer confusion research from an omnichannel perspective is still very scarce. With the increased adoption of the omnichannel strategy by retailers that allow free switching behaviour for their customers during their shopping journeys, a new dimension to the consumer confusion phenomenon is observed. Customers are not only exposed to potential confusion at a specific retail situation in a single channel but are now confronted with potential new negative experiences while comparing products, prices, or information across channels. Particularly, when confronted with *assortment inconsistencies across channels* while switching channels, customers can experience irritation, frustration, or annoyance if the desired item is not to be found on the other channel, leading to adverse reactions that can potentially impact the retailer's financial performance. Prior literature has considered consumer confusion induced by assortment size, variety, or layout, but neglected its occurrence from assortment inconsistencies across channels from a *channel switching perspective* so far. This thesis focuses on the consumer confusion phenomenon resulting from assortment inconsistencies across channels from a channel-switching perspective in omnichannel retailing.

Strategic assortment decisions in omnichannel retailing involve the coordination of the assortment between channels. Retailers can decide to realise a “Full”, “Asymmetric”, or “No Integration” approach for their assortment across channels. These strategic assortment decisions are taken at the *Marketing-Operations-Interface (MOI)*, an interface harmonizing oftentimes conflicting relationships between objectives of the marketing and operations

functions of the retailer. Although identical assortment across channels seems to be the desired solution to prevent consumer confusion (representing an objective from the marketing function), retailers oftentimes apply partial integration to benefit from channel-specific advantages such as the Long Tail effect (representing an objective from the operations function) which is detrimental to consumer confusion prevention. Retailers seem to neglect the significance of consumer confusion while making strategic assortment decisions at the MOI indicating that the phenomenon is not sufficiently explored or captured in an omnichannel context. Retailers appear to lack knowledge of the relevant concepts, dimensions, and consequences of the consumer confusion phenomenon. As a result, retailers are likely to fail in addressing and preventing the occurrence of the consumer confusion phenomenon in an omnichannel context.

Current studies on strategic assortment decisions and consumer confusion in omnichannel retailing are very scarce and primarily based on experimental studies with a strong lack of empirical contributions. More importantly, none of the studies considers channel switching behaviour in the context of consumer confusion although representing the primary condition for the phenomenon to occur. There is a need for the integration and alignment of knowledge capturing the domains for strategic assortment decisions, the consumer confusion concept, and its short- and long-term consequences from a channel switching behaviour perspective in order to inform strategic assortment decisions at the MOI.

Ontologies are explicit and formal specifications of shared conceptualisations that can structure and link information of specific domains and thus are a suitable technique for knowledge representation. Grounded on a Design Science project, this research designs and develops an ontology-based knowledge representation that captures and aligns domain knowledge on strategic assortment decisions, the consumer confusion concept and its consequences from a channel switching behaviour perspective in an omnichannel retailing context. The literature- and practitioner-informed *Omnichannel Assortment Ontology for Consumer Confusion* is able to integrate and represent relevant concepts and their relationships at the MOI in order to inform omnichannel retailers on the link between strategic assortment decisions and the consumer confusion phenomenon. The ontology is instantiated and evaluated through a System Dynamics model based on a case study that demonstrates successfully its ability to inform omnichannel retailers on strategic assortment decisions and the consumer confusion concept at the MOI.

This study contributes to theory and practice in various ways. From a theoretical perspective, this is the first study to link strategic assortment decisions with the consumer confusion concept from a channel switching behaviour perspective. The solution design embodies novel design knowledge on the construction of an ontology-based knowledge representation. Moreover, the study enhances the fields of omnichannel assortment, consumer confusion, and channel switching behaviour research by introducing novel concepts, tools, and an improved understanding of the domains and their interplay with each other. From a managerial perspective, the ontology effectively serves as a knowledge reference that is able to guide strategic decision-making in assortment integration for omnichannel retailers at the MOI. This allows omnichannel retailers to identify and mitigate potential adverse consumer reactions induced by consumer confusion, thus eventually preventing financial impact on their retail performance.

List of Publications and Presentations

Publications

1. **Cakir, G.**, Bezbradica, M., and Helfert, M. (2023). Omnichannel Assortment Decisions at the Marketing-Operations-Interface – A Systematic Literature Review. To be submitted to the *International Journal of Retailing and Distribution Management*.
2. **Cakir, G.**, Cirqueira, D., Pawlata, H., Bezbradica, M., and Helfert, M., (2022). Customer Confusion Detection in Omnichannel Assortments – Conceptualising an Explainable Sentiment Analysis Approach. *Electronic Markets Journal* (Under Revision).
3. **Cakir, G.**, Bezbradica, M., and Helfert, M. (2022). Visualizing Critical Objectives in Omnichannel Management Through Mental Models: The Application of an Assortment Integration Context. In *Communications in Computer and Information Science,* vol 1609. Springer, Cham.
4. **Cakir, G.**, Iftikhar, R., Bielozorov, A., Pourzolfaghar, Z., and Helfert, M. (2021). Omnichannel retailing: Digital transformation of a medium-sized retailer. *Journal of Information Technology Teaching Cases*, 11(2), 122-126.
5. Iftikhar, R., **Cakir, G.**, Wruck, T., and Helfert, M. (2021). How can Older Adults Shop Online in the Future? Developing Design Principles for Virtual-Commerce Stores. *ECIS 2021 Proceedings*, 122.
6. Climent, R. C., **Cakir, G.** (2021). Business Model Themes and Product Market Strategies as Value Drivers in Omni-Channel Retail: A Set of Propositions. *Journal of Business Accounting and Finance Perspectives*, 2(3), 0-0.
7. **Cakir, G.** (2020). Visualising Trade-offs of Objectives in Omnichannel Management: A Mental Model Approach. In *Proceedings of the 4th International Conference on Computer-Human Interaction Research and Applications - Volume 1: WUDESHI-DR*, ISBN 978-989-758-480-0, pages 291-298.
8. Cirqueira, D., Almeida, F., **Cakir, G.**, Jacob, A., Lobato, F., Bezbradica, M. and Helfert, M. (2020). Explainable Sentiment Analysis Application for Social Media Crisis Management in Retail. In *Proceedings of the 4th International Conference on Computer-Human Interaction Research and Applications - Volume 1: WUDESHI-DR*, ISBN 978-989-758-480-0, pages 319-328.
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Conference Presentations

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2. **Cakir, G.**, Bezbradica, M. and Helfert, M., (2020). Retail Strategy in the Age of Retail Apocalypse – Exploring the Role of Customer Experience Orientation on Retail Performance. *European Academy of Management Conference 2020*; accepted and presented in December 2020.
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AR	–	Action Research
ATV	–	Average Transaction Value
B&M	–	Brick & Mortar Store
BPM	–	Behavioural Perspective Model
CC	–	Consumer Confusion
CLD	–	Causal Loop Diagram
CSB	–	Channel Switching Behaviour
CQ	–	Competency Question
DR	–	Design Requirement
DS	–	Design Science
DSR	–	Design Science Research
DSRM	–	Design Science Research Methodology
EI	–	Expert Interview
ENDO	–	Endogenous Variable
EXO	–	Exogenous Variable
FG	–	Focus Group
IM	–	Information Modelling
IS	–	Information Systems
MCQ	–	Multiple Choice Question
MOA	–	Motivation-Opportunity-Ability
MOI	–	Marketing-Operations-Interface
OCA	–	Omnichannel Assortment
PAD	–	Pleasure, Arousal and Dominance
POS	–	Point of Sale
PPM	–	Push-Pull-Mooring
PSQ	–	Perceived Semantic Quality
PU	–	Perceived Usefulness
RO	–	Research Objective
ROPO	–	Research Online, Purchase Offline
RQ	–	Research Question

SAP-LAP	–	Situation Analysis, Actors, Processes – Learning, Actions, Performance
SD	–	System Dynamics
SDM	–	System Dynamics Model
SFD	–	Stock and Flow Diagram
SKU	–	Stock Keeping Unit
SLR	–	Systematic Literature Review
SNQ	–	Syntactic Quality
SoLoMo	–	Social-Local-Mobile
S-O-R	–	Stimulus-Organism-Response
SoW	–	Share of Wallet
SR	–	Scoping Review
TAM	–	Technology Acceptance Model
TPB	–	Theory of Planned Behaviour
UTAUT2	–	Unified Theory of Acceptance and Use of Technology
WOM	–	Word of Mouth

CHAPTER 1 – INTRODUCTION

1

"There is no single right answer or path forward, but there is one right way to frame the problem."

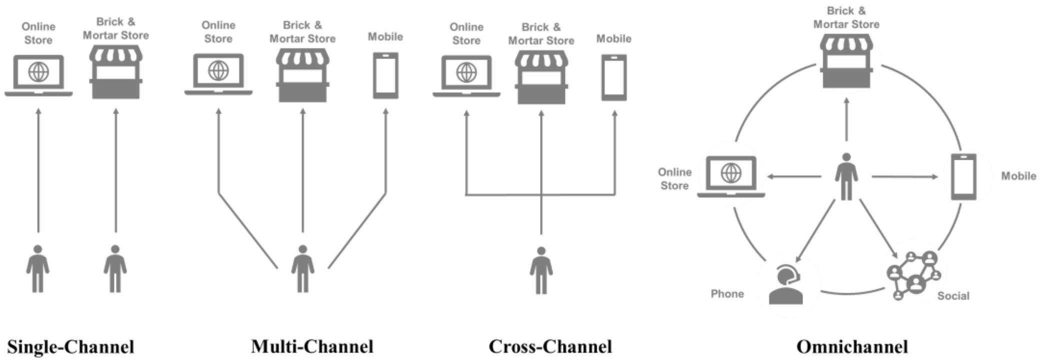
— Clayton M. Christensen

1.1 Research Background and Overview

The recent trends in the retailing industry show dynamic changes in various aspects and can be considered an ongoing disruptive development (Salvietti *et al.*, 2022; Verhoef *et al.*, 2015; Christensen, 2013). The influence and relevance of data, combined with digital technologies, the blurring competition landscape between online and offline retailing, and changing consumer behaviour are the challenges for retailers of today (Thaichon *et al.*, 2022; Hänninen *et al.*, 2021; von Briel, 2018; Balakrishnan *et al.*, 2014; Brynjolfsson *et al.*, 2013; Rigby, 2011), transforming the industry into a combination of traditional / physical and digital retailing (Hagberg *et al.*, 2016). Particularly driven by the pandemic, a shift of consumers into the digital sphere is observed, forcing many retailers to develop sustainable digitalisation initiatives (Timoumi *et al.*, 2022; Pantano *et al.*, 2020; Roggeveen and Sethuraman, 2020). Consumers utilise various digital and mobile devices, engage intensively on social media, demand multiple payment options and convenience at any touchpoint, or flexible product returns while continuously switching between web-shops, app stores, social media channels, and physical stores during their shopping journeys (e.g., Goraya *et al.*, 2022; Neslin, 2022; Salvietti *et al.*, 2022; Timoumi *et al.*, 2022; Bijmolt *et al.*, 2021; Hänninen *et al.*, 2021; Rooderkerk and Kök, 2019). Retailing is one of the most significant industries in the world representing up to 30% of a country's Gross Domestic Product (Business Wire, 2016). Despite the pandemic, the industry is still generating a total revenue of around US$ 17.4 trillion worldwide in 2021 alone, an absolute increase of 23.7% and a CAGR of 4.3% between 2016 and 2021 (Euromonitor, 2022). Considering the relevance of the entire retail industry across the globe, challenges and opportunities during this endeavour are discussed and investigated intensively among research scholars and practitioners.

Response and adaptation to those changes is the fundamental key to survival in the market (von Briel, 2018; Brynjolfsson *et al.*, 2013). Consequently, omnichannel management as a new strategic approach emerged in the industry (Piotrowicz and Cuthbertson, 2014). The term "omnichannel" origins from the retail industry where it describes the simultaneous use of various channels by customers (Shi, 2017) and is developed into an understanding of management practice, defined as "*the synergetic management of the numerous available channels and customer touchpoints, in such a way that the customer experience across channels and the performance over channels is optimized.*" (Verhoef *et al.*, 2015, p. 176). An effective omnichannel strategy is proven to be positively related to retail performance (Cao and Li, 2015; Pauwels and Neslin, 2015). While the preceding approach, known as "multi-channel", entails a structural separation between channels, the omnichannel approach, an evolutionary consequence of the cross-channel concept, allows customers free movement between the channels within one transaction process (Mirsch *et al.*, 2016; Piotrowicz and Cuthbertson, 2014) (**Figure 1**). The intermediate approach, "cross-channel" retailing, describes the (partial) integration of channels to create synergies between them. Studies on cross-channel retailing have been prevalent before omnichannel retailing has been established as its successor (e.g., Cao and Li, 2015; Avery *et al.*, 2012; Berry *et al.*, 2010; Verhoef *et al.*, 2007).

Figure 1: *The evolution from single to omnichannel retailing in the retail industry (source: own illustration)*



In an omnichannel retailing scenario, a customer can start the transaction process on a web-shop (for instance, to search for information or to evaluate alternatives) and finish the process in a physical store with the purchase of the product, expecting a smooth and unhindered transition across all encountered touchpoints between channels (Van Nguyen *et al.*, 2022; Kang, 2018; Verhoef *et al.*, 2015). This switching behaviour induces significant operational challenges for retailers understood as the need for "channel integration" (Goraya *et al.*, 2022; Balakrishnan *et al.*, 2014; Brynjolfsson *et al.*, 2013). Channels represent the sum of paths a company uses to deliver products, services, or information to recipients (Mehta *et al.*, 2002), for instance, a physical store, web-shop, or catalogue. Channel integration is described as the alignment between all channels and defined as the degree to which they interact with each other (Lee *et al.*, 2019; Herhausen *et al.*, 2015; Bendoly *et al.*, 2005) with the aim to provide a seamless transition for the customers across channels. However, with integration efforts, tensions between channels occur (Bijmolt *et al.*, 2021; Zentes *et al.*, 2017). First and foremost, this concerns the provision of consistent information, assortment, promotion, pricing, inventory, delivery, or product returns across all channels (Neslin, 2022; Bijmolt *et al.*, 2021; Zentes *et al.*, 2017; Rigby, 2011; Zhang *et al.*, 2010).

A study of US retailers shows that 87% of the largest retailers in the world pursue an omnichannel retailing strategy, but only 8% achieve it (Brightpearl, 2018), highlighting significant barriers to implementation. Another study (n = 457, US retailers) states that the most referred reasons are lack of budget, a lack of required skills / know-how for implementation, and a siloed organisational structure (Marketing Sherpa, 2018).

Particularly, the *alignment of assortment* represents a major challenge as consumers can experience confusion when confronted with assortment inconsistencies along channels (e.g., Gallino and Moreno, 2019; Rooderkerk and Kök, 2019; Bertrandie and Zielke, 2017; Zhang *et al.*, 2010). This occurs when consumers compare assortments along the channels during a shopping journey and expect the assortment to be identical on each channel. The phenomenon is referred to as an expression of *consumer confusion* and is similar to the out-of-stock experience. It is characterised by an impeded decision-making process of the consumer that results in negative emotional responses such as irritation, frustration, or annoyance. For the retailers, consumer confusion can lead to e.g., purchase abandonment or postponement (short-term), but also to loss of trust and loyalty (long-term) (e.g., Bertrandie and Zielke, 2017), eventually impacting the retailer financially through lost sales (Emrich *et al.*, 2015; Wobker *et al.*, 2015). It is therefore paramount to prevent the consumer confusion phenomenon induced by assortment inconsistencies across channels while pursuing an omnichannel approach. *Strategic assortment decisions* in omnichannel retailing involve the coordination of the assortment between channels that can be realised by a “Full”, “Asymmetric”, or “No integration” approach across channels (Rooderkerk and Kök, 2019; Emrich *et al.*, 2015). The strategic assortment decisions are taken at the *Marketing-Operations-Interface (MOI)*, a decision-interface harmonizing oftentimes conflicting relationships between objectives of the marketing and operations functions of the retailer (Bijmolt *et al.*, 2021; Mak, 2018; Malhotra and Sharma, 2002). Although identical assortment across channels seems to be the desired solution to prevent consumer confusion (from a marketing perspective) (Neslin and Shankar, 2009), retailers oftentimes apply partial integration to benefit from channel-specific advantages such as the Long Tail effect (from an operations perspective) detrimental to consumer confusion prevention. Retailers seem not to be fully aware of the consumer confusion phenomenon, its dimensions and short- and long-term consequences and thus neglect its significance while making strategic assortment decisions at the MOI. The phenomenon is not sufficiently explored or captured in an omnichannel context. Retailers apper to lack knowledge of the relevant concepts, dimensions, and consequences of the consumer confusion phenomenon in an omnichannel retailing context. As a result, retailers are likely to fail in addressing and preventing the occurrence of the consumer confusion phenomenon.

Current studies on strategic assortment decisions and consumer confusion in omnichannel retailing are very scarce and primarily based on experimental studies with a strong lack of empirical contributions. The majority of the studies focus on the alignment between assortment decisions and operational objectives at the MOI such as the optimization of assortment allocation, assortment layout, or inventory management from different perspectives across channels. More importantly, none of the studies considers *channel switching behaviour* in the context of consumer confusion although the behaviour represents the primary condition for the phenomenon to occur. There is a need for the integration and alignment of knowledge capturing the domains for strategic assortment decisions, the consumer confusion concept, and its short- and long-term consequences from a channel switching behaviour perspective in order to inform strategic assortment decisions at the MOI.

This research presents a Design Science project that designs, develops, and evaluates an ontology-based knowledge representation that captures and aligns the knowledge domains on strategic assortment decisions, the consumer confusion concept and its consequences from a channel switching behaviour perspective in an omnichannel context. *Ontologies* are explicit and formal specifications of shared conceptualisations that can structure and link information of specific domains and thus are a suitable technique for knowledge representation. One of the well-known works adopting an ontology approach in business and IS research is the Business Model Ontology developed by Osterwalder (2004) which evolved to the Business Model Canvas framework (Osterwalder and Pigneur, 2010) with a wide and successful application in the business domain today. The literature- and practitioner-informed *Omnichannel Assortment Ontology for Consumer Confusion* in this research is able to integrate and represent relevant concepts and their relationships at the MOI to inform omnichannel retailers on the link between strategic assortment decisions and the consumer confusion phenomenon. The ontology is instantiated and evaluated through a System Dynamics model based on a case study that demonstrates successfully its ability to inform omnichannel retailers on strategic assortment decisions and the consumer confusion concept at the MOI.

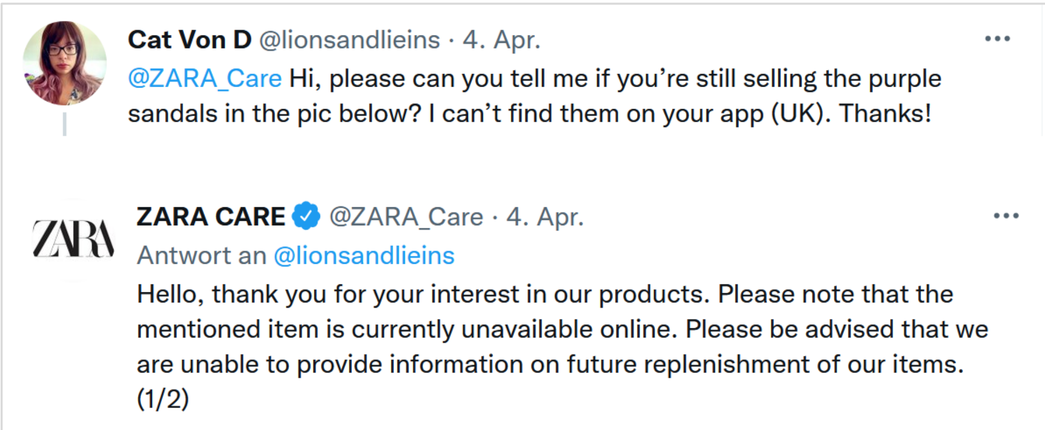
The following sections will outline the grounding of this research by presenting and formulating the research problem first, then deriving the research aim and objectives along with the formulation of the research questions afterwards, followed by arguing the relevance of this research project, the applied theoretical lens, presenting briefly the main contributions that are generated in this research, and finally by showing the organisation of the thesis.

1.2 Motivation and Research Problem

Inconsistencies in the assortment between on- and offline shopping channels of an omnichannel retailer (web-shop and physical store) can lead to unmet customer expectations who switch channels during a shopping journey (e.g., from web-shop to physical store or vice versa, known as “channel hopping”, e.g., Van Nguyen *et al.*, 2022; Kang, 2018; Sit *et al.*, 2018) and expect the desired item on each channel (e.g., Bijmolt *et al.*, 2021; Rooderkerk and Kök, 2019; Zhang *et al.*, 2010). The unmet expectation can lead to a negative customer experience resulting in purchase abandonment, postponement or to loss of trust and loyalty (e.g., Bertrandie and Zielke, 2017). In behavioural psychology, frustration occurs in situations with a negative outcome when a positive one is expected or desired (Anninou, 2013; Roseman, 1991). Shoppers would feel lost since they are not able to identify the desired item of choice (Dogu and Erkip, 2000). They would also experience helplessness because of a mismatch between expectations and actual stimuli surrounding them (Massara *et al.*, 2010). These negative customer experiences are captured as the consumer confusion phenomenon, consisting of a “cognitive”, “affective”, and “conative” dimension that summarize increased cognitive effort, state of negative feelings, and restrictions in behavioural intentions of the customer (Bertrandie, 2020; Anninou and Foxall, 2019; Johnson *et al.*, 2019; Bertrandie and Zielke, 2017; Garaus and Wagner, 2016).

Consumer confusion has been studied extensively in a single-channel context (e.g., Turri and Watson, 2022; Anninou and Foxall, 2019; Coskun *et al.*, 2019; Garaus, 2018), for instance, by investigating information overload phenomena in online shopping situations (Garaus, 2018; Li, 2017) or examining increased choice sets resulting from large assortment sizes in physical stores (Diehl and Poynor, 2010). However, although omnichannel retailing has become the current state-of-the-art in the retail industry today, consumer confusion research from an omnichannel perspective is still very scarce. With the increased adoption of the omnichannel strategy by retailers that allow free switching behaviour for their customers during their shopping journeys in order to provide a seamless customer experience (Verhoef *et al.*, 2015), a new dimension to the consumer confusion phenomenon is observed. Customers are not only exposed to potential confusion at a specific retail situation in a single channel but are now confronted with potential new negative experiences while comparing products, prices, or information across channels (Zhang *et al.*, 2010). Retailers are struggling to address this issue since the extent of the effect is not directly visible, making capturing and measuring attempts very difficult. In some instances, these negative experiences are expressed by customers on social media (Cirqueira *et al.*, 2020; de Oliveira Santini *et al.*, 2020; Choi *et al.*, 2018). An example from the Customer Care Twitter feed ("Zara Care") of the fashion retailer ZARA showing the consumer confusion phenomenon is captured below (**Figure 2**).

Figure 2: *Tweet showing the experience of consumer confusion (source: ZARA Care @Twitter)*



The customer tweet reveals the experience of (1) cognitive difficulty through the expression *"… is there a reason…?"* highlighting an increased state of information processing due to an inexplicable situation on item availability (cognitive confusion). Additionally, (2) an emotional response is also evident by the expression "*I'm gutted, …*" signalling frustration (affective confusion).

To explore this phenomenon further for this study, interviews with an Irish (retailer #1) and German (retailer #2) medium-sized retailer have been conducted to investigate and verify the research problem from a practitioner perspective (practitioner interviews are part of the evaluation strategy of this research, further interview excerpts are provided in **Appendix F-1**). The outcome reveals and confirms the occurrence of the consumer confusion effect in retail practice. For example, the following statements provide evidence of scenarios for the occurrence of the phenomenon.

> "*We lost customers when customers couldn't find the products in the store they see online. Our customer journey [/assortment]is not aligned yet in that perspective.*" (Retailer #1),

and

> "*Students come often to our stores and ask for service. They also ask specifically for items they saw online.*" (Retailer #2).

Another statement highlights the difficulty in identifying and addressing this issue:

> "*It's not currently really acknowledged [in our organisation] that there's that challenge [with the consumer confusion] and we talk about cart abandonment from the website, but we never talk about the customer who researches online and then comes into store. It's not really a conversation at the moment because it is very difficult to capture.*" (Retailer #1).

As mentioned above, so far, the link between assortment and consumer confusion is studied extensively within a single-channel context (e.g., Anninou and Foxall, 2019; Johnson *et al.*, 2019; Garaus and Wagner, 2016; Wobker *et al.*, 2015; Tjiptono *et al.*, 2014; Diehl and Poynor, 2010; Walsh and Mitchell, 2010). Stemming from behavioural psychology, the consumer confusion concept has been a relevant topic for the last six decades and established its relevance in behavioural marketing in the 70s. However, up to this date, research on assortment integration and consumer confusion within an omnichannel context is very rare. Until now, the experiment-based studies of Bertrandie and Zielke (2017), Bertrandie (2020), and the empirical study by Ma (2016), in conjunction with the conceptual work of Cakir *et al.* (2022) that represents a pre-study of this thesis, are currently the only studies examining the relationship between assortment integration and consumer confusion in a multi-channel/omnichannel context. Other scholars (e.g., Rooderkerk and Kök, 2019; Zhang *et al.*, 2010; Neslin and Shankar, 2009) discuss and acknowledge the phenomenon from a theoretical point of view. There is still a strong lack of empirical research on assortment integration and the consumer confusion phenomenon in general (Bertrandie, 2020).

Strategic Assortment Decisions

Concerning strategic assortment decisions in omnichannel retailing, theory identifies three different assortment integration types (Rooderkerk and Kök, 2019; Emrich *et al.*, 2015): "No integration" represents the utilisation of completely different assortments along channels and does not require alignment per se (factually corresponding to a non-omnichannel approach). "Full integration" means that assortment is identical along channels and "Asymmetrical integration" is characterised by a partial overlap of assortment (application of a small subset of the online/offline assortment to the offline/online assortment, or through a set of identical products on both channels but also exclusive items on each channel at the same time). Theoretical studies on channel integration propose to realise an identical assortment along both channels so the customers can find any item on any channel while switching channels to avoid adverse effects (e.g., Bijmolt *et al.*, 2021; Rooderkerk and Kök, 2019; Berry *et al.*, 2010; Zhang *et al.*, 2010; Neslin and Shankar 2009). However, most retailers do not offer identical assortments along their channels. In fact, asymmetrical integration seems to be the most common one observed in retail practice (Neslin, 2022; Rooderkerk and Kök, 2019; van Ameijden *et al.*, 2012). The assumption is that a range of contextual factors influences strategic assortment decisions. Contextual factors are those characteristics and conditions unique to the organisation and its context (e.g., Donaldson, 2001). Each retailer might have a unique market position, customer base characteristics, and its own supply chain requirements (Rooderkerk and Kök, 2019). For example, some retailers might want to utilise the Long Tail effect for the online channel and thus apply a larger assortment online that eventually corresponds to an asymmetrical integration type. The Long Tail effect describes the benefits of selling niche or hard-to-sell products online (Anderson, 2006). Due to their low popularity and reduced costs of offering them online (low buying costs, low marketing and distribution costs, and significantly low inventory costs since they are not presented in physical stores), the collective profit of these items can still contribute substantially to the overall performance of the retailer (Ratchford *et al.*, 2023; Anderson, 2006). Conversely, other retailers might prefer listing “need for touch” products only offline since they underperform in a web-shop (e.g., clothing), resulting in applying an asymmetrical integration with a larger offline assortment instead. Need for touch products, especially luxury goods, has been proven to be performing weakly in an online environment (e.g., Shankar and Jain, 2023; Arora *et al.*, 2017). Similarly, specific products seem not to fit in a web-shop, for instance, complementary decorative items that require hands-on examination by customers before purchase. The following quotes from the practitioner interviews highlight these contextual elements.

> *“Clothing is hard to sell online, we don’t have a lot of it online*.” (Retailer #1).
>
> *“We experience that customers spend some time at the decorations [products] shelf and arrange for example a collection of decoration items together on one plate and take that all together to the checkout – this is not possible in our web-shop.”* (Retailer #2).

Also, individual item performance seems to play a substantial role in deciding on assortment composition as conveyed by the following quote.

> *"If the product on the shelf is not popular compared to the web-shop and does not sell enough or cover its costs or contribute to the store sales then that's a candidate for delisting. Contribution margin is more important than confusing customers."* (Retailer #1).

Additionally, and in contrast, Hübner *et al.* (2022) explain in their study which is based on interviews conducted with retailers, that the importance of minimum required margin is the deciding factor for listing items in the online assortment. Related to this, generally, a full integration approach seems to be a costly undergoing since for example mirroring the whole online assortment in a physical store is severely constrained by physical space limitations (Bhatnagar and Syam, 2014; Zhang *et al.*, 2010). Not many retailers would take this risk since an asymmetrical approach seems way more profitable, especially with the benefits of the Long Tail effect online. Another angle is argued from a target group perspective: retailers observe that their channels seem to be addressing different customer groups thus deliberately distinguishing online and offline assortments to fit their needs:

> *"We experience that our web-shop customers differ from our general target group. Usually, they are much younger, for example, mostly students."* (Retailer #2).

Consumer Confusion Consequences

The consumer confusion phenomenon leads to several consequences. From a short-term view, the literature demonstrates and has proven the occurrence of i.e., purchase abandonment and postponement behaviour (Mitchell *et al.*, 2005; Mitchell and Papavassiliou, 1997), decision avoidance (Mitchell *et al.*, 2005; Mitchell and Papavassiliou, 1997) or confusion of other customers (Foxman *et al.*, 1992; Foxman *et al.*, 1990). Long-term consequences such as negative word-of-mouth (Walsh and Mitchell, 2010; Turnbull *et al.*, 2000), shopping fatigue (Mitchell and Papavassiliou, 1999), and loss of loyalty and trust (Walsh and Mitchell, 2010) are also evident. These adverse customer reactions can lead to a loss in sales (Hense and Hübner, 2022; Wobker *et al.*, 2015). For example, Wobker *et al.* (2015) estimate the loss of sales caused by consumer confusion related to the German grocery industry in 2011 as follows (p. 765): *"If, as a result of consumer confusion, just 1 per cent of all annual consumer food purchases is affected by non-purchase behaviour, the financial impact would be significant. Data for the food retail industry in Germany for 2011 a turnover of € 156.80 billion (GfK, 2012) with a 1 per cent loss means that a total of € 158.38 billion could have been achieved. Or in other words, the food retail industry would occur a loss of as much as € 1.58 billion as a result of non-*

purchase behaviour caused by consumer confusion." The challenge is also stressed by Hense and Hübner (2022) underlining the fact that if customers are not able to purchase what they desire or find a substitute, sales are lost, and dissatisfaction occurs. The effect of assortment integration on financial and non-financial outcomes has been also discussed by Bertrandie (2020), Emrich *et al.* (2015); Zhang *et al.* (2010), Neslin and Shankar (2009), Turnbull *et al.* (2000), Mitchell and Papavassiliou (1999), or Foxman *et al.* (1990). However, there are only a few studies investigating consequences from an omnichannel context so far.

Channel Switching Behaviour

Channel switching behaviour is one of the dominant characteristics of omnichannel customer behaviour (e.g., Schneider and Zielke, 2021; Kang, 2018) and the major condition for the consumer confusion effect to occur. However, current studies do not consider a customer journey and channel switching perspective on the confusion effect in an omnichannel context. Channel switching is characterised by moving from one channel to another within one customer journey (Goraya *et al.*, 2022; Van Nguyen *et al.*, 2022; Kang, 2018). Bertrandie (2020) and Bertrandie and Zielke (2017) specifically raise the need for studies viewing the consumer confusion phenomenon from a customer journey perspective.

The Marketing-Operations-Interface

Strategic assortment decisions are taken at the Marketing-Operations-Interface (MOI), an interface harmonizing oftentimes conflicting relationships between the objectives of the marketing and operations functions of the retailer (Bijmolt *et al.*, 2021; Malhotra and Sharma, 2002). It is a retailer-oriented framework aligning market needs (in this research: consumer confusion prevention) to the corresponding operational activities (in this research: assortment integration types) (Jose Zanon *et al.*, 2013; Slack and Lewis, 2002) (Section 3.2).

Problem Statement of the Study

The summary of the observations of the problem space of this study discussed above leads to the following formulation of the problem statement for this research:

When confronted with assortment inconsistencies across channels in omnichannel retailing while switching channels, customers can experience irritation, frustration or annoyance leading to short- and long-term consequences for the retailer resulting in a negative impact on sales. Since the phenomenon is not sufficiently explored or captured in an omnichannel *context, retailers are likely to fail in addressing and preventing the phenomenon accurately while deciding on the assortment across channels.*

1.3 Research Aim and Objectives

There is a need for an integrated view of the link between strategic assortment decisions, the consumer confusion concept and its consequences from a channel switching perspective at the MOI for omnichannel retailing. To address the problem, the overarching goal of this research is defined as

The design and development of a model that aligns and integrates relevant knowledge on strategic assortment decisions, consumer confusion, and its link to short- and long-term consequences, from a channel switching behaviour perspective at the Marketing-Operations-Interface in an omnichannel retailing context.

Hereby, knowledge is understood as the relevant concepts and relations of the respective domains that are necessary to be identified for alignment and integration. In this thesis, “concepts” refer to a generally accepted set of terms conveying shared meanings in a specific domain, for example, “channels” convey the meaning of “the sum of paths a company uses to deliver products, services, or information to recipients” (e.g., Mehta *et al.*, 2002). The integrated view is aimed at providing the necessary knowledge and alignment between strategic assortment decisions, the consumer confusion concept and channel switching behaviour, which the retailers can refer to while making strategic assortment decisions at the MOI.

Table 1 provides an overview of how the problem characteristics of the problem space are addressed with the envisioned characteristics of the solution proposal.

Table 1: *Mapping problem characteristics to solution characteristics*

Problem Characteristics	Proposed Solution Characteristics / Goodness Criteria
1. Lack of alignment of strategic assortment decisions with the consumer confusion concept.	Provision of an integrated view and alignment of strategic assortment decisions with the consumer confusion concept.
2. Lack of consideration of a channel switching perspective in consumer confusion research.	Consideration and integration of a channel switching perspective linked to the consumer confusion concept.
3. Lack of consideration of the short- and long-term consequences on the retailer resulting from the consumer confusion phenomenon.	Consideration and integration of short- and long-term implications for the retailer linked to the consumer confusion phenomenon.

Firstly, it is proposed that an integrated view and alignment of strategic assortment decisions with the consumer confusion concept is required to be established. Secondly, a channel switching perspective is proposed to be incorporated into the integration. Lastly, the consideration of short- and long-term implications for the retailer that are linked to the consumer confusion phenomenon is to be provided in the solution.

For the realisation of the above-described solution proposal, this research first identifies the required concepts and their relations that are critical to be considered in aligning strategic assortment decisions to consumer confusion and its consequences. Thereafter, all elements and their relations are integrated into a model representing knowledge suitable for informing strategic assortment decisions at the MOI related to the consumer confusion phenomenon, and its consequences from a channel switching behaviour perspective. In the subsequent step of the research project, the model is evaluated and instantiated in a System Dynamics model demonstrating its features as an effective knowledge representation for the application at the MOI.

Accordingly, the following research objectives are defined:

- **Research Objective 1 (RO1)**: to identify the major concepts and relations that constitute strategic assortment decisions, the consumer confusion concept, its short- and long-term consequences, and channel switching behaviour in omnichannel retailing.
- **Research Objective 2 (RO2)**: to create and formalise an integrated view aligning the major concepts and relations of strategic assortment decisions, the consumer confusion concept, its short- and long-term consequences, and channel switching behaviour.
- **Research Objective 3 (RO3)**: to demonstrate the utility of the model in order to evaluate its fitness to the proposed solution. The outcome should show its managerial utility in the application domain of the problem.

The application domain of the problem is defined as strategic assortment decisions at the MOI in omnichannel retailing. Relevant stakeholders of the solution proposal are therefore identified as assortment decision makers at the MOI in omnichannel retailing.

1.4 Research Questions

For the achievement of the research objectives, the following research questions are defined.

Main Research Question (Main-RQ):

How can an alignment between strategic assortment decisions and the consumer confusion concept from a channel switching perspective be represented in order to inform assortment decisions at the Marketing-Operations-Interface in omnichannel retailing?

To answer the Main-RQ, it is divided into the following three Sub-Research Questions.

Sub-Research Question 1 (Sub-RQ1):

What are the relevant concepts and relations that constitute strategic assortment decisions, the consumer confusion concept, its short- and long-term consequences, and channel switching behaviour in omnichannel retailing?

Sub-Research Question 2 (Sub-RQ2):

How can an integrated view of the concepts and relations be designed and formalised that aligns strategic assortment decisions with the consumer confusion concept, and its short- and long-term consequences from a channel switching behaviour perspective in omnichannel retailing?

Sub-Research Question 3 (Sub-RQ3):

Is the integrated view able to inform about the alignment between strategic assortment decisions with the consumer confusion concept and its consequences from a channel switching behaviour perspective in omnichannel retailing based on a practitioner's point of view?

1.5 Relevance of the Research Project

The research problem on assortment integration and consumer confusion represents an important issue faced by the retail industry and concerns researchers in the domain of retailing and consumer behaviour equally.

With regard to managerial relevance, studies find that omnichannel shoppers are more profitable than non-omnichannel shoppers (Business Wire, 2022; Wells, 2021; Sopadjieva *et al.*, 2017; Google, 2015), and more loyal (Petrak, 2022). For instance, a worldwide study from 2018 reveals that despite being merely 7% of all shoppers, omnichannel shoppers are contributing on average to 27% of total sales of omnichannel retailers (Criteo, 2018). This supports the research objective in contributing to addressing the issue of the consumer confusion phenomenon faced by omnichannel shoppers. In terms of channel switching behaviour, for example, a study on US and UK consumers (n = 2,000) shows that webrooming is the number one switching type (74%) versus showrooming (57%) and click-and-collect (54%) (Berthiaume, 2019). Web- and showrooming are two specific types of channel switching behaviour discussed in Section 2.6.1. Consumer confusion has always been an important challenge for retailers (e.g., Anninou and Foxall, 2019; Garaus and Wagner, 2016; Wobker *et al.*, 2015; Walsh and Mitchell, 2010). Today, with the adoption of omnichannel retailing, channel switching behaviour brings a new dimension to the consumer confusion concept. Customers are not only exposed to potential confusion due to product size, variety, brands, etc. but are now confronted with potential negative perceptions while comparing assortment across channels. Additionally, this issue can entail a reduced time spent in-store and thus an additional negative impact on sales (Anninou and Foxall, 2019). It is the retailer's objective to solve the tension between the customers' privilege of being able to switch channels and the consistency of the offered products across channels. Moreover, assortment decisions have always been one of the major decision variables within a retail strategy with high binding of resources. This justifies an additional necessary contextualisation of assortment decisions from a consumer confusion perspective. For instance, Tesco, the British multinational grocery retailer cut its product range by 30% in 2015 to reduce costs and complexity in shopping (The Guardian, 2015). Considering the total number of SKUs of 90,000 items offered by Tesco at that time, this equals a substantial decrease in resources bound to assortment, freeing up inventory spaces, net working capital, and a general reduction of complexity in managing assortment and supply chains. Today, assortment reduction strategies are still a way to optimize resources and cope with external factors (e.g., pandemic, and supply chain challenges) (Moore, 2021; Food Dive, 2020).

As for scientific relevance, scholars prove the fact that channel integration efforts in the course of omnichannel retailing can increase retail performance (Neslin, 2022; Cao and Li, 2015; Pauwels and Neslin, 2015) and highlight that omnichannel shoppers usually react with strong loyalty (Schramm-Klein *et al.*, 2011). Moreover, Pantano and Viassone (2015) show that the combination of on- and offline channels can positively influence consumers' perception of service quality and their attitude towards retailers. Consumers who use multiple channels buy more products, spend more, and pay higher prices than single-channel shoppers (Fernández *et al.*, 2018; Lee and Kim, 2008; Van Baal and Dach, 2005). Researchers have always emphasised that assortment decisions for retailers are of major strategic relevance (Rooderkerk and Kök, 2019; Broniarczyk and Hoyer, 2010; Mantrala *et al.*, 2009). With the presence of multiple channels and touchpoints offered by retailers today, managing the assortment has now even become more difficult than ever. The early work of Mantrala *et al.* (2009) points out the rising significance of challenges in assortment planning due to the introduction of multi-channel concepts and the increasing role of online retailing (Sethuraman *et al.*, 2022). Assortment planning across channels has developed into a sophisticated research topic today (e.g., Ratchford *et al.*, 2023; Hense and Hübner, 2022; Lo and Topaloglu, 2022; Neslin 2022). Moreover, it is important to realise that consumer confusion represents a "hygiene factor" (its absence does not lead to positive satisfaction, its presence however, can lead to irritation and frustration) posing a significant requirement for retailers to increase efforts in mitigating or preventing the phenomenon (Mitchell *et al.*, 2005). Lastly, Wobker *et al.* (2015) emphasise the potential financial implications of the phenomenon and underline its significance from a retail performance point of view.

Explorative Survey

An explorative online survey was conducted for this research with European retailers (n = 17, online, anonymous, see **Appendix F-2** for questionnaire). The survey aimed at gaining exploratory insights into assortment configuration and the experience of the consumer confusion phenomenon in the context of omnichannel retailing. The results reveal the following insights and underline the relevance of this research project further (see also EVAL1.2 results in Chapter 6):

- On the question "To your knowledge, how often do customers experience confusion because of assortment inconsistencies across your channels?", 52.9% of the respondents admit consumer confusion to be an occurring issue ("very often", "often", "sometimes", or "rarely") whereas 11.8% do not experience the phenomenon at all ("never"). Another 11.8% are not aware of the problem ("we do not know") and 23.5% state the problem not to be applicable in their case (single-channel retailers).
- On the question "How strongly do you see the consumer confusion effect as a problem for your company leading to lost sales potentials?", 18.2% refer to the issue as being a "serious problem", 45.5% as a "medium problem", 18.2% as a "small problem", and another 18.2% as a "very small problem / no problem at all."
- Moreover, retailers do acknowledge the phenomenon but stress the difficulty in addressing it (qualitative responses), e.g., "… *We do know about customers being confused when products are out of stock or not the same [in-store] as on the web*

shop. However, it is very difficult to gather data on this or measure it." (response #9).

- Furthermore, retailers are not aware of any decision support addressing the challenge (qualitative responses), e.g., "*... We are not aware of any magic formula [for consumer confusion prevention].*" (response #13).
- One retailer points out that customers oftentimes buy a different product when confused (qualitative response): "*Customers are sometimes irritated not finding the same product, but oftentimes buy a different product instead.*" (response #3).

A similar explorative study, conducted by Bertrandie (2020), reveals supporting insights based on consumer interviews. For instance, customers reveal being confused because of "differing assortment across channels" or "differing availability of products across channels", underlying the importance of assortment consistency across channels while deciding on omnichannel assortment. More details on the author's study are provided in the course of the literature review in Section 2.4.2.

1.6 Theoretical Lens

The theoretical lens is understood as a filtering mechanism on how we view certain phenomena (Niederman and March, 2019). Basically, a lens tells the researcher what theory or paradigm can be applied to determine key concepts, explanations, scope, limitations, and the positioning of the research within a specific research domain and/or discipline. As a theoretical lens, the Marketing-Operations-Interface Framework (MOI) is argued to have a strong explanatory fit to the research context and problem domain of this study. The following section describes and reasons briefly the application of the framework. Section 3.2 describes the MOI and its positioning as a theoretical framework in more detail.

The Marketing-Operations-Interface Framework

The applied theoretical framework for this research project is understood as the Marketing-Operations-Interface (MOI) and is generally defined as the "*Alignment between the marketing and operations strategy [of a firm].*" (Malhotra and Sharma, 2002, p. 215). In omnichannel retailing, the MOI is a retailer-focused framework that consists of three integrated panels, comprising (1) a customer journey element (representing the context for the retailer's marketing function), (2) the corresponding product flow (reflecting operational activities), and (3) the key decision areas in-between (assortment, distribution & delivery, and returns) linking both perspectives together (Bijmolt *et al.*, 2021). The interface represents a decision area where the objectives of both marketing and operations functions are addressed, coordinated and decisions made. The decisions are to be in line with the business strategy and goals. The customer journey follows a path from "need recognition", "information search", and "alternatives evaluation", to "order", "order pickup or receipt", and "consumption", "return", "post-journey evaluation", reflecting pre-purchase, purchase, and post-purchase phases that can be addressed directly by the decision areas. The product flow is illustrated through the steps "purchase" of the goods, "storage", "distribution", "last-mile delivery", and "collection / distribution of returns". Challenges arise at the interface (decision areas) as both functions are characterized by a different set of objectives and requirements. For example, the trade-off between inventory limitations to safe costs vs. high assortment variety and availability to meet customer needs represents a typical conflicting relationship.

There is a strong fit of the explanatory strength of the MOI for the research domain and problem space of this study. To begin with, assortment integration represents a strategic decision problem within the decision area between the consumer confusion phenomenon (representing the marketing aspect) as well as the assortment allocation across channels (representing the operations aspect). Secondly, the MOI in omnichannel retailing views the marketing perspective from a customer journey perspective, providing a strong basis for the need for a channel switching perspective in the solution characteristics of this study. Thirdly, the solution proposal of this research is characterised by the provision of strategic decision guidance positioning itself within the decision area intended to be utilised by relevant domain experts. Lastly, the consideration of short- and long-term consequences of the consumer confusion phenomenon represents the link to the business strategy component and its objectives (primarily the improvement of retail performance). Consequently, the theoretical and managerial contributions of this research are positioned within this field of theory. The MOI framework is described in detail in Section 3.2.1.

1.7 Contributions

This research is introducing the *Omnichannel Assortment Ontology for Consumer Confusion* that represents the alignment and integration of strategic assortment decisions and the consumer confusion concept at the Marketing-Operations-Interface for omnichannel retailers. The following summarizes the key contributions of this research from a theoretical and managerial point of view.

Theoretical contributions

- The Omnichannel Assortment Ontology for Consumer Confusion as design knowledge for the alignment of strategic assortment decisions and consumer confusion from a channel switching behaviour perspective in omnichannel retailing.
- Novel concepts that contribute to the omnichannel assortment body of knowledge.
- Novel concepts that contribute to the consumer confusion in omnichannel retailing body of knowledge.
- Novel concepts that contribute to the channel switching behaviour body of knowledge, including a typology depicting the channel switching intensity of customers.
- Enhancement of the understanding of the interplay between strategic assortment decisions, the consumer confusion concept, and channel switching behaviour while pursuing an omnichannel retailing approach in the current discourse of omnichannel transformation research.

Managerial contributions

- The Omnichannel Assortment Ontology for Consumer Confusion as a solution artefact capable of informing decision makers for strategic assortment decisions in omnichannel retailing about the linkage of strategic assortment decisions with the consumer confusion concept from a channel switching perspective. This allows the identification and mitigation of adverse consumer reactions that can lead to a potential negative impact on the retailer's financial performance.
- The formalisation of the ontology via Protégé offers free-to-use and distribution options.
- A set of practical formulas on how to determine the degree of overlap depending on the integration type.
- An overview of the paths for assortment integration a retailer can decide on.

1.8 Organisation of the Thesis

The logic of the thesis structure follows the Design Science Research Methodology (DSRM). The DSRM is argued as the appropriate research methodology for this thesis where its phases serve as a structural guidance for the organisation of the thesis content, beginning from the formulation of the *problem statement* and *solution objectives* to the *design and development* phase and *demonstration / evaluation* step. The problem statement and relevance of the research along with the objectives are presented and justified in the previous sections. The remainder of the thesis is organised as follows (**Figure 3**).

Chapter 2 outlines the theoretical background of this study and covers the literature review. Through the application of a systematic literature review, the chapter provides an overview and discussion on the state-of-the-art research about omnichannel assortment, its relation to consumer confusion and channel switching behaviour. The chapter concludes with a literature synthesis and a summary highlighting the research gap and positioning of the research project.

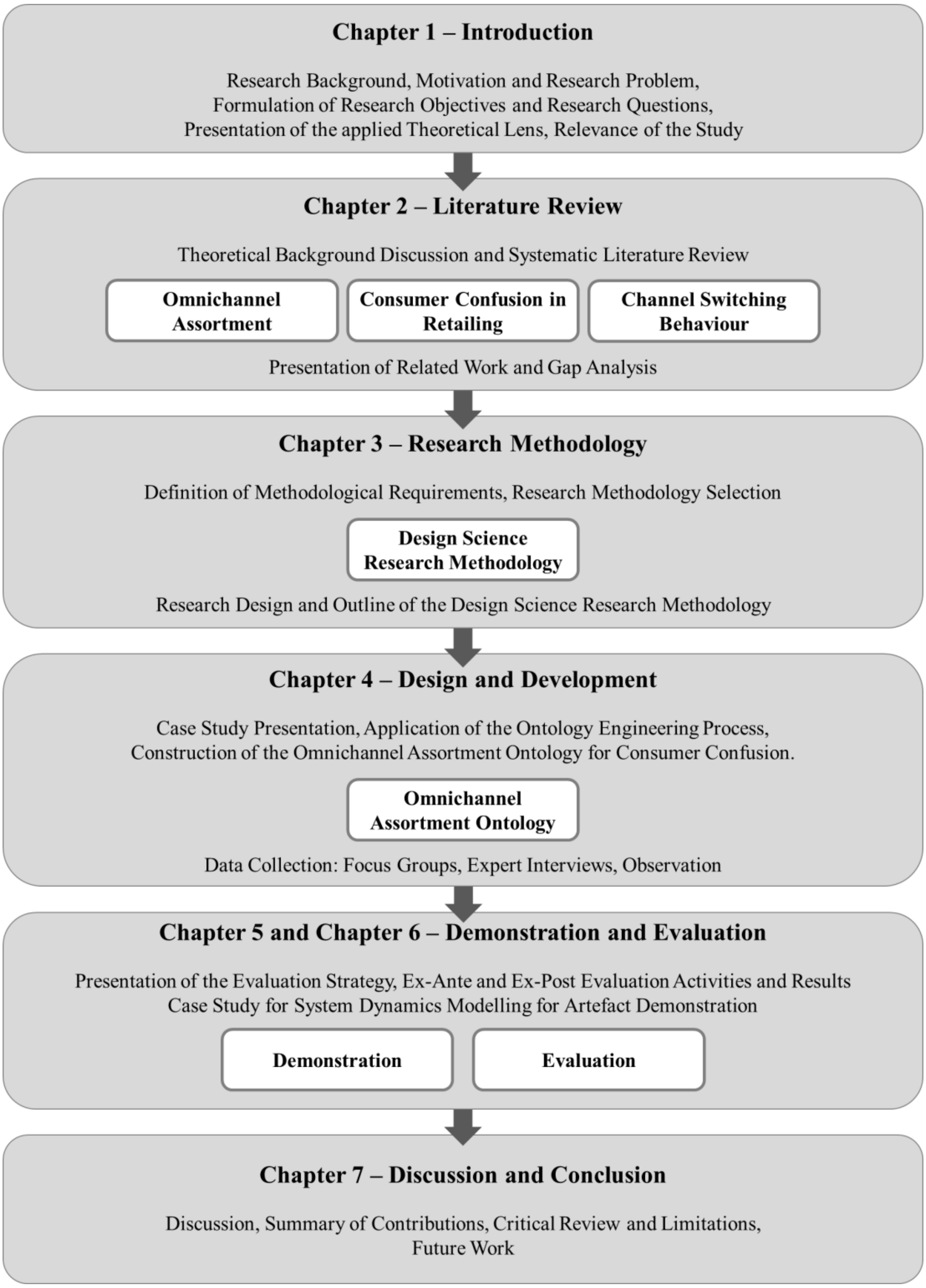
Chapter 3 is dedicated to the methodology of this research and includes a comprehensive overview and description of methodological requirements, specific methodologies, and a discussion of the theoretical framework of this research. Moreover, the rationale for the selection of the DSRM is argued, followed by the research design visualised and described in detail.

Following the Design Science Phases further, Chapter 4 covers the design and development activities for the construction of the ontology. After the presentation of the case study context serving as the empirical data source, and the data collection and analysis methods (focus groups, interviews, observations), the design and development of the Omnichannel Assortment Ontology for Consumer Confusion is described in detail.

The demonstration and evaluation of the ontology are presented in Chapter 5 and Chapter 6. Based on a case study, the use of the ontology is demonstrated via the instantiation into a System Dynamics model showing its fitness in meeting the solution requirements. Thereafter, the evaluation strategy is developed and presented, describing its implementation and results.

Chapter 7 revisits the research objectives and research questions, summarizes the core contributions of this thesis and concludes the study with a critical review of limitations and an outlook for future research.

Figure 3: *Thesis structure*



CHAPTER 2 – LITERATURE REVIEW

2

"Knowledge is an unending adventure at the edge of uncertainty."

— Jacob Bronowski

2.1 Introduction

This chapter is dedicated to the literature review of this study and outlines the systematic analysis and synthesis of state-of-the-art knowledge in the field of omnichannel assortment, consumer confusion, and channel switching behaviour in omnichannel retailing. A literature review aims at summarizing the current state of knowledge in the relevant field of a subject so that a contextualisation of the research project and its contributions can be provided adequately (Rowley and Slack, 2004). This involves the identification of existing research gaps and relevant research challenges in the current discourse in order to appropriately justify the research aim and research questions. The purpose of this chapter is therefore to review the relevant field for this study that is positioned at the intersection between the domains of omnichannel assortment, consumer confusion, and channel switching behaviour. The following paragraphs first describe the steps and methods of the systematic review that are applied to this research followed by a critical reflection on the existing work in the three research domains. Moreover, a particular focus is directed at the intersections of these three research areas to identify relevant contributions potentially addressing the research problem that is argued to be positioned at the intersection of all three research areas. In the course of the literature synthesis process, a total of 169 papers have been reviewed in-depth. Descriptive results of the systematic literature review are provided in **Appendix A-3**.

2.2 Definition of Key Terms

Before presenting the systematic review process, the findings, and the research gaps, the following table outlines how relevant key terms are defined within this research (sorted in alphabetical order) (**Table 2**).

Table 2: *Key terms and their definitions within this research*

Term	Definition	Key Source(s)
Alignment	"The degree to which the needs, demands, goals, objectives and/or structures of one component are consistent with the needs, demands, goals, objectives, and/or structures of another component."	Nadler (1983, p. 119.)
(Omnichannel) Assortment	The collection of goods or services a retailer offers to its consumers. Consequently, within an omnichannel strategy, omnichannel assortment represents the offering of goods (and services) across different channels.	Hense and Hübner (2022); Rooderkerk and Kök, (2019); Berman *et al.* (2018); Kumar *et al.* (2017); Kök *et al.* (2008)
Assortment Coordination	Decision on the desired type of assortment integration across all channels.	Rooderkerk and Kök, (2019); Emrich *et al.* (2015)

Assortment Integration	Represents the specific decision a retailer needs to make in order to achieve channel integration from an assortment perspective.	Rooderkerk and Kök, (2019); Bertrandie and Zielke (2017); Emrich *et al.* (2015)
Channels	The sum of paths a company uses to deliver products, services, or information to recipients (e.g., a physical store, web-shop, or catalogue).	Mehta *et al.* (2002)
Channel Integration	The degree to which channels interact with each other.	Lee *et al.* (2019); Herhausen *et al.* (2015); Bendoly *et al.* (2005)
Channel Switching	A customer's purchasing pattern where different channels (e.g., web-shop, brick-and-mortar store, mobile store) are used to acquire information and purchase products.	e.g., Van Nguyen *et al.* (2022); Schneider and Zielke (2021); Hsiao *et al.* (2012)
Consumer Confusion	"A three-dimensional, reflective second-order construct, consisting of the three reflective first-order dimensions: (1) emotion, which represents affective feelings of the discomfort associated with retail shopper confusion; (2) cognition, which captures the exceedance of cognitive processing abilities; and (3) conation, which describes the restriction in behavioral intention."	Garaus and Wagner (2016, p. 3461)
Consumer Confusion Consequences	Short- and long-term consequences for the consumer and retailer resulting from consumer confusion.	Bertrandie and Zielke (2017)
Customer Journey	The buying process of a customer which starts with "need recognition" leading to "purchase" and "post-purchase evaluation".	e.g., Bijmolt *et al.* (2021); Herhausen *et al.* (2019); Lemon and Verhoef (2016)
Marketing-Operations-Interface Framework	"The alignment between the marketing and operations strategy [of a firm]." Within a retailing context, the framework consists of three integrated panels, comprising a customer journey element, the corresponding product flow, and the key decision areas in-between linking both perspectives together.	Bijmolt *et al.* (2021); Malhotra and Sharma (2002, p. 215)
Omnichannel Management	"The synergetic management of the numerous available channels and customer touchpoints, in such a way that the customer experience across channels and the performance over channels is optimized."	Verhoef *et al.* (2015, p. 176)
Omnichannel Retailing	Describes the simultaneous use of various channels by customers.	e.g., Shi (2017); Verhoef *et al.* (2015)
Ontology	A formal, explicit specification of a shared conceptualization.	Gruber (1993)
Retail Performance	Defined as the performance of a retailer whereby the performance is distinguished by their measurability between financial and non-financial measures.	Cakir *et al.* (2019)
Showrooming	Channel switching behaviour of consumers who collect product information in physical stores first and complete the purchase in the online store.	e.g., Aw (2020); Flavián *et al.* (2020); Kang (2018)
Strategic Assortment Decisions	Involve the development and realisation of the assortment strategy and consists of assortment expansion and assortment coordination decisions in an omnichannel retailing context.	Rooderkerk and Kök (2019)
Webrooming	A specific type of channel switching behaviour evident in consumers who research product information online but purchase in a physical store.	Aw *et al.* (2021); Kang (2018); Flavián *et al.* (2016)

2.3 Goals and Technical Approach of the Systematic Literature Review

A literature review represents an essential first step and a fundamental basis for a research project (Baker, 2000) since it informs about the current knowledge existing in the subject area (Rowley and Slack, 2004). Generally, the main purpose of a literature review is to uncover, organise and assess the existing body of knowledge in the field of interest (Rowley and Slack, 2004; Tranfield *et al.*, 2003). It is crucial in identifying key concepts, theories, major issues and current topics in the relevant domain in order to develop an understanding of the current discourse taking place among contributing scholars (Hart, 2018; Rowley and Slack, 2004; Tranfield *et al.*, 2003). A well-conducted literature review can provide a strong and reliable overview of the state-of-the-art in the domain of interest and allows an effective positioning of own contributions. Two major styles for a literature review can be distinguished: a traditional (narrative) and a systematic approach (Jesson *et al.*, 2011). Both approaches can serve different goals depending on the nature of the inquiry and the quality of the literature (Baumeister, 2013).

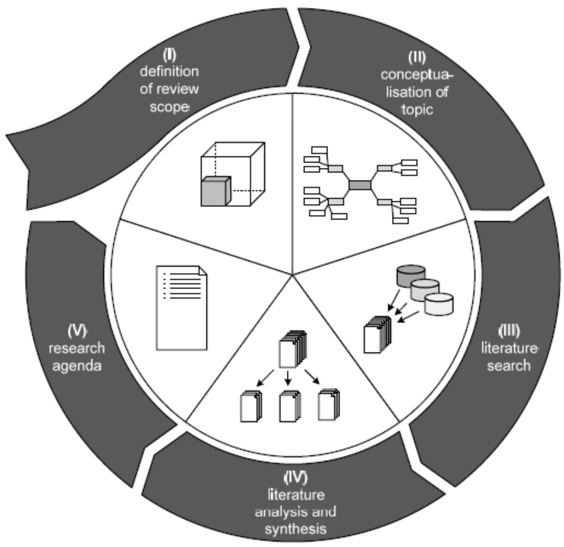
The traditional approach is characterised by a broad question serving as a basis, no application of specific steps, methods or selection criteria while approaching the literature base, and a predominantly qualitative and oftentimes subjective synthesis of the gathered content that is considered non-exhaustive. In contrast, a systematic style is motivated by a rather specific purpose statement, the outline of transparent and explicit steps on how to conduct the review (search protocol) and a more objective synthesis compared to a narrative approach (Snyder, 2019; Jesson *et al.*, 2011; Tranfield *et al.*, 2003). Since a systematic approach follows an explicit search strategy, the identified and analysed literature can be considered exhaustive within the applied method parameters (Siddaway *et al.*, 2019). Therefore, unlike a systematic approach, a traditional style of reviewing the literature is most likely not or very hard to reproduce. Systematic literature review (SLR) approaches have recently gained more traction in the domain of business research (Snyder, 2019). For this study, a systematic approach is applied for the following reasons:

- A specific question that resulted from a scoping study prior to the research project (see **Appendix A-1**) provides a concrete scope and boundary for the relevant domains to be reviewed.
- The relevant domains show a large and wide variety of rich sources, requiring a systematic selection process to identify the "right" literature with inclusion and exclusion criteria, to ensure comprehensiveness and thus high quality.

- Similar terminology use in different disciplines and periods requires a systematic approach for identification and differentiation (e.g., the interchangeable use of "omnichannel" and "multi-channel").
- The aim is to provide an objective and transparent process to minimise bias and meet validity and reliability requirements and thus ensure high-quality output.

An SLR usually involves several steps guiding the researcher in the systematic identification, collection, analysis, and synthesis of the current body of knowledge (Siddaway *et al.*, 2019; Okoli 2015; Brocke *et al.*, 2009; Kitchenham *et al.*, 2009; Webster and Watson, 2002). This literature review process is guided by the framework from the work of Brocke *et al.* (2009) (**Figure 4**) and is organised with the steps further below. The framework is adopted, particularly due to its nature of "circularity" allowing iterative cycles in the research and reviewing process to account for the incorporation of new publications or the refinement of the literature search tactics (e.g., keywords). This feature ensures keeping a literature review output as topical as possible while maintaining a stable repository of a relevant knowledgebase.[1] Moreover, the framework offers high flexibility in terms of phase specification utilising the review taxonomy proposed by Cooper (1988) (see **Appendix A-2**) offering different instances of phase characteristics.

Figure 4: *Literature review framework by Brocke et al. (2009)*



[1] It should be noted that during the literature review process, several iterations have been conducted following the cyclic steps. The iterations helped to identify the major research streams and define the scope of the review process more accurately (e.g., keyword and synonym refinement).

Definition of review scope (I): This initial phase defines the focus (most important subject of the review process, e.g., identification of existing theories or applications), goal (main purpose, e.g., integration, critique, or central issue identification within the literature), organisation (historical, conceptual, or methodological), perspective (neutral or espoused position), audience (e.g., specialised or general scholars, practitioners or the general public), and coverage (the extent of the articles that are covered in the review text, e.g., entire literature, selected, representative, or central papers) of the literature review.

The conceptualisation of topic (II): in this phase, the broad concepts and key terms of the literature domain are to be defined or identified, serving as a basis for search terms and entry points in the subsequent search activity. This should be done with the use of seminal sources (e.g., established textbooks in the domain), existing reviews, recent publications, or concept mapping (e.g., Kane and Trochim, 2007; Novak, 1990).

Literature search (III): This step involves the actual literature search on databases through the application of search strings and the conduction of backward (review of articles that are cited in the retrieved articles) and forward (articles that are citing the retrieved articles) citation search. Sources include primarily high-quality journals and conference proceedings. A major part of this step is accounted for the evaluation of the retrieved results through relevance checks (e.g., review of title, abstract and keywords assigned to the article), eventually limiting the number of articles to a certain quantity.

Literature analysis and synthesis (IV): In this phase, the collection of literature is analysed and synthesised. For this, a concept-centric approach (Webster and Watson, 2002; Salipante *et al.*, 1982) that organises identified concepts into units of analysis is recommended. The synthesis summarises and highlights major observations and gaps in the analysis process.

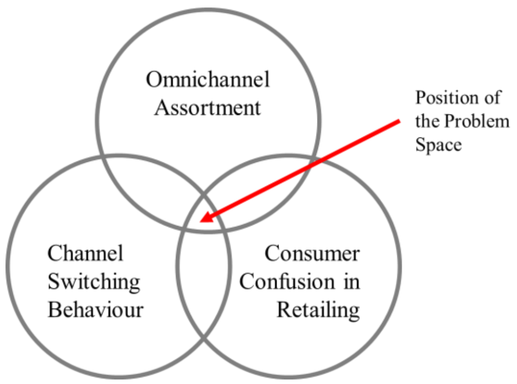
Research agenda (V): The last step condenses the conclusions of the synthesis step and formulates a research agenda, represented by highlighting research gaps and opportunities to extend the current state-of-the-art knowledge. It also represents the entry point for a restart of the reviewing process beginning again with phase I in case an update or refinement of the literature review is desired or needed.

The following section describes how the framework is applied to this literature review

The purpose of this literature review is to investigate the state-of-the-art of contributions in the knowledgebase of omnichannel assortment, consumer confusion, and channel switching behaviour in order to assess to what extent research is addressing the problem space as stated in Section 1.2. For the **definition of the review scope**, the *focus* of the literature review is therefore defined as identifying research outcomes and theories relevant to addressing the problem space (related work). The *goal* is to integrate and criticise the findings *covered* in an exhaustive and selective way as well as uncover central issues in the discourse while *organising* the results conceptually and upholding a neutral objective position in the *perspective* relative to the defined problem statement of this research. The *audience* is considered as specialised and non-specialised scholars in the domain of omnichannel retailing research as well as practitioners operating in the retailing industry.

The **conceptualisation of the topic** is informed by the findings from a scoping review conducted before the research project (see **Appendix A-1** for the procedure). The synthesis of the scoping review reveals that the relation between omnichannel assortment integration (as an instance of channel integration) and consumer confusion induced by customers' channel switching behaviour (as an instance of customer experience) represents a problem as outlined in Chapter 1, allowing limiting the scope of the literature review to the three research areas of (1) omnichannel assortment, (2) consumer confusion, and (3) channel switching behaviour. The problem space can be positioned at the intersection of these research areas as depicted in **Figure 5**. Seminal sources are represented by the works of e.g., Verhoef *et al.* (2015) on omnichannel management and Rooderkerk and Kök (2019) on omnichannel assortment.

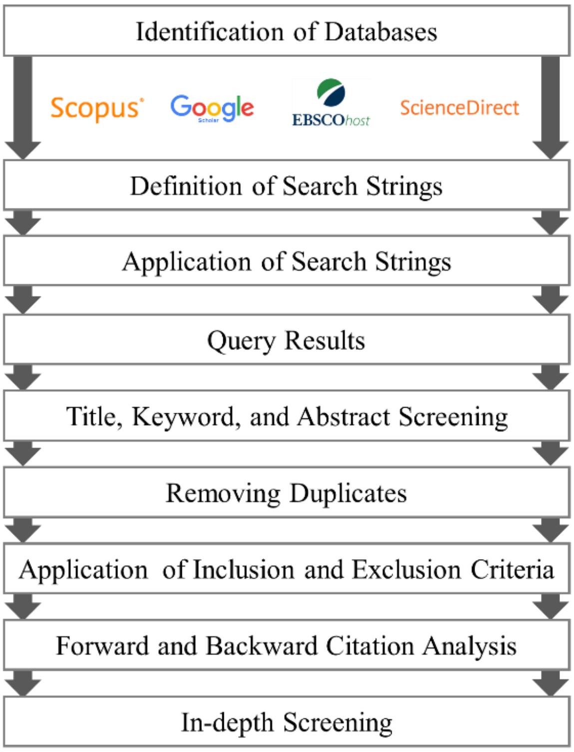
Figure 5: *Research streams, intersections, and problem space positioning*



Looking through the MOI perspective, the essence of the research problem is situated in the assortment decision area, aimed at resolving the tension between the structural configuration of omnichannel assortment (operations function) and the behavioural outcome on the customer side (marketing function). The theme of the structural configuration of omnichannel assortment is situated in the domain of strategic assortment planning (Rooderkerk and Kök, 2019; Mantrala *et al.*, 2009). The rationale of the literature review is to identify research addressing the problem space most accurately. Each intersection (marked with "∩") offers a further focus narrowing down the inquiry to areas where two of the three main concepts are addressed in the literature (omnichannel assortment ∩ consumer confusion in retailing, omnichannel assortment ∩ channel switching behaviour, and consumer confusion in retailing ∩ channel switching behaviour). The problem space itself is positioned at the intersection of all domains. The review is sequenced to analyse the key research areas first, then consolidate findings from the intersections in a second step. This is due to the fact that an initial targeted search on only the intersections yielded unsatisfactory results evident by limited findings (see Section 2.7 documenting the synthesis process), therefore requiring cross-validation through targeted domain reviews first and subsequent intersection reviews.

Along with the identification of the relevant research domains, corresponding concepts, and terms, keywords are retrieved to be applied in the subsequent **literature search process**. A search protocol has been developed to guide the literature search process (**Figure 6**).

Figure 6: *Literature search protocol guiding the literature search process*



This literature review considers the databases Scopus, EBSCOhost, ScienceDirect, and Google Scholar. These databases represent the major destinations for a comprehensive and reliable literature search for high-quality articles in the management and IS field and provide appropriate features for effective search string applications. More than one database has been selected to validate the findings of one database with those of the other databases. Moreover, differences in the coverage of databases (e.g., dissertation works can be retrieved via Google Scholar unlike Scopus) act as a complementary feature for relevant article identification within the research process. The databases serve as entry points for the bodies of knowledge.

In the next step, the applied keywords retrieved from the conceptualisation step are defined and adjusted for each database as shown in **Table 3**. For the first research domain (omnichannel assortment), different synonyms for "omnichannel" are considered, e.g., "omni-channel" but also "multi-channel" / "multichannel" or "multiple channels" since some studies tend to use these terms synonymously with the meaning of "omnichannel" (Galipoglu *et al.*, 2018), e.g., in Ratchford *et al.* (2023), Bertrandie and Zielke (2017). For the keyword "assortment" the alternative expression "merchandis*" has been identified in an initial search cycle as a valid synonym for "assortment" (an asterisk covers the extensions of "merchandising", "merchandise", or "merchandiser"). Similarly, it became evident that "customer" and "consumer" have been used interchangeably throughout the literature in consumer confusion research (e.g., "customer" in Bertrandie, 2020). Also, the additional synonym "shopper" or "shopping" confusion has been added (e.g., from Coskun *et al.*, 2019; Garaus and Wagner, 2016) with the use of an asterisk. The initial queries yielded high results so that a refinement on the context seemed appropriate: the subsequent query excluded the most occurring adjacent contexts "brand confusion" and "label confusion" in the consumer confusion research domain that are not within the focus of this research through the utilisation of the Boolean operator "NOT" where applicable. For channel switching, show- and webrooming, the synonyms "ROPO" which stands for "research online, purchase offline", e.g., in Patel (2022) and Kowalczuk (2018), and "research shopping" or "research shoppers", e.g., in Pallant *et al.* (2020) and Viejo-Fernández *et al.* (2019), have been considered. In the ScienceDirect search, no wildcards are supported so the synonyms have been added manually to the search strings. Although it seemed appropriate to incorporate keywords addressing the MOI to sharpen the focus of the inquiry, initial queries in doing so produced very low results and showed limitations in capturing potentially relevant literature. Moreover, the domain of MOI in the context of omnichannel retailing has acquired some attention just very recently, predominantly with the publication of Bijmolt *et al.* in 2021. Therefore, MOI keywords have been omitted in the search string application to account for a comprehensive literature capture beyond the theoretical framework for this study.

Table 3: *Keywords and applied search strings for the literature search process*

Database	Applied search strings
Scopus	• TITLE-ABS-KEY (omnichannel) OR TITLE-ABS-KEY (omni-channel) OR TITLE-ABS-KEY (multichannel) OR TITLE-ABS-KEY (multi-channel) OR TITLE-ABS-KEY ("multiple channels") AND TITLE-ABS-KEY (assortment OR merchandis*) • TITLE-ABS-KEY ("consumer confusion" OR "customer confusion" OR "shopp* confusion") AND NOT TITLE-ABS-KEY (brand) AND NOT TITLE-ABS-KEY (label) • TITLE-ABS-KEY ("channel switching" OR showroom* OR "show-room*" OR webroom* OR "web-room*" OR ropo OR "research shopp*")
Google Scholar via Publish or Perish	• "omni-channel" OR "omnichannel" OR "multi-channel" OR "multichannel" OR "multiple channels" AND assortment OR merchandis* • "consumer confusion" OR "customer confusion" OR "shopp* confusion" • "channel switching" OR "showroom*" OR "show-room*" OR "webroom*" OR "web-room*" OR ropo OR "research shop*"
EBSCOhost	• AB (omnichannel OR "omni-channel" OR multichannel OR "multi-channel" OR "multiple channels") AND AB (assortment OR merchandis*) • AB ("consumer confusion" OR "customer confusion" OR "shopper confusion") NOT AB brand NOT AB label • AB "channel switching" OR showroom* OR "show-room*" OR webroom* OR "web-room*" OR ropo OR "research shopp*"
ScienceDirect	• "omni-channel" OR "omnichannel" OR "multi-channel" OR "multichannel" OR "multiple channels" AND assortment OR merchandising OR merchandise • "consumer confusion" OR "customer confusion" OR "shopper confusion" OR "shopping confusion" • "channel switching" OR "showrooming" OR "show-rooming" OR "showroomer" OR "show-roomer" OR "webrooming" OR "web-rooming" OR "webroomer" OR "web-roomer" OR ropo OR "research shopper" OR "research shopping"

While screening the databases, search strings are applied on "titles, abstracts, and keywords" (Scopus, ScienceDirect), and on "abstract" (EBSCOhost). The applied sequence is (1) Scopus, (2) Google Scholar, (3) EBSCOhost, and (4) ScienceDirect. For Google Scholar search, Harzing's "Publish or Perish" software tool (2021)[2] has been utilised to organise and manage the findings since Google Scholar itself has limited filtering and categorization abilities. In the course of screening Google Scholar, results with broken metadata or simple citation records have been omitted. For EBSCOhost, all relevant sub-databases have been considered. The query was applied to the abstracts of articles only. In the course of the screening, unrelated themes ("chemical", "pulse", "microwave" and similar) have been filtered out and excluded from the results. Further filters are adjusted to "Academic journals only", and "Abstracts only", including the exclusion of the fields "law", "copyright", "trademark", "food labelling", and "brand". For ScienceDirect, the

[2] https://harzing.com/resources/publish-or-perish.

query is applied for "Title, Abs, Keywords". For Scopus, no filtering adjustments have been applied since the queries already yielded a manageable number of results, except for the channel switching domain query, where the initial results also contained articles from e.g., the engineering, materials science, or mathematics field (potentially triggered by the keyword "channel switching"). Therefore, a limitation to the "Business, Management and Accounting" discipline was applied, yielding a reduced output of 455 articles in the last search iteration.

The first query results conducted in early 2021 yielded over 3,000 papers from all three domains (**Table 4**). The last iteration was conducted in August 2022.

Table 4: *Query results and final number of reviewed articles*

Steps	**Omnichannel Assortment**	**Consumer Confusion**	**Channel Switching Behaviour**	**Total**
Query Output				
Scopus:	150	210	455	
Google Scholar:	439	440	610	
EBSCOhost:	172	119	304	
ScienceDirect:	22	35	76	
Total:	**783**	**804**	**1,445**	**3,032**
Title, Abstract, Keywords screening, application of inclusion and exclusion criteria	-649	-718	-1,084	-2,451
Duplicates removed	-72	-45	-244	-361
Remaining	62	41	117	**220**
Forward and Backward Citation Analysis	14+9	6+6	28+7	70
In-depth Analysis	85	53	152	**290**
Rejected	44	14	63	121
Final number of articles accepted	**41**	**39**	**89**	**169**

After the screening of titles, abstracts, and keywords as well as the application of inclusion and exclusion criteria a total number of 2,451 papers have been removed. Most of the rejections are accounted to results retrieved from Google Scholar where only roughly around 20% of the results were useful hits. The further removal of duplicates reduced the number of papers by 361 to 220. A forward citation analysis added 48 papers, resulting in 268 papers in total being reviewed in-depth. While reviewing, additional 22 papers have been identified through backward citation analysis. In the critical analysis of the 290 papers, a total of 121 papers have been rejected due to not meeting the required relevance for the research aim of this research adequately, resulting in a final paper number of 169 (41 papers from the omnichannel assortment domain, 39 from the consumer confusion domain, and 89 papers covering the channel switching behaviour domain) considered for this research. The rationale for the rejections is provided for each research domain in the subsequent sections below. For forward-tracking of citations, citing papers for each retrieved article have been identified and added to the search process. Similarly, backwards-tracking of citations was conducted to identify those papers that have been cited within the retrieved articles. Both forward and backward citation analysis served as validation for the core sample of retrieved articles in the search process.

The search protocol documents inclusion and exclusion criteria (e.g., Webster and Watson, 2002) (**Table 5**). Explicit inclusion criteria are high-quality publications, relevance (study is positioned in at least one of the three research domains and has a retailing context), no time restrictions (no specific limitation on the document or type of source, e.g., conference proceedings as well as dissertations are included to capture all relevant contributions and ensure comprehensiveness), multidisciplinary approach (omnichannel retailing is a subject of multidisciplinary research in Management, Information Systems, Marketing, and Operations Management) (Wang *et al.*, 2021). Excluded are articles that are of non-English language, master, or bachelor theses, but also articles that are considered to be positioned at a pure multi-channel context not addressing channel switching behaviour and thus classified as out of the scope of this research (e.g., study on the impact of assortment on e-loyalty for a multi-channel retailer versus pure online player, Jin and Kim, 2010). Moreover, studies from medicine, neuroscience, chemistry, engineering, or any other non-related disciplines are excluded as well.

Table 5: *Inclusion and exclusion criteria applied in the literature search process*

Inclusion Criteria	Exclusion Criteria
▪ High-quality publications ▪ Addresses research context accurately ▪ Retailing context ▪ Omnichannel / relevant multi-channel context ▪ No time restriction ▪ Document or source type independent ▪ Multidisciplinary: management, information systems, marketing, operations management	▪ Non-English sources ▪ Non-retailing context (health, hospitality, tourism, banking, psychology, law) ▪ Pure multichannel context ▪ Master or bachelor theses ▪ Disciplines: medicine, neuroscience, agricultural or biology, physics and astronomy, chemistry, energy, environmental science, engineering

In addition to the general inclusion and exclusion criteria, specific exclusions are made for each research area. In the domain of omnichannel assortment, studies on logistics or supply chain management are omitted since they are not positioned at the strategic level of assortment decisions in omnichannel retailing and do not involve a direct consumer focus (e.g., Kembro and Norrman, 2019). Similarly, assortment touched in adjacent areas such as promotion (e.g., Schrotenboer *et al.*, 2022; Xin *et al.*, 2020), branding (e.g., Chang and Kwon, 2022), after-sales (e.g., Mehta and Balakumar, 2021), technology (e.g., Ovezmyradov and Kurata, 2022; Thomas *et al.*, 2021), or movie sales (e.g., Kumar *et al.*, 2014; Kumar *et al.*, 2012) have also been omitted on the basis of being out of scope. Research on tourism has also been rejected (e.g., Múgica and Berné, 2019) since not related directly to the retail domain. The search yielded also results that have not been considered from the disciplines such as neuroscience or signal processing engineering since these research areas share the terminology "omnichannel" but from a purely technical view (e.g., signalling, audio channel characterisation). In the domain of consumer confusion research, omitted research encompasses studies in the context of health (e.g., Chauhan and Sagar, 2021; Mathur, 2021), tourism (e.g. Sharma *et al.*, 2023), confusion in the context of drug prescriptions (e.g., Amoozegar *et al.*, 2017), brand similarity (e.g., Foxman *et al.*, 1992), eco-labelling confusion (e.g., Moon *et al.*, 2017), law (e.g., Ullrich, 2021), nutrition (e.g., Parasidis *et al.*, 2015; Spiteri Cornish and Moraes, 2015), education (e.g., Drummond, 2004), confusion in credit products (e.g., Adams *et al.*, 2022), telecommunications products (e.g., Ait Omar *et al.*, 2019; Ebina and Kinjo, 2019), supply chain (e.g., Casini *et al.*, 2008), B2B service markets (e.g., Jan Lakotta, 2014), and a study focusing on pro-confusing strategies (Crosetto and Gaudeul, 2017). In the research domain of channel switching behaviour, predominantly characterised by the concepts of show- and webrooming, the following studies have been excluded due to being out of scope: Bian *et al.* (2022), Ji *et al.* (2022), Sun *et al.* (2022; 2020), Li and Zhang (2021), Li *et al.* (2020), Kuksov and Liao (2018), that all consider show- or webrooming behaviour as a variable in the context of a supply chain or industry perspective topics, not accounting directly to a consumer perspective. Similarly, studies on the market effects of store closures (Akturk and Ketzenberg, 2022), or on showrooms as a concept of channel extension (Konur, 2021) have been rejected. Basak *et al.* (2020) and Raj *et al.* (2020) consider show- and webrooming in the context of pricing policy design between manufacturers and retailers and thus are out of the scope of this research as well. The work of Zhang *et al.* (2021) examining an analytical issue of manufacturer and retailer product competition is rejected in addition. Moreover, various studies on profit or pricing modelling without consumer behaviour context have been excluded as well (e.g., Zeng and Hou, 2022; Li *et al.*, 2021; Liu *et al.*, 2020). Finally, a study in the context of entrepreneurship has also been rejected due to being out of scope for this research (Battisti and Brem, 2020).

For the **literature analysis and synthesis step**, concept-centric analytical frameworks (Webster and Watson, 2002) are constructed. The approach corresponds to the organisation of the literature in a conceptual way as proposed by Cooper (1988). The dimensions for the construction of the frameworks are primarily informed by the problem discussion of this study and contain relevant concepts retrieved from the three research domains (e.g., the concepts “strategic”, “tactical”, and “operational” decisions from the omnichannel assortment domain, or “cognitive”, “affective”, “conative” dimensions from the consumer confusion domain), concepts from the observations of the problem space (e.g., consequences of the consumer confusion phenomenon), and concepts addressing different types of applied methodologies. Methodologies are distinguished by either being of conceptual/theoretical nature (predominantly qualitative characteristics, no empirical data is retrieved or analysed, a conceptual framework and/or a review is provided), empirical (empirical data is collected and analysed), or on the basis of experiments or analytical approaches (e.g., mathematical modelling and optimisation methods). Additionally, prescriptive knowledge generation which is the study goal of this research is also considered. Lastly, the framework provides meta-details on the publications such as the name of the author(s), the year published, or the name of the publication outlet for further differentiation in the analysis process (**Table 6**).

Table 6: *Structure of the analytical frameworks*

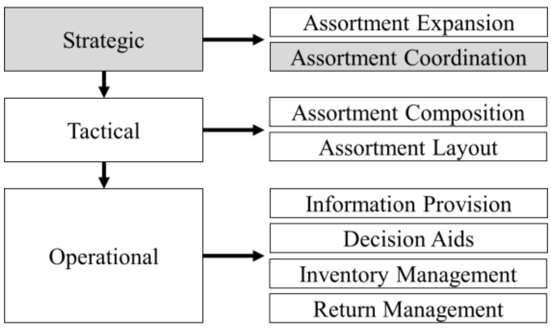
#	Author Names	Year	Focus of the study	concept	concept	concept
1	…	…	…		✓	✓
n	…	…	…	✓		

For the implementation of the analysis, Microsoft Excel is utilised. For each screened study, checkmarks corresponding to the concepts in the framework are applied in each case they are addressed in the paper. The studies are evaluated whether the concepts or methods are addressed adequately or not. However, merely mentioning the concepts does not qualify for consideration, but rather an elaborated discussion around the concept does (this is the same with the methods that are applied in the study that need to be executed and demonstrated explicitly). Moreover, concepts that are not the focus but utilised within research designs (e.g., as moderator/mediator variables) are taken into account since conclusive statements about their effects can also inform the synthesis process with valuable insights. Next to the analytical frameworks, a Venn diagram is utilised to visualise and position all articles across the three research domains and the intersections. The synthesis itself is undergone in Section 2.7, representing the development of a **research agenda** for this research as proposed by Brocke *et al.* (2009). It focuses on the critical review of the literature in view of the research objectives, beginning with the summary of the main research areas followed by the synthesis of articles in the intersections. The whole research process was initially conducted in 2019, then iterated in 2021 and 2022 to account for new publications and further refinements. As a result, the systematic literature review process provides a comprehensive picture of the existing research with strong validity. The following presents each research domain along with its current state of research in detail relevant to this study.

2.4 Omnichannel Assortment

The requirement for the integration of assortment along channels is an ongoing and challenging issue discussed in current omnichannel literature (e.g., Bijmolt *et al.*, 2021; Rooderkerk and Kök, 2019), and an important but complex strategic decision for retailers (Cao, 2019; Kumar *et al.*, 2017; Broniarczyk and Hoyer, 2010; Zhang *et al.*, 2010). Assortment can be described as the collection of goods or services a retailer offers to its consumers (Berman *et al.*, 2018; Kumar *et al.*, 2017; Kök *et al.*, 2008). Consequently, within an omnichannel strategy, assortment represents all goods or services provided to consumers in all available channels the retailer utilizes. Assortment management within an omnichannel context refers to the offering and management of goods across different channels (Hense and Hübner, 2022; Rooderkerk and Kök, 2019). The challenge lies in the required coordination and integration efforts to realise an effective assortment integration across channels. Rooderkerk and Kök (2019) describe this task as *"… the process of coordinating all aspects of the assortment (composition, layout, pricing, inventory levels, etc.) across channels to facilitate a seamless consumer experience across all consumer touchpoints."* (p. 55) and point out that these coordination and planning activities happen at the MOI. They further organise these decision areas into three decision levels: strategic, tactical, and operational assortment decisions (**Figure 7**, the components in grey highlight the relevant level and decision element for this study).

Figure 7: *Omnichannel Assortment Planning (adapted from Rooderkerk and Kök, 2019)*



The next section will outline these decision levels as part of omnichannel assortment planning in detail. Afterwards, an overview of the current research in this domain is provided, structured along the decision levels in the analytical framework.

2.4.1 Omnichannel Assortment Decisions

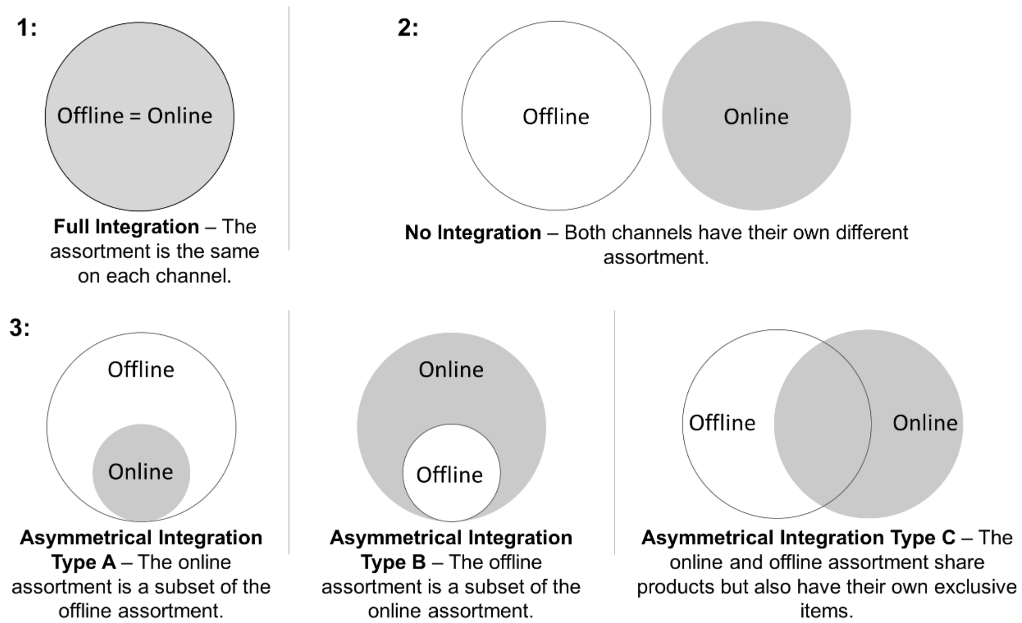
In principle, decisions on the omnichannel assortment can be categorized along the three decision levels strategic, tactical, and operational (Rooderkerk *et al.*, 2022; Rooderkerk and Kök, 2019; Zentes et *al.*, 2017) (**Figure 7**). Strategic assortment decisions involve the development and realisation of the assortment strategy and consider a long-term planning view covering several years since substantial resources on assortment are committed. Usually, the decisions are reviewed annually, and the responsibility lies on an executive level. Tactical assortment decisions are considered mid-term decisions spanning one year or less and usually encompass the steps for strategy implementation directed at a middle management level. Tactical decisions are usually reviewed monthly. Operational planning captures decisions that are made on a daily basis such as inventory decisions and are typically led by the lower management. Accordingly, reviews are conducted on a weekly or daily basis (Rooderkerk *et al.*, 2022). The following portrays each level in detail.

Strategic Assortment Decisions

Retailers deal with a strategic assortment decision in omnichannel retailing at the moment they want to decide whether the offered products should be expanded to new channels or not – this is referred to as *assortment expansion*. On the other hand, *assortment coordination* refers to the desired type of assortment integration across all channels (e.g., Emrich *et al.*, 2015) when more than one channel exists where products are offered. The two strategic components of assortment strategy involve a long-term planning window (Srivastava *et al.*, 2022) and are thus critical in the alignment with the business strategy. The motivations for channel expansion can be manifold. A major driver is the prevention of customers to switch to a competitor's channel when a desired product is not offered while being on a shopping journey at a retailer's channel. Offering its own channels can help to mitigate this risk (Rooderkerk and Kök, 2019). A retailer can thus introduce new channels to their business, e.g., a pure physical retailer can introduce a web-shop and reach out to new customer segments in the e-commerce sphere. Conversely, a pure e-commerce retailer can consider establishing physical stores to tap into the physical market potential as successfully demonstrated by Amazon through the acquisition of "Whole Foods" (Debter, 2017; Cusumano, 2017; Simon, 2017), or the physical presence of the online retailers Alibaba or Warby Parker (Zhang and Neslin, 2021). All these activities are based on assortment expansion decisions at the MOI.

Once different channels exist, coordination of the assortment across channels is required. Based on Emrich *et al.* (2015) and Bertrandie and Zielke (2017), Rooderkerk and Kök (2019) differentiate three assortment coordination types between on- and offline channels for omnichannel assortment (**Figure 8**). “No integration” represents the utilisation of completely different assortments along channels and does not require coordination per se. In fact, a “no integration” approach is more in line with a multi-channel approach since there is de facto no integration of the assortment which corresponds to a siloed channel approach. “Full integration” means that assortment is identical along channels, and it does not make any difference for the customer where to shop – every item would be available on each channel. This is the preferred approach to avoid consumer confusion (Bertrandie and Zielke, 2017). A full integration approach is difficult to realise but argued as the most favourable type of configuration (Rooderkerk and Kök, 2019; Berry *et al.*, 2010; Neslin and Shankar, 2009). The third alternative, “Asymmetrical integration”, is characterised by a partial overlap of assortments and can be expressed by three subtypes. In the first subtype A, the online assortment is a subset of the larger offline assortment – this is the opposite in the second subtype B. The third subtype C is evident when the on- and offline assortment share common products but also maintain their own exclusive items at the same time, effectively offering three different sets of assortments.

***Figure 8:** Assortment Integration Types (adapted from Rooderkerk and Kök, 2019)*



Empirical studies show that asymmetrical integration (type B) is the most common one applied in retail practice (Bertrandie and Zielke, 2017; van Ameijden *et al.*, 2012). Rooderkerk and Kök (2019) argue that subtype A seems to be the preferred configuration for retailers introducing an online channel to their business in order to learn gradually the online business and thus limit complexity in the assortment, or in case retailers want to keep certain products deliberately exclusive for the offline channel (e.g., to drive traffic to physical stores or allow halo effects) (Ailawadi *et al.*, 2006). Moreover, the authors point out that a missing impulse buying behaviour in the online environment or a strong need for sales staff support (e.g., for guidance, and information provisioning) can also motivate retailers to keep certain products in the offline store only. For subtype B, Rooderkerk and Kök (2019) argue that predominantly the trouble of limited physical shelf space and the benefits of the Long Tail effect online (Ratchford *et al.*, 2023; Anderson, 2006) motivate retailers to operate a larger online assortment. The Long Tail effect allows offering slow-selling items online since they do not require costly offline shelf space but still contribute substantially to the overall profit (Anderson, 2006). Finally, subtype C can be the desired type for assortment configuration when retailers want to keep unique items for each channel while offering a certain set of products that are available on both channels (Rooderkerk and Kök, 2019). The choice of the assortment integration type represents a strategic assortment decision at the MOI where no ideal integration type is proposed in the current research. Following Abrudan and Dabija (2020), the current discourse in assortment coordination is divided into two research streams, one arguing the favourability of full integration (e.g., Abdulkader *et al.*, 2018; Herhausen *et al.*, 2015) and the other of no need for a full integration approach (e.g., Emrich *et al.*, 2015). As mentioned earlier in the introduction, a full integration approach is the favourable choice to prevent the occurrence of consumer confusion. However, since different variables, and not only consumer confusion prevention, are considered at the same time for the decision on the adequate integration type, no absolute answer on an ideal type exists.

Tactical Assortment Decisions

Tactical assortment decisions are covering decisions on the assortment composition and layout. *Assortment composition* is defined as the process of defining and selecting product categories and products to be listed in the channels (Hense and Hübner, 2022) and is typically focused on its optimization (e.g., Vasilyev *et al.*, 2023; Chen *et al.*, 2022; Lo and Topaloglu, 2022; Zhang *et al.*, 2021). Rooderkerk and Kök (2019) propose that omnichannel retailers should seek to transfer working methods and techniques for assortment composition from one channel to another. However, this seems a daunting task since the channels differ from each other from different perspectives (e.g., the online channel is not limited by physical space allowing the utilisation of a larger assortment, including those items that are slow-moving; the online channel should not overwhelm the customers with over choice but provide “curation”). Moreover, customer preferences (e.g., willingness to pay), personalisation and contextualisation of assortments, are also key factors in the composition decisions. The coordination of the assortment composition across channels requires the consideration of the following factors.

- The composition of the offline assortment should account for showrooming behaviour (Section 2.6.1) since this can lead to more profit overall (Dzyabura and Jagabathula, 2018). Low-performing items can therefore still have a positive effect on performance from a customer journey perspective.
- The composition of the online assortment should account for webrooming behaviour (Section 2.6.1) despite low-performing goods since these can address information needs resulting in physical store visits / purchases in-store, contributing to overall performance from a customer journey view.
- The need for integration of data / information across channels to allow a clear mapping of customer journey paths.
- Reconsideration of leading metrics such as profit per square foot since a customer journey view across channels is required to map the big picture in an omnichannel setting.
- Focus on customer experience in physical stores instead of financial metrics only.
- Continuous limitations of product space in physical stores are induced by concepts such as “click-and-collect” that require the physical store as a distribution centre.
- The optimisation of profit margin and cost of inventory for slow-moving items on the online channel in the context of the Long Tail effect.

Consequently, the factors described above might explain the dominance of the application of asymmetrical integration by practitioners in the industry. Moreover, product characteristics should be not neglected while deciding on the assortment composition across channels (e.g., consumers tend to evaluate products differently by channel, Dzyabura *et al.*, 2019).

In terms of *assortment layout*, the appearance and exhibit of the assortment, online and offline layouts differ from each other substantially. Offline layouts are characterised by a certain organisation style, e.g., by brand, package, product variation, or a combination of those whereas online layouts predominantly seem to be unorganised or not follow a certain presentation rule due to the usually overwhelming size of items. However, filtering and sorting options online that are not applicable offline help customers do the job. Assortment layout decisions for omnichannel settings need to consider these peculiarities to provide a seamless experience for the customers (e.g., Schäfer *et al.*, 2023; Marmol *et al.*, 2020). Rooderkerk and Kök (2019) propose that learnings from each channel's peculiarities should be transferred across channels (e.g., searching and filtering patterns observed online can help to improve the organisation of offline assortments).

Operational Assortment Decisions

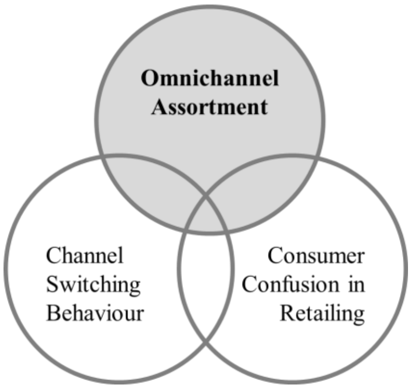
Operational decisions for assortment cover information provision, decision aids, inventory and return management (e.g., Hense and Hübner, 2022; Sodero *et al.*, 2021; Geunes and Su, 2020). *Information provision* on assortment (e.g., product description) should be identical on both channels. That means consistency on the web-shop, on in-store displays and through salespeople and service touchpoints. Crucial in asymmetrical assortment integration types is the provision of product availability information that informs about the fact the desired product is available only at the other channel (e.g., through in-store kiosks offline). Although very difficult to ensure, information about current stock levels of products enriches cross-channel information provision. Synergies such as in-store QR codes allowing access to online information, the use of AR (augmented reality) apps, and printouts of typical online reviews at the point of sale (POS), are also concepts ensuring operational integration of information provision. *Decision aids* assist customers in the selection and decision-making process, usually, through means of interactive support. In an online environment, these are category selection support, e.g., additional descriptions on categories highlighting main differences on similar products, shortlisting options, e.g., through filtering and/or sorting, or comparison options allowing a side-by-side comparison of major product characteristics (e.g., storage size, battery lifespan, camera resolution when comparing mobile phones). Rooderkerk and Kök (2019) argue that decision aids should be cross-channel, meaning that they should also consider cross-channel aiding. For instance, by providing information online on product availability at a nearby (or currently visited store) through interactive geographical maps that utilise geofencing technology, or by offering interactive tablets serving as on-shelf advisors and locators (e.g., purpose, material, location, availability, etc.) located directly at the shelf. *Inventory management* represents the range of tasks involving buying, restocking, allocating, and forecasting decisions at the store as well as on the warehouse level. The pre-omnichannel era viewed these decisions as isolated to a specific channel and location where demand and fulfilment take place. However, in an omnichannel customer journey, a separation of the location for demand and fulfilment is typical due to the consideration of the channel switching behaviour (showrooming / webrooming, Section 2.6.1). These circumstances can represent substantial challenges for inventory management demanding a transparent view of the channel switching behaviour in order to predict the allocation of resources for supply and fulfilment processes more accurately and to avoid imbalances. The inventory dynamics between the channels are evident for instance when stock-outs of fast-selling goods are communicated on the web-shop effectively reducing store traffic and resulting in overall lower profitability (Gao and Su, 2017).

Similarly, *returns management*, the activity of handling returns, re-packaging, and reverse logistics, is shaped differently in an omnichannel setting. Allowing customers to return items at physical stores (regardless of where they purchased them), can increase footfall and cross- or re-sell opportunities. Moreover, the pooling of returns data arising from on- and offline channels can help to reveal patterns and thus identify opportunities for mitigation of returns or understanding of customer preferences.

2.4.2 State-of-the-Art in Omnichannel Assortment Research

As depicted in Section 2.1, this section is dedicated to the current state of knowledge in the omnichannel assortment research domain. This includes the discussion of research on the overlap with the areas “consumer confusion in reatiling” and “channel switching behaviour” (**Figure 9**). In the analytical framework, the consumer confusion domain is represented by analysing whether the concept and its consequences are explicitly addressed in the study or not. Channel switching behaviour is captured through whether the study explicitly addresses show- and/or webrooming as two typical expressions of the switching behaviour (Section 2.6.1). Overall, 41 papers have been identified, with 27 capturing relevant contributions in the key domain, 3 papers in the intersection with the consumer confusion domain, and 11 in the intersection with research addressing channel switching behaviour. No papers are identified that are positioned in the problem space of this research (intersection of all three research domains). The analytical framework is shown in **Table 7**. The following covers and organises the literature into strategic, tactical, and operational assortment as defined by Rooderkerk and Kök (2019) chronologically, starting from the most recent studies. All contributions can clearly be classified into the decision levels, with the exception of one article positioning itself between tactical and operational assortment decisions (Schäfer *et al.*, 2023) and the contributions from review articles touching on a range of omnichannel assortment aspects that are covered separately. To the best of the researcher's knowledge, no prior SLR exist in the domain of omnichannel assortment that could have been used or extended on.

Figure 9: *Omnichannel Assortment research domain and intersections*



Studies on Strategic Omnichannel Assortment

Until today, several contributions characterised by topics on strategic assortment decisions in omnichannel retailing exist. Most recently, Ratchford *et al.* (2023) examine the relationship between different types of cross-channel purchase behaviour and the effect on sales concentration while accounting for assortment coordination. From a Long Tail perspective, the authors argue that the prevalent utilisation of asymmetrical integration type B in practice might not be recommended in case customers do not opt to buy because of a greater variety online compared to online but because of buying different products per channel. The Long Tail effect holds true when customers seek variety online, evident by sales from niche products otherwise not profitable offline. However, if the customer's actual motivation is to seek different products online compared to offline, the Long Tail proposition might not hold true, and the overall share of niche products would be indeed low. In that case, asymmetrical type C or even no assortment integration would be an appropriate configuration type, rendering conventional Long Tail literature obsolete. They argue that this would be the case for products that have different informational characteristics (e.g., sensory attributes that are inspected personally such as touch & feel, or ripeness of fruits), eventually motivating consumers to select the offline channel and distinguish their choice for the channel by product characteristics (e.g., Betancourt *et al.*, 2016). The authors test their hypothesis utilising transaction panel data of two large retailers in the fashion goods industry and confirm that both retailers show (1) consumer channel choice through product popularity highlighting product characteristic-driven choices rather than variety, (2) that consumers look for similar variety in both on- and offline channels (contrary to the traditional Long Tail view), and (3) that this behaviour diminishes overall sales concentration when web-shop sales increase. The authors recommend practitioners to examine the fit of product-to-customer information needs while deciding on assortment coordination. These findings reveal an interesting explanation for the assortment coordination discussion under the premise that customers do expect different assortment across channels. Unfortunately, the study does not include the concept of consumer confusion in the empirical investigation but refers to the phenomenon in the discussions, acknowledging its existence out of assortment inconsistencies and recommending the effect to take into account while weighing benefits in assortment coordination decisions across channels. The concept of channel switching behaviour is not part of the research.

The work of Cakir *et al.* (2022) applies a Venn-diagram-based mental model approach to capture the conflicting relationship between the omnichannel assortment management objectives “assortment integration”, “customer confusion reduction”, and “purchase postponement/abandonment reduction” as a specific consequence of the consumer confusion phenomenon. The study postulates that, in the course of channel integration measures, meeting all three objectives is challenging and trade-offs are evident. The authors provide recommendations for actions for different conflicting scenarios in order to help retail managers in improving the understanding and decision-making for omnichannel assortment decisions while pursuing channel integration. The conceptual study represents an initial work of this thesis aiming at relating the consumer confusion concept to assortment integration decisions from an objectives point of view.

Srivastava *et al.* (2022) develop a revenue maximisation model for omnichannel assortment planning in a COVID-19 context and address the need for a revenue perspective. The model is applied for a pre- and mid-COVID-19 scenario while accounting for four different revenue contributions (offline, online, mobile app, and omni). The authors justify the model by the changing distribution of customers across channels during the pandemic (severe losses in the offline channels) and the need for reallocation of “assortment”. Based on datasets from seven different grocery retailers, the model demonstrates the possibility of offsetting losses on offline sales through the reallocation of the assortment in favour of digital channels. Although providing a model with certain utility, the decision-support does not cover configurational questions about assortment coordination nor the consideration of the consumer confusion effect. The model views assortment as means for the distribution of sales probabilities across channels and thus is more in line with the notion of assortment expansion as understood in this research (Section 2.4.1). Therefore, despite providing a decision-support for revenue maximisation in omnichannel assortments on a strategic level, the integration of the concept of omnichannel assortment in the study is dissimilar to the one addressed in this research (which is assortment coordination). Similarly, channel switching behaviour is not viewed or addressed from a customer journey perspective (switching within one journey) but is rather understood as a "switching of channel preference" and is thus more in line with the understanding of "channel migration" (Ansari *et al.*, 2008).

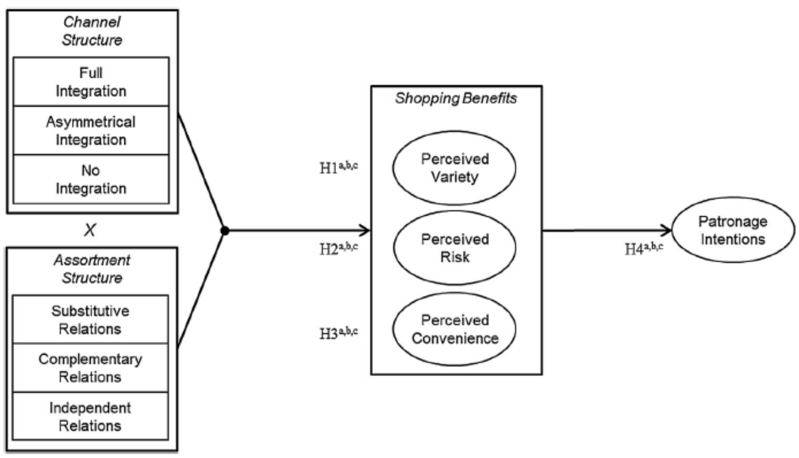
Lee and Chun (2021) develop a research model on the effects of assortment and price integration (full and asymmetrical) on shopping benefits (utilitarian and psychological) as well as retailer loyalty in omnichannel retailing that accounts for the moderating effect of the show- and webrooming behaviour. The experimental study is one of the few papers incorporating channel switching behaviour into the effects of assortment coordination types. Among other conclusions, the authors demonstrate that perceived benefits can be reduced by an asymmetrical assortment integration approach when customers switch channels. However, the study does not incorporate the concept of consumer confusion into its experimental model.

To investigate the benefits of showrooming behaviour on retailer's profit while accounting for product fit (the extent of consumers' informational uncertainty reduction through information gathering, e.g., touching and feeling the product), Li *et al.* (2020), offer an analytical approach considering no showrooms (no opportunity for product fit checks), partial showrooms (partial assortment for product fit available), and full showrooms (full assortment for product fit available). The showroom assortment integration types resemble those proposed in this research and are in line with Rooderkerk and Kök (2019) (no, full, and asymmetrical type B). Partial assortment integration seems to be a preferable strategy for positive showrooming results considering price and information service variables. However, the authors point out that also product category characteristics influence the integration type (potentially resulting in the adoption of a more rational integration type compared to only accounting to product-fit decision variables). Finally, despite considering a channel switching behaviour, there is no effects consideration on the consumer confusion phenomenon.

One of the key papers for this research, Bertrandie and Zielke (2017), addresses the "customer confusion" problem related to omnichannel assortment. The concept of customer confusion is subdivided into the constructs "choice difficulty" and "choice confusion", addressing a cognitive and an affective element to capture the phenomenon. The two constructs correspond to the cognitive and affective dimensions of consumer confusion (Section 2.5.1). The authors conduct a series of experiments to examine which assortment coordination type is favourable to reducing customer confusion. The study builds on the work of Emrich *et al.* (2015) and applies an internal (same retailer) and external (competing retailer) integration approach, resulting in different conditional outcomes. For example, the experiments show that assortment integration in general influences customer confusion. An internal asymmetrical integration approach leads to less cognitive and affective confusion, whereas a full integration approach leads to less cognitive confusion. The study successfully links assortment integration decisions with the consumer confusion concept and defines short- and long-term consequences and thus provides a strong contribution to addressing the problem of this research. However, in view of its experimental nature and aims, it is not providing a comprehensive view of the variety of consumer confusion constructs or their consequences. More importantly, the channel switching behaviour and its types are not addressed in the study. Bertrandie and Zielke explicitly state that this limitation should be addressed in further research.

In 2015, Emrich *et al.* conducted a series of empirical experiments to investigate the effects of assortment types for multiple channels (no, full, asymmetric) on shopping benefits and patronage intentions of customers (**Figure 10**).

Figure 10: *The Effects of Assortment Integration Strategies on Shopping Benefits and Patronage Intentions (source: Emrich et al., 2015)*



The aim was to determine to what extent a retailer should integrate its assortment across channels. The authors prove that under the consideration of “assortment structure” (substitute, complementary, independent assortment relations) full integration of assortment is superior to no integration. However, an asymmetrical integration approach can indeed be superior to a full integration approach under certain conditions. The study is one of the earliest investigations into the effects of assortment integration and the origin of the different assortment integration types. Although motivated by determining ideal integration types, it is not the intent of the study to incorporate the consumer confusion concept nor consider channel switching behaviour effects in the experiments.

Studies on Tactical Omnichannel Assortment

Various studies view omnichannel assortment decisions from a tactical perspective. To begin with, Schäfer *et al.* (2023) consider a tactical as well as an operational problem (assortment composition, assortment layout, inventory management) for omnichannel retailers and investigate analytically the demand effects under the interrelationship between these problems. Inter alia, findings include the significant role of “space-elasticity”, “shelf-segmentation” and “position demand” in omnichannel assortment planning. However, the authors decided to keep consumer confusion or channel switching behaviour out of the research scope.

Chen *et al.* (2022) view an offline assortment optimization problem that also accounts for geographic store locations in an omnichannel context in order to maximise both online and offline profits. The analytical study shows that retailers applying an omnichannel approach should consider location dependency in their offline assortment decisions but also emphasises the need for on- and offline integration while optimizing. The tactical decision-oriented research neglects the consumer confusion concept and channel switching behaviour in the investigation.

Lo and Topaloglu (2022) aim to maximize revenue while determining the ideal subset composition of the offline assortment based on the larger online assortment in an asymmetrical integration type B setting, thus contributing to omnichannel assortment composition optimisation. The analytical study considers product features organised as a features tree and webrooming behaviour while optimising via an FPTAS algorithm approach, concluding with the need for empirical data for validation purposes. Although not considering any consumer confusion effects, the study incorporates webrooming, representing one type of channel switching (Section 2.6.1), successfully demonstrating its need for alignment with assortment composition decisions. It also demonstrates the subsequent alignment of strategic assortment decisions (assortment coordination) and tactical assortment decisions (assortment composition). Similarly, Vasilyev *et al.* (2023) introduce a discrete choice model to capture product demand that considers product substitution behaviour within and across channels while optimising assortment composition across channels in an omnichannel scenario. The model is able to determine an optimal assortment composition in one channel as long as the other channel provides all products (contributing to asymmetrical integration optimisation) but also demonstrates that an integrated omnichannel assortment optimization positively influences a retailer's profitability more than a siloed optimisation does. Moreover, the authors emphasise that optimal assortments are a multi-factor decision problem (channel choice, willingness to switch, etc.) and cannot be achieved through single-factor approaches. Similar to other works, the authors demand further research with real-world data for validation purposes. The analytical work also accounts explicitly for the channel switching behaviour in the model development, though, a link to consumer confusion concepts is not existent.

Zhang *et al.* (2021) focus on manufacturer encroachment and investigate the optimal channel structure for assortment composition (two products) across the online channel of a manufacturer and the offline channel through a retailer. The analytical study finds out that encroachment for the two-product approach reduces product competition at the cost of channel competition. Also in this study, consumer confusion or channel switching behaviour is out of the scope.

Marmol *et al.* (2020), develop a model that seeks to maximise the attractiveness value of displayed assortment in a retail store or web-shop. Clearly addressing a tactical assortment problem in omnichannel retailing (assortment layout), the authors consider various variables (e.g., expensive, and non-expensive products, minimum profit margin constraint) in their analytical model that proves to be superior to conventional solutions. Consumer confusion and channel switching behaviour are not addressed within this study.

Similarly, Shao (2020) examines experimentally which vertically differentiated products to offer in different channels to account for profit maximisation. Several scenarios are analysed. The main findings postulate that an optimal assortment across channels depends on price, level of product quality, and wholesale price. For instance, it is worthwhile to offer high-quality products offline under the condition of a higher unit margin than the low-quality version. Also, this study does not capture the consumer confusion concept nor channel switching behaviour explicitly.

Dzyabura and Jagabathula (2018) view an omnichannel assortment composition problem seeking to maximise profits across channels while optimising the offline assortment that is a subset of the online assortment. The authors develop a model that considers the physical evaluation of products while accounting to show- or webrooming behaviour that can lead to reconsideration of initial purchase intentions. Further accounting for this dynamic behaviour, the model demonstrates an increase in overall profit for an omnichannel retailer. Clearly addressing an assortment composition problem, the study demonstrates the relevance of channel switching behaviour based on customer channel preferences while doing so. However, consumer confusion is not discussed within the research scope.

Horizontally differentiated products are also a subject of the study by Gu and Tayi (2017). The authors develop a model that considers pseudo-showrooming behaviour (inspecting a product offline followed by the purchase of a related but different product online) and reveal that retailers adopting an on- and offline channel gain profit increases when consumers are exposed to a selective set of products offline from the full online channel assortment instead of carrying the identical product in both channels. The research tackles an assortment composition problem successfully linked to a specific channel switching behaviour but does not incorporate the concept of consumer confusion.

Ma (2016) focuses on an apparel retailer applying an online and a catalogue channel with an asymmetric integration (type B) as the choice of configuration (the catalogue channel represents a subset of the larger online assortment where all items are available). The author proposes that online customers spend more on the main products (those located at the intersection of the assortments) than catalogue-only customers and argues that this effect is due to lowered search costs for products in the online channel. Overall, a larger online assortment is advocated. The author also touches on the choice overload phenomenon of customers (Iyengar and Lepper, 2000) when confronted with a large assortment (Section 2.5.1). With regard to channel switching behaviour as a concept, it is not explicitly incorporated into the research design of the study. Similarly, the consumer confusion problem induced by channel switching behaviour is not part of the investigation either. However, confusion induced by the exposure to large assortments represents a critical variable in the research design and thus qualifies this study to be considered at the intersection between Omnichannel Assortment and Consumer Confusion.

Rodríguez and Aydın (2015) also view a scenario of a build-to-order manufacturer who is selling its products directly but also via a retailer. The retailer offers a subset of the full assortment of the manufacturer. The results show that manufacturers may want to have the retailer carry those products with high demand variability while the retailer might prefer to list those items with low demand variability. The study for price and assortment optimization understands the notion of channels as channels between manufacturer and retailer and does not distinguish between on- and offline channels per se. Nevertheless, the nature of the investigation is an assortment composition problem, though, not touch consumer confusion or channel switching behaviour.

Bhatnagar and Syam (2014) consider a retailer with on- and offline channels and provide a model that allows optimizing of assortment composition across the channels with the objective to keep fast-moving and profitable items offline and to remove the slow-moving items from there to offer them exclusively online. The motivation is argued not to lose the customer groups related to the low-performing products. Results demonstrate the role of online customer retention, relative price elasticity of demand, and online discount. As one of the early studies on how to integrate assortment across channels, the research successfully demonstrates a cost- and profit-oriented perspective on assortment composition decisions. However, neither a consumer confusion view nor a channel switching perspective is an element of the investigation.

Studies on Operational Omnichannel Assortment

Among the omnichannel assortment research contributions, some studies viewing challenges from an operational perspective are identified. For instance, Hense and Hübner (2022) propose an optimisation model for cross-channel substitution behaviour and assortment integration with the aim of maximizing profit while considering shelf space and warehouse space limitations. The study contributes to decisions on space allocation for each product listed and determines the ideal stock level for each channel. The authors conclude with findings stating that a high product affinity in cross-channel substitutions increases a retailer’s gains and thus drives omnichannel profits. While reviewing existing literature, the authors also reflect on customer-related implications in decision-making and point out the cognitive overload effects, lower choice accuracy, and subsequent deferred purchases when categories are planned inadequately, referring to the consumer confusion effect. Interestingly, the authors address the consumer confusion effect from a consumer response perspective and see it as a feature of assortment planning that considers a consumer’s willingness to opt for a substitute product when confronted with the unavailability of a product in a channel. They consider substitutes as valid options for profit maximisation even if the substitute is less profitable. Noteworthy is the fact that the study incorporates channel switching behaviour (referred to as "cross-channel hopping") as a key concept in the analytical investigation.

Schäfer *et al.* (2023) conduct an empirical study that not only considers a tactical (assortment composition, assortment layout) but also an operational problem (inventory management) in omnichannel assortment and investigates demand effects under the interrelationship between these decision areas. As already outlined above, findings emphasise the role of space-elasticity, shelf-segmentation and position demand in omnichannel assortment planning. Consumer confusion and channel switching behaviour are not considered in the study.

Considering the peculiarity of seasonal products (the requirement of preseason negotiations with suppliers due to long lead times) to be allocated before actual demand can be determined, Sodero *et al.* (2021) develop an analytical model for assortment and inventory planning for store and drop shipping channels. The authors conclude that traditional stores and drop-shipping can be complementary since traditional stores can promote demand while drop-shipping can capture excess demand, contributing to operational decision-making in omnichannel settings. Earlier, Sodero and Rabinovich (2019) conducted a similar study in the context of wholesale and drop shipping channels, combining inventory and channel choice decisions, grounding the basis for the latter one. However, in both studies, neither in the early nor later study, consumer confusion as a concept or channel switching behaviour as a demand factor is considered. Similarly, Geunes and Su (2020) propose a planning model for assortment allocation across channels for seasonal products under consideration of shelf space, price and inventory level decisions. The analytical model is suitable for retailers who are offering products with seasonal characteristics and utilising an on- and offline channel. Nevertheless, concepts of consumer confusion or channel switching behaviour are absent in the research design.

Related Contributions – Omnichannel Assortment as Element of Study

Assortment in an omnichannel context is oftentimes a concept of interest while modelling conceptual or analytical research models in various omnichannel retailing studies. Those contributions that do not consider omnichannel assortment concepts as the focus of the study per se but as a construct, e.g., a mediator/moderator variable are presented as follows. For instance, Goraya *et al.* (2022) incorporate the construct "perceived assortment" as a mediator variable in investigating channel integration on cross-channel patronage intentions, while also considering channel switching behaviour (show- and webrooming) as moderating variables. The variable is defined as a composite perception of assortment not only accounting for the substitutive, complementary, independent nature of products typically observed in a single channel context, but also for assortment coordination across levels in an omnichannel context. This is in line with the assortment coordination task as defined on the strategic level of assortment decisions. The authors conclude that, along with other variables, perceived assortment indeed mediates the relationship between channel integration and patronage intentions. Unlike assortment integration and channel switching, consumer confusion is discussed briefly, but not conceptualised in the research model.

Among a series of marketing-mix variables, Campo *et al.* (2021) consider assortment characteristics (breadth, depth, integration between on- and offline channels) to predict the influence of online grocery shopping on the retailer's Share-of-wallet (SoW) expansion. The study offers an operationalisation of the assortment overlap that is "the ratio of category's p online assortment size at the chain cover category p's offline assortment size at the chain c" (p. 160). The study concludes that assortment integration positively influences the expansion of the SoW. In an earlier study, the same authors found that total sales can increase when customers adopt the introduction of the retailer's online channel, especially for full assortment integration (Melis *et al.*, 2016). Two of the authors, Campo and Breugelman (2015), incorporate "assortment differences" into a conceptual model examining the impact of "acquisition" and "transaction utility" perceived by customers on their category spending allocation across the on- and offline channel in an earlier empirical study. Assortment differences account for assortment size as perceived by customers postulating that a larger size is preferred while choosing a channel. The series of studies build on the findings in the article by Melis *et al.* (2015), stating that shoppers tend to choose the same online grocer they know from their offline experience, particularly because of an integrated assortment. However, all four studies do not account for the consumer confusion effect or channel switching behaviour.

Kang (2018) incorporates "assortment seeking" next to other consumer psychographics characteristics (e.g., price comparison, social interaction) and examines their effects on the show- and webrooming behaviour as well as on user-generated content creation intention. Assortment seeking is defined as the motivation to have access to a variety of products or brands (e.g., Verhoef *et al.*, 2007). The study hypothesises that this also holds true for channel switchers in an omnichannel environment and demonstrates that assortment seeking positively influences webrooming. Although the concept of consumer confusion is out of the scope of the study, Kang successfully argues and links an assortment integration perception with channel switching behaviour.

Further earlier studies incorporate assortment integration in various aspects such as "assortment consistency" for omnichannel shopping value (Huré *et al.*, 2017) or breadth and price of assortment in an operational view (Li *et al.*, 2015). However, these studies do not conceptualise consumer confusion or channel switching behaviour in the research models. Van Baal (2014), one of the first key papers addressing the notion of integration ("harmonization") of marketing variables in a research model, also considers the strategic aspect of assortment integration by incorporating the concept of whether assortments of two channels are identical or not as part of an independent variable encompassing also price and image harmonization. Results seem to confirm that the harmonization of these variables is positively related to the dependent variables of customer retention, loyalty, as well as cannibalization. Although consumer confusion is not part of the research design, confusion in general as a consequence of not harmonizing marketing across channels is discussed and argued to lead to lower trust or satisfaction. Similarly, channel switching is mentioned as a customer characteristic but not explicitly built into the research model as a concept.

Related Contributions – Contributions from Review Studies

Review articles are based on (systematic/narrative) literature reviews on related and adjacent topics such as channel integration, omnichannel operations or fulfilment with a conceptual framework development in most cases. While covering a wide range of omnichannel topics, review articles oftentimes touch upon omnichannel assortment challenges.

To begin with, Hübner *et al.* (2022) investigate the implications for physical stores in omnichannel operations planning (short- and mid-term view / tactical and operational) and address the need for resolving assortment tensions between channels. Particularly, assortment allocation across channels (assortment composition) from a cost and profit view as well as its interdependency with inventory management is highlighted. However, despite addressing customer behaviour peculiarities (use of multiple channels) a strategic perspective to what extent these tactical decisions might impact effects such as consumer confusion is out of the scope of the study. Similarly, channel switching behaviour is touched upon very briefly. Nevertheless, conducted interviews reveal that practitioners' priority seems to be margin-related when it comes to assortment decisions, especially considering limited space capacities in physical stores, thus neglecting consumer confusion phenomena. A deficiency in current omnichannel assortment research is accounted for by the lack of tools and support aiming at capturing integrated operations measurement and letting go of siloed approaches. The authors also discuss the concept of "Digital Assortment Extension", a virtual extension of the available in-store assortment through digital devices such as tablets, arguing its suitability for large products (e.g., furniture) or an assortment with a wide variety in sizes or designs (e.g., fashion). This concept allows retailers to offer all their products in-store while respecting limited shelf space at the same time. The authors conclude with a call for decision support and guidelines for integrated operations measurements and optimisation models.

Neslin (2022) provides a conceptual framework introducing the "omnichannel continuum", a concept integrating a customer's decision process (search, purchase, after-sales) with channel integration reflected by different strategies along the "Extensiveness of Integration". Based on an extensive review of current literature on omnichannel integration, the work represents the latest comprehensive work on channel integration and also discusses harmonized assortment as one of its key determinants in the marketing mix. Neslin concludes that more empirical work on the effect of assortment integration on omnichannel success is needed since current study findings are not unambiguous and can be considered tentative. Channel switching behaviour is also an integral part of the conceptualising captured as "research shopping" and positioned among consumer behaviour characteristics. However, consumer confusion is not explicitly stated as one of the key variables.

Timoumi *et al.* (2022) view the past omnichannel literature from a cross-channel effects perspective, discuss assortment-related challenges while integrating channels, and incorporates channel switching behaviour in their conceptual model. Specifically, the authors define "show"- and "webroomer" as particular customer types who are undergoing a show- or webrooming customer journey, linking customer behaviour to a customer type. There is no dedicated investigation on the consumer confusion effect as a concept though.

The work of Bijmolt *et al.* (2021) who provide the theoretical framework for this study (MOI, see Section 3.2), point out that due to the advent of multiple channels in retailing, the size of the assortment has increased, leading to increased costs at the same time (e.g., inventory costs, ensuring fast and flexible delivery). The authors also point out the potential choice overload problem due to the increased sizes but exclude the confusion problem induced by assortment inconsistencies across channels. However, they emphasize that product characteristics need to be considered while deciding where to list the products in the MOI perspective, addressing assortment composition challenges in omnichannel retailing. For example, niche products are suitable to be listed online thanks to their nature of being on irregular demand (Long Tail effect, Anderson, 2006); however, if those products are also characterised by a strong need for feel & touch (e.g., fashion, produce), the decision on where to list them is not so straightforward anymore. A strategic perspective in the review is taken as the authors discuss the advent of multi-sided platforms as a new business model to expand and offer assortment (assortment expansion). Operational issues in assortments are addressed in conjunction with inventory management. Among other opportunities, the review of assortment decisions concludes with a call for a more integrated assortment decisions approach reconciling marketing and operations objectives in omnichannel retailing. Channel switching behaviour is incorporated explicitly in the conceptual model and embedded as an integral characteristic of the omnichannel customer journey aspect on the marketing side of the model.

Patten (2021) reviews the literature on the key drivers for omnichannel service quality and introduces a framework incorporating assortment integration next to the concepts of pricing and promotions, fulfilment, and web and store design positioned at the interplay between the omnichannel retailer and the customer. Consumer confusion is addressed under the notion of price inconsistencies but not related to assortment across channels. Channel switching behaviour is discussed but not embedded into the conceptual model.

In their book chapter, Rooderkerk and Kök (2019) comprehensively cover omnichannel assortment planning and link successfully prior major contributions, involving the structuring of assortment decision levels, different integration types, the MOI, various challenges, and the role of channel switching behaviour as a customer journey view on channel integration issues. They also discuss the consumer confusion effect and its relevance in assortment integration decisions. Although of conceptual nature, the work represents one of the key papers for this research.

Melacini *et al.* (2018) conduct a literature review on e-fulfilment and distribution and examine omnichannel assortment planning challenges. The authors summarize relevant studies that address the notion of physical space limitations offline versus digital shelf space online causing tensions while coordinating assortment across channels. Moreover, the practice of the Long Tail effect and the deliberate listing of key items on both on- and offline channels are highlighted addressing omnichannel assortment composition challenges. From an operational view, a combined view of omnichannel assortment and inventory or delivery time is emphasised as well. Unfortunately, no explicit contributions towards consumer confusion or channel switching behaviour.

Early studies such as from Neslin and Shankar (2009) or Zhang *et al.* (2010) point out the need for a harmonized assortment while pursuing an integrated approach for multi-channel retailing. This is proposed before the term “omnichannel” within the retail context received attention among scholars. In the course of a comprehensive literature synthesis, Neslin and Shankar’s review (2009) opens questions on the operational alignment of marketing mix variables and addresses the need to answer whether products should be aligned across channels, and if not, how to determine what products to allocate for the different channels. They also highlight the importance of customer communication about how the product integration policy has been designed eventually. Zhang *et al.* (2010) who conducted a similar review propose the same questions and also that assortment integration has implications for the inventory management for each channel. The authors argue that the cost of carrying, and the cost of inventory pose important constraints while deciding on the integration level (e.g., the cost of carrying items for a brick & mortar store is significantly higher compared to the costs associated with the online channel). These propositions and observations correspond to a trade-off decision situation at the MOI. The study concludes with open research gaps on how to best determine the length and breadth of assortment for each channel. In both studies, consumer confusion and channel switching in the context of inconsistencies is not a dominantly addressed concept.

The studies are summarized below in the analytical framework in **Table 7**.

***Table 7:** Analytical Framework – Omnichannel Assortment Research*

#	Author(s)	Year	Focus	Assortment Decision Level			Consumer Confusion		Channel Switching		Methodology				Research Domain(s)		
	Key Contributions (Omnichannel Assortment as Focus of Study)			Strategic	Tactical	Operational	Effect	Consequences	Showrooming	Webrooming	Conceptual/Theo.	Empirical	Analytical/Exp.	Prescript. Know.	OCA	OCA ∩ CC	OCA ∩ CSB
1	Ratchford *et al.*	2023	Assortment Coordination	✓								✓			✓		
2	Schäfer *et al.*	2023	Assort. Comp. & Layout & Inv. Mgt.		✓	✓						✓	✓		✓		
3	Vasilyev *et al.*	2023	Assortment Composition		✓				✓	✓			✓				✓
4	Cakir *et al.*	2022	Assortment Integration	✓				✓			✓					✓	
5	Chen *et al.*	2022	Assortment Composition		✓							✓	✓		✓		
6	Hense and Hübner	2022	Space opt. & Cross-Channel Subst.			✓			✓	✓	✓		✓		✓		
7	Lo and Topaloglu	2022	Assortment Composition		✓					✓			✓				✓
8	Srivastava *et al.*	2022	Assortment Expansion	✓							✓	✓	✓		✓		
9	Lee and Chun	2021	Assortment Coordination	✓					✓	✓	✓	✓	✓				✓
10	Sodero *et al.*	2021	Inventory Management			✓						✓	✓		✓		
11	Zhang *et al.*	2021	Assortment Composition		✓						✓		✓		✓		
12	Geunes and Su	2020	Inventory Management			✓							✓		✓		
13	Li *et al.*	2020	Assortment Coordination	✓					✓				✓		✓		
14	Marmol *et al.*	2020	Assortment Layout		✓								✓		✓		
15	Shao	2020	Assortment Composition		✓								✓		✓		
16	Sodero and Rabinovich	2019	Inventory Management			✓						✓	✓		✓		
17	Dzyabura and Jagabathula	2018	Assortment Composition		✓				✓	✓		✓	✓				✓
18	Bertrandie and Zielke	2017	Assortment Coordination	✓			✓	✓			✓		✓			✓	
19	Gu and Tayi	2017	Assortment Composition		✓				✓				✓			✓	
20	Ma	2016	Assortment Composition		✓		✓	✓				✓	✓			✓	
21	Emrich *et al.*	2015	Assortment Coordination	✓							✓		✓		✓		
22	Rodríguez and Aydin	2015	Assortment Composition		✓								✓		✓		
23	Bhatnagar and Syam	2014	Assortment Composition		✓								✓		✓		

OCA = Omnichannel Assortment; CC = Consumer Confusion in Retailing; CSB = Channel Switching Behaviour; ∩ = intersection.

... continued

#	Author(s)	Year	Focus	Assortment Decision Level			Consumer Confusion		Channel Switching		Methodology				Research Domain(s)		
	Related Contributions (Omnichannel Assortment as Element of Study)			Strategic	Tactical	Operational	Effect	Consequences	Showrooming	Webrooming	Conceptual/Theo.	Empirical	Analytical/Exp.	Prescript. Know.	OCA	OCA ∩ CC	OCA ∩ CSB
1	Goraya *et al.*	2022	Channel Integration	✓					✓	✓	✓	✓	✓				✓
2	Campo *et al.*	2021	Share-of-Wallet Expansion	✓								✓	✓		✓		
3	Kang *et al.*	2018	Show- and Webrooming	✓					✓	✓	✓	✓					✓
4	Huré *et al.*	2017	Omnichannel Shopping Value	✓							✓	✓			✓		
5	Melis *et al.*	2016	Share-of-Wallet Expansion	✓								✓	✓		✓		
6	Campo and Breugelmans	2015	Category Allocation Decisions		✓						✓	✓	✓		✓		
7	Li *et al.*	2015	Price, Assortment, Delivery Time			✓							✓		✓		
8	Melis *et al.*	2015	Retail Mix and Online Store Choice	✓							✓	✓	✓		✓		
9	Van Baal	2014	Cross-Channel Effects and Marketing	✓							✓	✓			✓		
	Contributions from Review Studies																
1	Hübner *et al.*	2022	Retail Stores in Omnichannel		✓	✓			✓	✓	✓	✓			✓		
2	Neslin	2022	Channel Integration	✓	✓				✓	✓	✓						✓
3	Timoumi *et al.*	2022	Cross-Channel Effects		✓				✓	✓	✓						✓
4	Bijmolt *et al.*	2021	Marketing-Operations-Interface	✓	✓	✓			✓	✓	✓						✓
5	Patten	2021	Omnichannel Service Quality	✓					✓	✓	✓				✓		
6	Rooderkerk and Kök	2019	Omnichannel Assortment Planning	✓	✓	✓	✓		✓	✓	✓						✓
7	Melacini *et al.*	2018	E-Fulfilment and Distribution		✓	✓					✓				✓		
8	Zhang *et al.*	2010	Channel Integration		✓	✓					✓				✓		
9	Neslin and Shankar	2009	Multichannel Customer Management	✓							✓				✓		

OCA = Omnichannel Assortment; CC = Consumer Confusion in Retailing; CSB = Channel Switching Behaviour; ∩ = intersection.

2.5 Consumer Confusion

In this research, consumer confusion is understood as a negative customer reaction such as irritation, frustration, or annoyance resulting from experiencing inconsistencies while shopping and can generally be defined as an “aversive consequence of a retail situation.” (Anninou and Foxall 2019, p. 140). It reflects a customer’s negative response to an unmet expectation while making decisions in the customer journey. For instance, the products on the web-shop are different to those in the store or the pricing in the store is higher than on other channels, demanding increased customer decision-making efforts. The phenomenon can lead to various negative short- and long-term consequences (e.g., purchase abandonment, loss of trust or loyalty) for the retailer (Bertrandie and Zielke, 2017) and thus represents a crucial challenge to mitigate or avoid in order to provide a seamless customer experience. Consumer confusion should not be mixed up with “confusion marketing”, a discipline deliberately utilising confusion tactics to achieve marketing goals (Kasabov, 2015). Confusion marketing is not within the scope of this research. The following sections cover the concepts and origins of the phenomenon, its dimensions, antecedents, and consequences, and, thereafter, present the state-of-the-art in consumer confusion research in the context of retailing.

2.5.1 The Concept of Consumer Confusion

The following sections organise the concept of consumer confusion into an outline of its origin, its key dimensions as proposed by the research, its antecedents and consequences, as well as its discussion within an omnichannel retailing context.

Origins of the Consumer Confusion Research

In behavioural psychology, *confusion* is understood as a cognitive state where individuals struggle to interpret stimuli in order to act on them (“I am confused”) (Neelon *et al.*, 1996; Slater and Lipman, 1977) but also as a cognitive feeling that connects a feeling to a certain state of knowledge namely a state of “not-knowing” (“I feel confused”) (Clore, 1992). With origins in psychology (Friedman, 1966), studies on confusion have always been a relevant topic in the psychological and medical literature. Since then, it is investigated as “*a disturbance of consciousness that can cause an individual to be restless and scatty, to misjudge the environment and to act futilely.*” (Walsh *et al.*, 2007, p. 699). The expression *consumer confusion* (or “customer confusion”, e.g., in Bertrandie and Zielke, 2017) is transferring the cognitive state or feeling understood from the behavioural psychology into a “consumer” and “shopping” context where the state of confusion is observed within a shopping situation and experienced by a retail customer. Historically, the concept of confusion attained relevance to consumer behaviour through the markets beginning to introduce the notion of "variety" in their offerings. The assumption is that consumers started to seek variety to address various individual needs such as freedom of choice, stimulation, or exploration in order to find the perfect alternative ("variety-seeking behaviour", e.g., Kahn and Ratner, 2005) and companies started to respond by increasing the variety in their offerings to meet those needs and realise competitive advantages (Kahn, 1998). However, this consecutively established the conditions for the occurrence of the consumer confusion phenomenon: with increasing variety, confusion phenomena have started to be observed. Some customers began feeling overwhelmed by the many choices they are now confronted with and felt overloaded with information in their decision-making process, eventually resulting in frustration and dissatisfaction. Accordingly, marketing and consumer behaviour research acknowledged and adopted the phenomenon as a relevant and significant research subject. Mitchell and Papavassiliou (1999) define consumer confusion in shopping situations as "*a state of mind which affects information processing and decision making*." (p. 327). Others define the phenomenon as "*[a] consumer failure to develop a correct interpretation of various facets of a product/service, during the information processing procedure.*" (Turnbull *et al.*, 2000, p. 145). For this research, the latest definition from Garaus and Wagner (2016, p. 3461) is adopted since it covers the current state-of-the-art dimensions, the cognitive, emotional, and behavioural element of the phenomenon: "*[Consumer confusion] is a three-dimensional, reflective second-order construct, consisting of the three reflective first-order dimensions: (1) emotion, which represents affective feelings of the discomfort associated with retail shopper confusion; (2) cognition, which captures the exceedance of cognitive processing abilities; and (3) conation, which describes the restriction in behavioral intention.*"

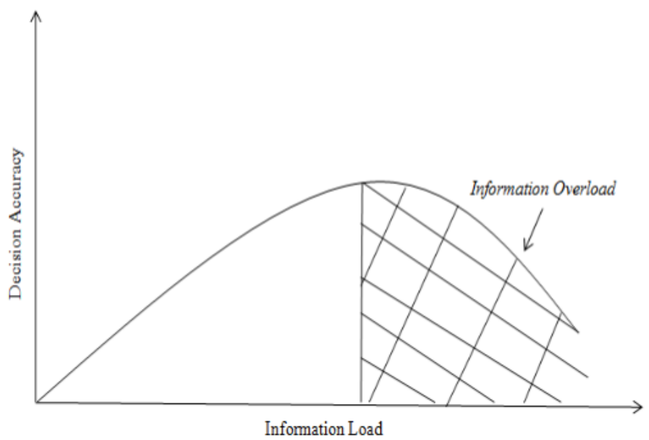
Dimensions of Consumer Confusion

The dominant observed dimension of consumer confusion is referred to as *cognitive* confusion and describes the inability in processing information leading to impaired efficiency, being less careful, or less productive in the shopping activity (Schweizer *et al.*, 2006; Mitchell and Papavassiliou, 1999; Zeithaml, 1988). For instance, choosing from an overwhelmingly large assortment can lead to increased information processing resulting in confusion and frustration within the decision-making process (e.g., Chernev *et al.*, 2015; Diehl and Poynor, 2010; Iyengar and Lepper, 2000). *Affective* confusion addresses the emotional dimension of consumer confusion and captures the emotional responses evident through feelings such as irritation, frustration, or annoyance (Walsh *et al.*, 2007). The third dimension, *conative* confusion, is associated with restrictions on the individual's behavioural intentions such as shopping goals which in the case of violation, e.g., helplessness is experienced (Garaus *et al.*, 2015; Dogu and Erkip, 2000). Consumer confusion can be triggered by many different sources as the variety in consumer confusion antecedents research demonstrates (Chauhan and Sagar, 2021).

Antecedents of Consumer Confusion

Throughout the years, the research discussed the sources of the phenomenon from different perspectives and can currently be distinguished between informational, individual, and situational antecedents for consumer confusion (Chauhan and Sagar, 2021). *Informational* antecedents concern those sources of the consumer confusion phenomenon that stem from the individual's information processing capabilities. The "information overload theory" postulates that confusion is a result of the limited human information processing capacity when confronted with overwhelming variety and complexity in the stimulus reception (e.g., Malhotra, 1982; Scammon, 1977; Jacoby *et al.*, 1974a; 1974b). The argument is that humans are not able to process all necessary information within a specific period of time (all relevant choice options and information, being conscious about all own preferences) as claimed in traditional economics ("homo economicus", Simon, 1955) but are confronted with cognitive limitations and time constraints in the decision-making process (Anninou, 2013; Mitchell *et al.*, 2005). **Figure 11** illustrates how information processing can lead to a collapsing decision accuracy once it is overloaded as postulated by Eppler and Mengis (2008).

Figure 11: *Information Overload mechanism (source: Eppler and Mengis, 2008)*



The decreased decision accuracy can lead to poor decision-making and subsequently to emotional responses evident in the experience of affective confusion (frustration, annoyance, stress, etc.) (Broniarczyk, 2018; Mick *et al.*, 2004; Mitchell and Papavassiliou, 1999). The information overload effect is particularly discussed in the context of assortment size, variety, complexity, or density (Bertrandie and Zielke, 2017; Fasolo *et al.*, 2009; Broniarczyk *et al.*, 1998). The information overload perspective on consumer confusion represents the theoretical concept of choice for this research. Bertrandie and Zielke (2017) argue that information overload while comparing assortments across different channels should be lower in the case when channels provide identical assortments and higher in the case of inconsistent assortments. Next to the information overload effect, "information similarity" represents another expression of limited information processing capability at the POS. This effect is predominantly captured by the concept of "brand confusion" (or "product similarity confusion") where customers feel irritation when confronted with private label products from retailers (also referred to as "lookalike brands", "me-too" or "copycat" products) offered alongside with almost identical brand products from suppliers, adversely affecting customers' effective choice-making (e.g., Balabanis and Craven, 1997; Kapferer, 1995; Foxman, 1992; Foxman, 1990; Loken *et al.*, 1986). Brand confusion has been discussed extensively in the literature in the last three decades of the 20th century (Mitchell and Papavassiliou, 1999) and is not addressed within this research since it predominantly concerns legal issues such as trademark infringement. Another form of the informational antecedent is referred to as "information ambiguity", a source of confusion that is characterised by complex information difficult to be processed by the shopper. Mitchell *et al.* (2005, p. 143) describe the effect as "*a lack of understanding during which consumers are forced to re-evaluate and revise current beliefs or assumptions about products or the purchasing environment.*" Sources are e.g., false, vague, or misleading product claims (Parasidis *et al.*, 2015; Mitchell and Papavassiliou, 1999; Foxman *et al.*, 1990), confusing product labelling (e.g., Leek *et al.*, 2015), or conflicting product information (Fitzgerald *et al.*, 2019). Although information ambiguity caused by channel hopping in omnichannel retailing seems also a plausible source of consumer confusion, it is not studied so far in omnichannel retailing research.

Consequences of Consumer Confusion

In the course of consumer confusion research in the last six decades, studies have observed and identified a range of consequences from the phenomenon. It is noteworthy that Mitchell *et al.* (2005) argue that consumer confusion corresponds to a "hygiene factor" (Herzberg, 2017) in the decision-making process of the customers, meaning that the absence of the consumer confusion phenomenon does not lead to positive satisfaction. Its presence, however, leads to irritation and frustration expressed by different behavioural outcomes.

This poses a significant requirement for organisations such as retailers to increase efforts in mitigating or preventing the phenomenon not to occur in the first place. Yet, consequences are barely avoidable and evident according to research and can be distinguished between short- and long-term consequences (Bertrandie and Zielke, 2017). For this research, short-term consequences are regarded as consequences occurring and observed at the POS (e.g., decision avoidance, purchase abandonment) in the pre-purchase or purchase phase of the customer journey (Bijmolt *et al.*, 2021), whereas long-term consequences (e.g., WOM, loss in trust) reflect customer behaviour resulting from the post journey evaluation phase (Bijmolt *et al.*, 2021).

Table 8: *Summary of consequences of the consumer confusion phenomenon*

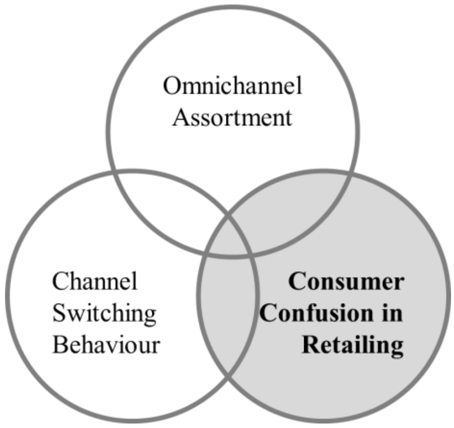
	Consequences	Key Sources
Short-term	Purchase Abandonment	Walsh *et al.* (2007); Mitchell *et al.* (2005); Mitchell and Papavassiliou (1999)
	Purchase Postponement	Walsh *et al.* (2007); Mitchell *et al.* (2005); Mitchell and Papavassiliou (1999)
	Confusion Reduction	Mitchell *et al.* (2005)
	Decision Avoidance	Mitchell *et al.* (2005); Mitchell and Papavassiliou (1999)
	Helplessness	Garaus *et al.* (2015); Mitchell *et al.* (2005)
	Reactance	Settle and Alreck (1988)
	Cognitive Dissonance	Mitchell and Papavassiliou (1999)
	Confusion of other Customers	Foxman *et al.* (1992); Foxman *et al.* (1990)
Long-term	Negative WOM	Tjiptono *et al.* (2014); Walsh and Mitchell (2010); Turnbull *et al.* (2000)
	Shopping Fatigue	Mitchell and Papavassiliou (1999)
	Dissatisfaction	Walsh and Mitchell (2010); Mitchell and Papavassiliou (1999)
	Loss in Loyalty	Walsh and Mitchell (2010); Walsh *et al.* (2007); Mitchell *et al.* (2005)
	Loss in Trust	Tjiptono *et al.* (2014); Walsh and Mitchell (2010)
	Impact on Brand Image	Mitchell and Papavassiliou (1999)
	Purchase Intention	Shiu and Tzeng (2018)

Mitchell *et al.* (2005) view the consequences from a "coping mechanism" perspective and argue that customers either abandon the purchase intent (no coping) or try to reduce the options as well as consult others to share the decision (confusion reduction). Other researchers conclude to various short-term outcomes such as avoidance in making a decision or postponing the purchase (e.g., Mitchell *et al.*, 2005; Mitchell and Papavassiliou, 1997), reactance (unpleasant emotional reaction induced by pressure leading to the adoption of the opposite choice) (Settle and Alreck, 1988), cognitive dissonance (Mitchell and Papavassiliou, 1999) or even to the confusion of other customers (Foxman *et al.*, 1992; 1990). From a long-term perspective, the phenomenon can lead to negative word-of-mouth behaviour (Walsh and Mitchell, 2010; Turnbull *et al.*, 2000), shopping fatigue (Mitchell and Papavassiliou, 1999), and loss of loyalty and trust (Walsh and Mitchell, 2010). The range of key consequences is summarized in **Table 8**.

2.5.2 State-of-the-Art in Consumer Confusion in Retailing Research

In this section, the current state of knowledge of consumer confusion in retailing research is presented. The review contains articles that are positioned in the key research domain of consumer confusion plus the intersections with the domains of omnichannel assortment and channel switching behaviour (**Figure 12**). In total, 39 studies of the domain have been considered where 37 accounted for the key research area, 2 for the intersection between consumer confusion and omnichannel retailing, and 0 papers in the intersection between consumer confusion and channel switching behaviour. No papers are identified that are positioned in the problem space of this research (intersection of all three research domains).

Figure 12: *Consumer Confusion in Retailing research domain and intersections*



The following organises the literature into consumer confusion studies addressing conventional retailing contexts and contributions related to omnichannel retailing in a chronological way, starting from the most recent studies. To the author's knowledge, only one prior SLR study exists that reviews consumer confusion research systematically. The work of Chauhan and Sagar (2021) provides a rich overview of the current state of consumer confusion research, however, while not specifically focusing on retailing or incorporating an omnichannel context. Thus, the study includes studies that are explicitly excluded within this research (e.g., studies on brand confusion, studies with a tourism or hospitality context, etc.), making a new review necessary for this research. The analytical framework (**Table 10**) incorporates the dimensions, consequences, and antecedents of consumer confusion to analyse relevant literature. Moreover, the channel (offline vs. online) that is addressed in the study is captured as well. The omnichannel criteria "assortment" and "channel switching" capture whether articles address the relevant concepts at the intersections with the other domains of this research.

Consumer Confusion in traditional retailing settings

The following studies address consumer confusion in traditional retailing settings (online or offline) and represent the core of consumer confusion research in the retailing context.

Friedman (1966) introduces the concept of consumer confusion through his empirical study examining "truth" with regard to the pricing and packaging information in a supermarket setting. The author positions the notion of consumers being confused due to poorly presented information, misleading information, or unnatural representation of quantity, in the retailing context. The study captures early the psychological elements of cognitive overload or ambiguity and arguably establishes the consumer confusion research domain within psychology and marketing literature. Throughout the years, the studies on the phenomenon mature but it is only until the late 90s that the first comprehensive study is proposed. Mitchell and Papavassiliou (1999) introduce a comprehensive framework of consumer confusion combining major antecedents and outcomes and formulating corresponding consumer reduction strategies. Reduction strategies are customer-related actions of coping and seek to reduce the experience of confusion through behavioural reactions such as searching for more information or simply postponing the purchase. Earlier, the authors investigate empirically sources of confusion in the case of the watch market (Mitchell and Papavassiliou, 1997). In the key paper from Iyengar and Lepper (2000), the authors conduct experiments to demonstrate that an abundance of choice is not always desirable from a consumer point of view. In fact, limited choice among alternatives seems to be more beneficial to consumers, grounding the notion of choice overload theories in subsequent consumer confusion studies. Turnbull *et al.* (2000) emphasise the risk reduction strategies in information search activities by consumers who want to counteract risks in shopping. The authors develop a conceptual framework of consumer confusion for the mobile phone market industry.

Following an environmental psychology approach, Schweizer (2004) analyses and conceptualises all consumer confusion triggers within a retail store environment. The mixed-method study summarizes triggers into eight categories (price, assortment, location, technology, personnel, service, market cultivation and promotions, and store layout) and highlights that these triggers are in fact differentiation parameters in the control of the retailer (Anninou, 2013). Later, Schweitzer *et al.* (2006) develop a corresponding scale with a focus on environmental stimuli consisting of the constructs “variety”, “novelty”, “complexity”, “conflict”, “comfort”, and “reliability”.

In 2005, Mitchell *et al.* condense the past consumer confusion literature and develop a conceptual model based on to that point widely agreed main dimensions of consumer confusion denoting them as “Similarity Confusion”, “Overload Confusion” and “Ambiguity Confusion” with each construct having a cognitive, affective, and a behavioural aspect. The model entails the three main constructs along with antecedents, mediators and moderators, as well as the coping strategies introduced by Mitchell and Papavassiliou (1999) and the consequences of the confusion effect. Moreover, the authors argue, based on the attribution theory (Ryan and Connell, 1989), that the more customers attribute the confusion effect to company-related aspects (external attribution), the higher the effect on company-related consequences. Within the same year, Drummond and Rule (2005), highlight the market development aspect of confusion. The authors examine the UK wine market and assess the implications of marketing variables (segmentation, marketing mix) on confusion. Similarly, in the context of the Chinese personal computer market, Leek and Kun (2006) investigate sources for confusion and postulate that technological complexity is a major antecedent for confusion.

Situated in a grocery retail setting, Buser (2008) investigates the feasibility of RFID concepts utilisation in physical retailing in order to reduce consumer confusion. The author proposes an architecture that holds different features and highlights two specific scenarios for consumer confusion reduction. The study represents the only work within the review that is based on generating prescriptive knowledge (design of an RFID-based architecture) in order to address a specific problem. Although not fully empirically evaluated, the proposed architecture demonstrates its merits and represents an early work in integrating digital aspects with physical ones way before omnichannel and digital retailing became a trend in the industry.

Diehl and Poynor (2010), specifically focus on the relationship between assortment size and customer confusion. The experimental studies show that larger assortments are not always beneficial for customers because of potentially overwhelming options and information but can also induce negative effects on customer satisfaction once the customer makes a choice (post-choice consequence). This is postulated through the “expectation-disconfirmation” effect, explaining the gap between a customer’s expectation to meet his/her preferences and the actual perception of the (weaker) preference match once a choice is made. Consumers can feel dissatisfaction when the perceived preference match is lower than the expectation because of a large assortment.

Walsh and Mitchell (2010) apply the dimensions of consumer confusion proneness in a marketplace setting and their relationship to three outcome variables (WOM, trust, and satisfaction). This approach was later adopted in the context of a developing country (Indonesia) by Tjiptono *et al.* (2014). The concept of consumer confusion proneness is introduced earlier with the work of Walsh *et al.* (2007), establishing the notion of a consumer's tendency in being affected by confusion stimuli through a scale development study. They define the characteristic as a trait that "*can be seen as a consumers' general tolerance for processing similarity, overload or ambiguity information, which negatively affects consumers' information processing and decision-making abilities.*" (Walsh *et al.*, 2007, p. 699). The three proneness constructs that focus on cognitive confusion are "Similarity Confusion", "Overload Confusion", and "Ambiguity Confusion". The authors further present antecedents and consequences and discuss mitigation strategies for retailers. Later in 2016, Walsh *et al.* (2016) extends the scale with the concept of cross-cultural differences.

Matzler *et al.* (2011) view consumer confusion from the angle of mass customisation in online shopping. The authors find out that product satisfaction, the experience of fun in the process, and trust are negatively related to confusion induced by excessive information and choice in the mass customisation process. Earlier, Matzler *et al.* (2007) investigate on the basis of an experiment the role of user's product knowledge and website usability for mass customisation on confusion and coping strategies. Also within an online context, Özkan and Tolon (2015) examine whether consumers buying intentions are affected by confusion resulting from information overload out of user-generated content.

Supported empirically by a focus group and a survey, Stanton and Paolo (2012) investigate the information overload phenomenon and coping strategies in the context of apparel shopping while considering consumer confidence (degree of knowledge is sufficient or correct for the right decision-making) and coping strategies. Anninou (2013) covers consumer confusion in her dissertation from a behavioural perspective model (Foxall, 2004) in two specific shopping situations (grocery and high technology). The comprehensive work provides a rich and critical review of (until then) existing frameworks, scales, and concepts around the consumer confusion phenomenon, covering most of the contributions in the field that are addressed in this review.

In 2015, Kasabov addresses “confusion marketing” in the consumer confusion discourse. As described earlier, confusion marketing is understood as the deliberate practice of confusing consumers in order to achieve marketing goals (e.g., maximise sales, revenue or profit) through e.g., intentionally not disclosing information, over-promotion, overly complicated bills or tariff descriptions. The review integrates all aspects of consumer confusion research until that point and proposes a range of novel sources, aspects, and consequences addressing the confusion practices of businesses.

Shiu (2017) focuses on linking consumer confusion antecedents with their consequences for an integrated view in the context of Taiwanese convenience stores. In the empirically supported work, the author incorporates the constructs “store knowledge” and “stimuli” as specific antecedents of the three confusion dimensions (ambiguity, similarity, overload). He also introduces “inertia” (persistence of cognitive and behavioural patterns) next to “decision postponement” as a specific consequence in the model, combining informational, individual and situational sources. Later in 2018, Shiu and Tzeng, focus on the moderating role of consumer confusion on the relationship between inertia and purchase intention. Within the same context (Taiwanese convenience stores), inertia behaviour seems to counteract confusion in view of purchase intentions.

Garaus and Wagner (2016) draw on the “trilogy of mind” paradigm (Hilgard, 1980) and conceptualise consumer confusion in shopping situations through the constructs “affective feelings”, “cognition”, and “conation”, representing the three components necessary for mental functioning of human minds. This is the follow-up research on the study by Garaus *et al.* (2015) focussing on the effect of the retail store environment (ambient, design, social factors) on consumer confusion (cognitive, affective, conative). Affective confusion entails all negative emotional aspects associated with the situation such as frustration, irritation, or anger. Cognitive confusion represents all thought-driven processes in the shopping situation and is limited by the individual’s cognitive abilities. Thus, increased cognitive requirements (such as through information overload) exceeding cognitive abilities can lead to less efficient decision-making (Garaus and Wagner, 2016). Conation reflects the intention manifested in the mind and can be affected negatively when goal achievement through confusion is inhibited. This construct corresponds to the empirical work of Wang and Shukla (2013) on the role of choice goals in the consumer confusion effect. The authors examine empirically the concept of choice goals related to confusion and investigate whether choice confidence (the extent to which consumers are confident to realise their choice goals) and evaluation costs (the cognitive effort to evaluate alternatives) have an impact on decision satisfaction.

With a focus on similarity confusion, Sarabhai and Singh (2014) develop a scale to investigate product clutter and similarity in the context of the Indian personal care market (face wash products). The authors associate the occurrence of overload confusion with the shopping journey phases "alternate generation" and "information search".

Based on an empirical study, Wobker *et al.* (2015) investigate the phenomenon in the context of food retailing, revealing the crucial positive role of "broader-scope trust" to the retailer (trust in the social context of relationship, e.g., industry; Grayson *et al.*, 2008) prior to the confusion effect. Moreover, the authors highlight the monetary implications for retailers out of the effect such as for revenue (loss in sales) and costs (mitigation spending).

Brolio *et al.* (2016) investigate in a qualitative study the role of information search in pre-purchase phases and how information overload can cause confusion in that process. Based on a focus group study, Li (2017) concentrates the investigation on the information overload problem in online shopping environments specifically accounting for the consumer's motivations (shopping plan, time spent, etc.) and their different processing capabilities.

Another scale development study is conducted by Ermec Sertoglu and Kavak (2017) who account for situational and personal factors as sources for consumer confusion. Coothoopermal and Chittoo (2017) focus on consumer decision-making styles and how they relate together with situational factors to specific confusion contexts (product, price, packaging, etc.). Garaus (2018) introduces the online shopper confusion concept for the investigation of the effect within the online environment. The concept captures the causes (design, navigation, information, functionalities) of purchase intention. Later in 2019, Garaus and Wagner investigate the effects of store environment design on the confusion effect ("store environment confusion") and synthesise eight factors (aisle design, store architecture, customer flow, shelving and storage, signage, space allocation, technology, and visual merchandising). The study develops a "store environmental confusion index" to support retailers in consumer confusion mitigation.

Johnson *et al.* (2019) investigate the relationship between consumer confusion and the usage intention for mobile self-checkout applications in brick-and-mortar stores while accounting for cognitive, affective and conative confusion constructs. Anninou and Foxall (2019) examine the role of consumer confusion (overload and similarity) on in-store customer experience in a retail situation that accounts for past shopping experiences as a moderator variable utilising the Pleasure, Arousal and Dominance (PAD) theory as well as the Behavioural Perspective Model (BPM). In their experimental study, Coskun *et al.* (2019) capture the consumer confusion effect as retail shopper confusion induced by specific stimuli from the store environment (human crowding, store messiness) and investigate its effect on shopping intentions.

In terms of the recent literature, Chauhan and Sagar (2021) analyse and synthesise past works on the consumer confusion effect, propose a conceptual framework for the findings and formulate research questions for future research opportunities. The systematic review of the 80 articles is followed by a thematic analysis leading to the conceptualisation of consumer confusion with two major types of antecedents (informational and individual/situational factors), two types of consequences (adverse outcomes and coping strategies, where adverse outcomes have been further broken down into cognitive, affective, behavioural, and marketing outcome), and a set of moderators and mediators (e.g., demographics, time constraints, buying involvement, or switching costs). The comprehensive overview condenses the past 55 years of consumer confusion literature and concludes with open questions for future research. However, none of the questions is addressing an inquiry into the dynamics between consumer confusion and consumer's channel switching behaviour despite existing research (e.g., Bertrandie and Zielke, 2017). Turri and Watson (2022) conduct an experiment to investigate the role of assortment size (large vs. small) in a physical store on overload confusion while accounting for the external factors filtering (using vs. not using) and situational involvement (high vs. low). Although omnichannel assortment and channel switching behaviour is addressed briefly, the concepts are not part of the research model.

Consumer Confusion in Omnichannel Retailing Research

Although consumer confusion has always been a research topic of interest in the domain of retailing, little research so far focuses on it in the context of omnichannel retailing. For example, the review work of Zhang *et al.* (2010), despite not directly referring to the integration of channels to "omnichannel", is one of the early studies highlighting the importance of creating channel synergies for different operational activities (pricing, assortment, inventory, promotion, returns) while pursuing channel integration. The authors emphasise the need for integration in order to achieve efficiency and avoid consumer confusion. Earlier, Neslin and Shankar (2009) already raised the concern for effective harmonization of channels in multichannel depending on decisions on identical vs.

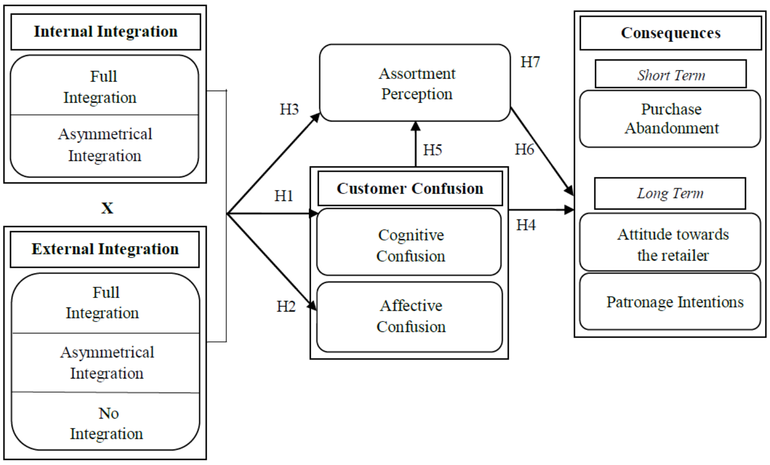
different products and prices in the course of coordinating measures. The authors pinpoint the issue that different prices and products across channels might alienate customers (=confuse them) and thus emphasise the need for prevention measures (communication of an integrated product/price policy to the customers).

Today, Neslin (2022), raises particularly the question of the viability of price discrimination strategies outweighing the associated costs incurred through customer unfairness perception and confusion. Especially higher prices in offline stores than on the online channel can induce these reactions (Chatterje and Kumar, 2017). The question arises due to the fact that a harmonized price policy across channels is not necessarily the ideal approach for maximising profitability as scholars argue in the discussion on integration (Chen *et al.*, 2018).

In 2015, Emrich *et al.* conduct a series of experiments to determine to what extent a retailer should integrate its assortment across channels. They conceptualise a model with various assortment types and investigate their effects on shopping benefits, eventually determining the patronage intentions of customers (dependent variable). The authors also argue from a consumer confusion standpoint, emphasising the need for its consideration justified by its influence on the shopping benefits. In particular, they highlight that perceived variety of assortment (the extent of the number and diversity of items perceived by the customer), a major construct determining shopper benefits, is positively associated with patronage intentions as long as overabundance which can lead to confusion effects is avoided (Iyengar and Lepper, 2000).

As discussed in the previous review on omnichannel assortment, a similar experiment-based study conducted by Bertrandie and Zielke (2017) investigates the impact of assortment integration types on customer confusion, assortment perception and consequences. Unlike previous studies, the work of Bertrandie and Zielke represents the first study with consumer confusion (defined as “customer confusion” in the article) as a central concept in a multiple-channel context. Interestingly, the study also considers assortment integration with competitors (external integration). The authors demonstrate that asymmetrical integration is associated with low cognitive and affective confusion compared to full integration and that especially a smaller offline assortment is favourable in the asymmetry. They also demonstrate that full external integration leads to the lowest cognitive confusion. The research model covers different assortment integration types as discussed in Section 2.4.1 and successfully links consumer confusion constructs in order to assess consequences, showing a strong contribution to the research problem of this study (**Figure 13**).

Figure 13: *Assortment Integration Effects on Customer Confusion (source: Bertrandie and Zielke, 2017)*



Bertrandie and Zielke (2019) also investigate the impact of customer confusion next to perceived price fairness through pricing integration (identical prices in both channels for the same products). The study argues that cognitive overload can occur when customers are overwhelmed with different price information across channels (product price, promotion, shipping fees) eventually provoking customer confusion. The authors primarily conclude that channel cost advantages (e.g., online channel in general) and disadvantages (shipping fee) are positively associated with price fairness perception by customers.

Prior to both of these studies, Bertrandie (2020) conducted qualitative research with retail customers on the antecedents of customer confusion and synthesised the outcome into four main categories and 13 subcategories as a basis of her dissertation (**Table 9**).

Table 9: *Consumer Confusion Antecedents in omnichannel retailing (source: Bertrandie, 2020)*

Category	Subcategory
Product Information	1. Differing recommendations in different channels. 2. Too much information on different channels. 3. Differing (contradictory) information in different channels.
Price	4. Differing prices in different channels. 5. Differing prices through promotions in different channels.
Assortment and Availability	6. Differing assortment (product is generally not offered in every channel). 7. Differing availability (product is temporarily not available in every channel). 8. Poor information exchange / coordination regarding assortment across channels. 9. Poor information exchange /coordination regarding product availability across channels. 10. Differing product type designation for an identical product in different channels.
Channel Service Features	11. Differing time of product receipt upon purchase in different channels. 12. Differing return policies in different channels.

The open question-based questionnaire collected responses on their experiences about confusion, irritation or frustration while looking for or buying a product on multiple channels and how the participants reacted if they had experienced those situations.

The antecedents cover a range of perceived inconsistencies such as differing information (up to contradictions), information overload, the application of differing marketing instruments (e.g., price promotions, return policies), differences in availability, information exchange across channels, and different quality of services across channels. The author emphasises that participants' responses explicitly contained emotional expressions that are characteristic of customer confusion such as frustration, annoyance, and being overwhelmed. Moreover, their reactions indicate typical customer confusion consequences such as decision avoidance, purchase postponement, or the development of doubts about the retailer. However, she also highlights the fact that the antecedent categories are predominantly under the retailer's control and thus able to be addressed proactively. The comprehensive work addresses the consumer confusion problem from an assortment and pricing context and investigates sources for confusion in multi-channel shopping. The notion of "multi-channel" in the research is interchangeable with the understanding of omnichannel since the precondition of channel integration is grounded in the switching behaviour of omnichannel shoppers. The author conducts a pre-study and three different research projects with the aim to (1) identify sources for confusion (see **Table 9**), (2) examine confusion explained from an assortment integration perspective, (3) from an assortment organisation integration perspective, and (4) investigate confusion explained from a pricing integration perspective. However, a channel switching perspective is not incorporated into the models and experiments.

Table 10: *Analytical Framework – Consumer Confusion Research in Retailing*

#	Author(s)	Year	Focus	Dimensions			Con-seq.		Antecedents			Cha-nnel		Omni-channel		Methodology				Research Dom.(s)		
	Key Contributions of Consumer Confusion in Retailing			Cognitive	Affective	Conative	Short-term	Long-term	Informational	Individual	Other	Offline	Online	Assortment	Channel Switch.	Conceptual/Theo.	Empirical	Analytical/Exp.	Prescript. Know.	CC	CC ∩ OCA	CC ∩ CSB
1	Turri and Watson	2022	Confusion Overload and Assortment Size	✓			✓		✓			✓		✓		✓		✓		✓		
2	Anninou and Foxall	2019	Consumer Confusion and Retail Exp.	✓	✓				✓	✓	✓	✓				✓	✓			✓		
3	Bertrandie and Zielke	2019	Pricing and Customer Confusion	✓	✓		✓	✓	✓			✓	✓			✓		✓		✓		
4	Coskun *et al.*	2019	Consumer Confusion & Stimuli Overload	✓	✓	✓	✓	✓	✓		✓	✓				✓		✓		✓		
5	Garaus and Wagner	2019	Confusion Potential of Store Environment	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓			✓		
6	Johnson *et al.*	2019	Consumer Confusion and Mobile Self Ch.	✓	✓	✓			✓	✓	✓	✓				✓	✓			✓		
7	Garaus	2018	Online Shopper Confusion	✓	✓	✓	✓	✓	✓		✓		✓			✓	✓	✓		✓		
8	Shiu and Tzeng	2018	Inertia-Purchase Intention and Confusion	✓			✓		✓	✓		✓					✓			✓		
9	Bertrandie and Zielke	2017	Customer Confusion and Assortment	✓	✓		✓	✓	✓			✓	✓	✓		✓		✓			✓	
10	Coothoopermal and Chittoo	2017	Decision-Making Styles and Confusion	✓	✓				✓	✓	✓	✓				✓	✓			✓		
11	Li	2017	Online Shopping & Information Overload	✓					✓	✓			✓			✓	✓			✓		
12	Sertoglu and Kavak	2017	Situational and Personal Factors	✓					✓	✓	✓	✓				✓	✓			✓		
13	Shiu	2017	Consumer Confusion and Inertia	✓	✓		✓	✓	✓	✓	✓	✓				✓	✓			✓		
14	Brolio *et al.*	2016	On- and Offline Information Search	✓					✓	✓		✓	✓			✓	✓			✓		
15	Garaus and Wagner	2016	Retail Shopper Confusion Scale	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓			✓		
16	Garaus *et al.*	2015	Retail Shopper Confusion	✓	✓	✓			✓			✓				✓	✓			✓		
17	Özkan and Tolon	2015	User-Generated Content and Confusion	✓			✓		✓	✓			✓			✓	✓			✓		
18	Wobker *et al.*	2015	Consumer Confusion in Food Retailing	✓	✓		✓		✓			✓				✓	✓			✓		
19	Sarabhai and Singh	2014	Overload Confusion Proneness in India	✓			✓		✓	✓		✓					✓			✓		
20	Wang and Shukla	2013	Consumer Confusion and Choice Goals	✓		✓	✓		✓	✓		✓				✓	✓			✓		
21	Stanton and Paolo	2012	Information Overload & Apparel Shopping	✓	✓		✓		✓	✓		✓	✓			✓	✓			✓		
22	Matzler *et al.*	2011	Consumer Confusion and Mass Custom.	✓			✓	✓	✓	✓			✓			✓	✓			✓		

. . . *(continued)*

. . . *(continued)*

23	Diehl and Poynor	2010	Assortment Size and Consumer Confusion	✓	✓			✓	✓			✓						✓		✓		
24	Walsh and Mitchell	2010	Proneness on WOM, Trust, Satisfaction	✓	✓			✓	✓			✓					✓			✓		
25	Buser	2008	RFID Architecture & Consumer Confusion	✓					✓			✓				✓			✓	✓		
26	Matzler *et al.*	2007	Product Knowledge and Mass Custom.	✓			✓		✓	✓			✓			✓		✓		✓		
27	Leek and Kun	2006	Consumer Confusion in PC Market	✓			✓		✓			✓					✓			✓		
28	Schweitzer *et al.*	2006	Consumer Confusion Scale Development	✓	✓				✓			✓				✓	✓			✓		
29	Drummond and Rule	2005	Consumer Confusion in the Wine Industry	✓	✓		✓		✓			✓	✓				✓			✓		
30	Mitchell *et al.*	2005	Consumer Confusion Conceptual Model	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓				✓		
31	Iyengar and Lepper	2000	Choice Overload and Consumer Motiv.	✓			✓		✓			✓					✓	✓		✓		
32	Turnbull *et al.*	2000	Consumer Confusion and Risk Reduct.	✓			✓	✓	✓			✓				✓	✓			✓		
33	Mitchell and Papavassiliou	1999	Causes and Consequences of Confusion	✓			✓		✓			✓				✓				✓		
34	Mitchell and Papavassiliou	1997	Consumer Confusion in the Watch Market	✓			✓		✓			✓					✓			✓		
35	Friedman	1966	Consumer Confusion in Supermarkets	✓					✓			✓					✓			✓		

CC = Consumer Confusion in Retailing; OCA = Omnichannel Assortment; CSB = Channel Switching Behaviour; ∩ = intersection.

#	Author(s)	Year	Focus	Components			Con-seq.		Antecedents			Cha-nnel		Omni-channel		Methodology				Research Dom.(s)		
	Other Contributions (Reviews, Dissertations)			Cognitive	Affective	Conative	Short-term	Long-term	Informational	Individual	Other	Offline	Online	Assortment	Channel Switch.	Conceptual/Theo.	Empirical	Analytical/Exp.	Prescript. Know.	CC	CC ∩ OCA	CC ∩ CSB
1	Chauhan and Sagar	2021	Systematic Literature Review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓				✓		
2	Bertrandie (Dissertation)	2020	Customer Confusion in Multi-Channel	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓				✓	
3	Kasabov	2015	Review on Confusion in Marketing	✓	✓		✓	✓	✓	✓		✓	✓			✓				✓		
4	Anninou (Dissertation)	2013	Behavioural Perspective on Confusion	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓			✓		

CC = Consumer Confusion in Retailing; OCA = Omnichannel Assortment; CSB = Channel Switching Behaviour; ∩ = intersection.

2.6 Channel Switching Behaviour

The omnichannel approach allows customers free movement between channels within one transaction process (Goraya *et al.*, 2022; Mirsch *et al.*, 2016; Piotrowicz and Cuthbertson, 2014). For example, customers can start their shopping journey on a web-shop to search for information on a product or compare alternatives and finish the process by buying the product at a physical store. This unhindered "switching" behaviour is possible since there are no barriers between the channels in an omnichannel shopping environment. Originally, the concept was formerly captured as the "free riding behaviour" (Van Baal and Dach, 2005), where customers visit a retailer's channel to acquire and evaluate information on products but switch to another retailer for purchase. Today, the behaviour is referred to as *channel switching* and is defined as a customer's purchasing pattern where different channels (e.g., web-shop, brick-and-mortar store, mobile phones) are used to acquire information and purchase products (Van Nguyen *et al.*, 2022; Schneider and Zielke, 2021; Hsiao *et al.*, 2012). The behaviour reflects an expression of the customer journey process and is associated with multi-channel and omnichannel consumer behaviour. A customer journey is the buying process of a customer starting from need recognition to purchase and post-purchase evaluation (Bijmolt *et al.*, 2021; Herhausen *et al.*, 2019; Lemon and Verhoef, 2016; Butler and Peppard, 1998; Howard and Sheth 1969). The linear process has developed into a complex journey due to the advent of digital technologies and the myriad of new touchpoints today (Barwitz and Maas, 2018; Srinivasan *et al.*, 2016). The understanding of channel switching behaviour is in line with the concepts of "Cross Channel Hopping" (Huré *et al.*, 2017; Heitz-Spahn, 2013) or "Research Shopping" (Neslin and Shankar, 2009; Konuş *et al.*, 2008; Verhoef *et al.*, 2007). Channel switching behaviour in research is strongly associated with *showrooming* and *webrooming* behaviour, the two most common types of channel switching.

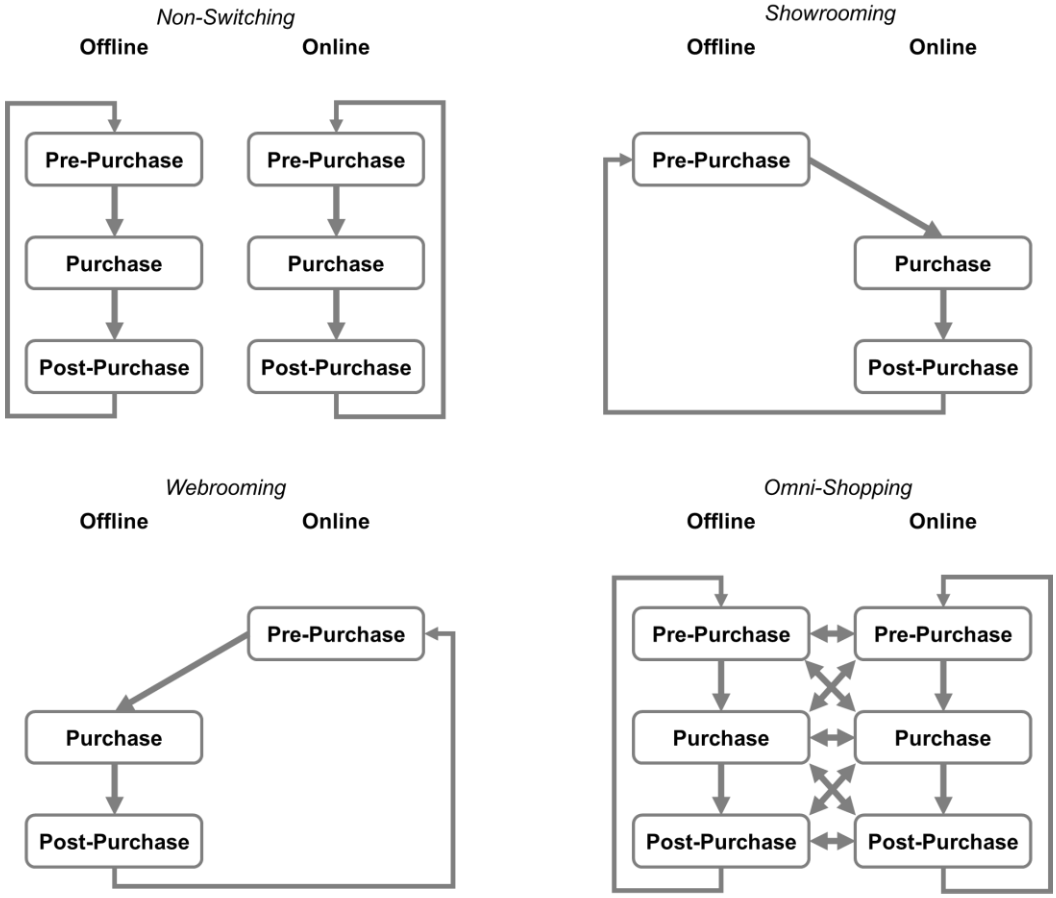
The following sections describe both types of channel switching behaviour in detail and provide an overview of the current research in the domain. Researchers focus on one specific or both types in their studies, eventually structuring the research domain into the following three streams: showrooming literature, webrooming literature, and literature that focuses on both show- and webrooming. This structure is adopted for the review.

2.6.1 Showrooming and Webrooming

According to the literature, channel switching is typically associated with show- and webrooming and is regarded as a common consumer practice in today's retailing landscape (Flavián *et al.*, 2020). Both switching types represent basic examples of consumer switching. The showrooming behaviour is characterised by consumers who collect product information in physical stores first and complete the purchase in the online store (Aw, 2020; Flavián *et al.*, 2020; Kang, 2018). Correspondingly, webrooming behaviour is evident in consumers who research product information online but purchase in a physical store (Aw *et al.*, 2021; Kang, 2018; Flavián *et al.*, 2016). Of both switching behaviours, webrooming represents the most popular type observed (Aw *et al.*, 2021; Aw, 2019), sometimes also referred to as "reverse showrooming" (Flavián *et al.*, 2016). A study on US and UK consumers (n = 2,000) shows that webrooming is the number one switching type (74%) versus showrooming (57%) and click-and-collect (54%) (Berthiaume, 2019). A common observation in showrooming behaviour is the simultaneous use of mobile technology to compare products while being in-store (Rapp *et al.*, 2015). Timoumi *et al.* (2022) further differentiate between intra-product (inspecting a product offline and purchasing it online) and inter-product showrooming (inspecting a product offline but purchasing a different or related product online). Gu and Tayi (2017) define a similar form of showrooming referred to as "pseudo-showrooming" (inspecting a product offline followed by the purchase of a related but different product online). Frasquet and Miquel-Romero (2021) define competitive showrooming, that is switching the retailer while changing channels, vs. loyal showrooming, as switching to the channel of the same retailer. In contrast, a form of webrooming is labelled as "competitive webrooming" which describes a form of channel switching from the online channel of one retailer to the offline channel of another (Manss *et al.*, 2020; Genlser *et al.*, 2017). This form damages the profitability of the online retailer (Manss *et al.*, 2020) since there is no conversion occurring despite providing informational value or even online support – also labelled as "free riding behaviour" (Heitz-Spahn, 2013).

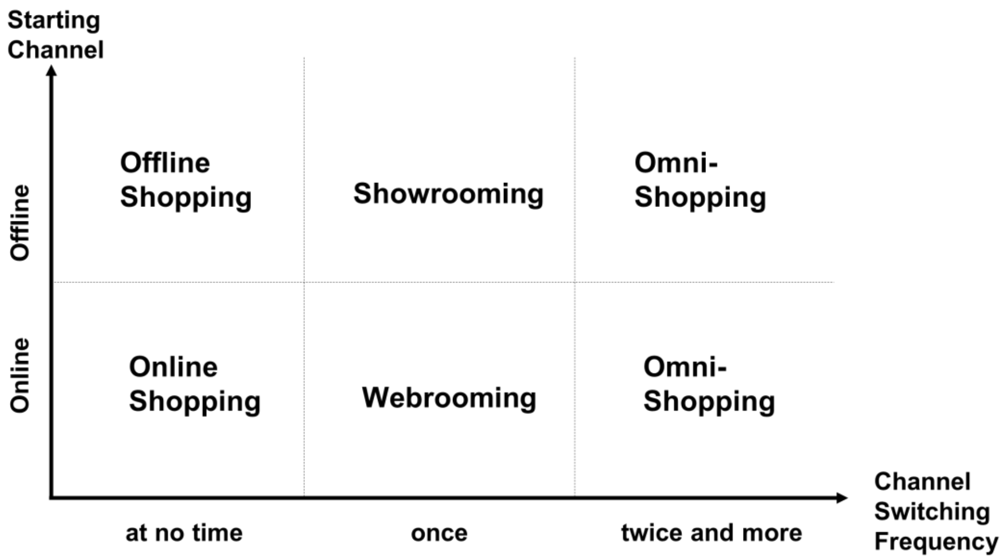
The motivations for channel switching are manifold. Showrooming is argued to be performed in order to find lower prices online or to avoid waiting for in-store service (Arora *et al.*, 2017; Gensler *et al.*, 2017). In contrast, webrooming can be motivated by an unwillingness to pay for shipping, being able to touch and feel the desired product before purchase, returning products to the store if required, or just not wanting to wait for delivery (Rooderkerk and Kök, 2019). Determinants for show- or webrooming behaviour are predominantly consumer-related and therefore highly variable depending on the customer type. Timoumi *et al.* (2022) define different customer types based on the customer journey in omnichannel retailing and differentiate between "single-channel", "multichannel", "web-and showroomers", and "omnichannel" customers. Similarly, Neslin (2022) views channel switching behaviour from the consumer decision process (information search, purchase, aftersales support) and the corresponding degree of omnichannel integration strategies of the retailer (from an unconnected, horizontal, vertical, to a complete integration strategy), reflecting a similar maturity of connectivity across channels. Inspired by both Timoumi *et al.* (2022) and Neslin (2022), channel switching in this research is distinguished by four main customer journey expressions (**Figure 14**). “Non-switching” represents a linear customer journey process from pre-purchase to purchase and post-purchase solely carried out on one channel (offline or online). It represents the traditional way of shopping without any switching behaviour but can still be evident in an omnichannel environment. “Showrooming” and “webrooming” are characterized by one switching activity after the pre-purchase phase where customers switch from the offline to the online channel or vice versa. The third case, “omnichannel shopping” is constituted by a dynamic and continued switching practice by the customer independent from the journey phase and reflects the most extreme expression of channel switching behaviour. Correspondingly, all four switching types can be individualised to customer types to characterise customers based on their switching behaviour: “non-switcher”, “showroomer”, “webroomer”, and “omni-shopper”.

Figure 14: *Channel Switching Types (adapted from Timoumi et al., 2022, and Neslin, 2022)*



Reflecting Timoumi *et al.*'s (2022) and Neslin's (2022) propositions, for this research, the switching types can be further distinguished by the notion of "frequency of switching". While both studies distinguish by customer journey phases / customer decision process and the channels, this research adds a new dimension of how often a customer conducts channel switching, expressed between "at no time" ("offline/online shopping" = non-switching behaviour, staying in one channel for the whole customer journey), "once" (show- and webrooming, starting from one channel and switching once to the other channel and completing the customer journey), and "twice and more" (omni-shopping, starting from one channel and continuously switching between the channels until completion of the customer journey). A 2x3 typology matrix on these channel switching types is proposed and shown in **Figure 15**.

Figure 15: *Channel Switching Types based on switching frequency (source: own concept)*

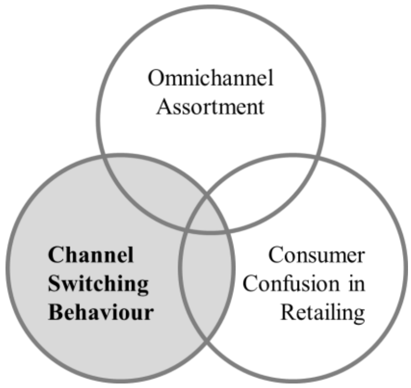


2.6.2 State-of-the-Art in Channel Switching Behaviour Research

The content of this section covers the current state of knowledge of the channel switching behaviour research domain. The review contains articles that are positioned in the key research domain including the intersections with the domains of omnichannel assortment and consumer confusion in retailing (**Figure 16**). In total, 89 studies of the domain have been considered where 76 account for the key research area, 8 for the intersection between channel switching behaviour and omnichannel assortment, and 5 papers on the intersection between channel switching behaviour and consumer confusion in retailing. No papers are identified that are positioned in the problem space of this research (intersection of all three research domains). As mentioned above, the following sections organise the literature into studies for showrooming, webrooming, and studies that focus on show- and webrooming. To the author's knowledge, only one prior SLR study exists that reviews channel switching behaviour systematically (Sahu *et al.*, 2021). However, the review is focused on the determinants of the show- and webrooming and does not account for strategic assortment decisions nor the consumer confusion phenomenon, thus providing limited utility.

The Analytical framework (**Table 11**) incorporates the two distinct channel switching behaviour types, show- and webrooming as concepts. Moreover, the relevant concepts of the other two domains are incorporated under the "omnichannel" umbrella as well (capturing "assortment" and "consumer confusion" concepts within the reviewed studies).

Figure 16: *Channel Switching Behaviour research domain and intersections*



Studies focussing on Showrooming

Based on the literature search results, studies on showrooming represent the majority of research conducted within the channel switching research area. To begin with, earlier studies such as Mehra *et al.* (2013) identify and analyse strategies to counter showrooming free-riding behaviour. In an experiment, Luo *et al.* (2014) investigate the reasons for and against the showrooming intention and consider the factors of the online-offline price difference and employee knowledge in the analysis.

Rapp *et al.* (2015) focus on the retail salesperson who faces showrooming behaviour and suggests specific salesperson behaviour and strategies to prevent consumers from leaving the store after product inspection. The authors also contribute a specific scale that measures perceived showrooming by salespersons. In similar studies, Fassnacht *et al.* (2019), focus on salesperson interaction quality to increase the in-store buying intention of showroomers while Schneider and Zielke (2021) view how service usage can compensate for price differences across online and offline retailers in showrooming. In another sales service-focused study, Wang and Wang (2022) incorporate the concept of in-store service in their game-theoretic model.

Grounded on the theory of planned behaviour (TPB), Arora *et al.* (2017) show that customers are motivated by the need for touching and feeling the product, and the assistance of sales staff to conduct showrooming behaviour. In their study, the authors also argue that the customer's attitude towards showrooming is positively impacted by the intention of reducing confusion potentially induced in the online channel due to information overload. Grounded on the same theory, Rejón-Guardia and Luna-Nevarez (2017) empirically investigate antecedents of showrooming in the context of consumer electronics. Later, Arora and Sahney (2018) develop an integrated framework based on the theory of planned behaviour and the technology acceptance model (TAM) (Davis, 1989) along with the incorporation of the construct "better product assortment" capturing the beneficial wider product assortment online. In 2020, Arora *et al.*, adopt the S-O-R (stimulus-organism-response) perspective (Mehrabian and Russell, 1974) to enhance the understanding of situational vs. intentional showrooming behaviour. In their empirical work, Shankar *et al.* (2021) also adopt the S-O-R framework and investigate the role of convenience (offline search and online purchase) in showrooming intention. Chokkannan *et al.* (2023) utilise the same framework while investigating deal-seeking on mobile devices and the intention to redeem digital coupons for mobile shopping intention in the fashion retailing context. In their latest study, Arora *et al.* (2022) build on their situational vs. intentional showrooming behaviour framework and introduce two comprehensive models based on the S-O-R, the motivation-opportunity-ability (MOA) (Leung and Bai, 2013), and the SAP-LAP (situation analysis, actors, processes, to learning, actions, performance; Sushil, 1997) theory. The TAM is also applied in its extended UTAUT2 form (Unified theory of acceptance and use of technology, Venkatesh *et al.*, 2012) in the work of Chimborazo-Azogue *et al.* (2022) that focuses on the two drivers "value consciousness" and "purchase involvement" on showrooming intention while considering "mobile dependency" as a moderator variable. The authors conduct another study on the intention for mobile shopping and subsequent user-generated content creation (Chimborazo-Azogue *et al.*, 2021). The TPB is also utilised by Radzevičė and Banyte (2021) who examine consumer irrationality based on the three constructs confusion, self-indulgence, and automatic impulsiveness, in their empirical study. Specifically, "confusion" is addressed in the context of online store information overload and the inertia phenomenon and connects to the consumer confusion literature. The authors discuss consumer confusion also in the context of assortment inconsistencies but do not account for assortment in their research model.

Brown *et al.* (2017) examine showrooming behaviour in the context of small retailers and develop a consumer typology with four specific consumer behaviour groups along with six strategies to mitigate showrooming problems. Viewing competitive showrooming, Gensler *et al.* (2017) conduct an empirical study and show that price savings are indeed a motivation for showrooming behaviour. Mehra *et al.* (2018) demonstrate competitive showrooming being detrimental to offline retailers and consider exclusive product assortment offline as a long-term counterstrategy against showrooming. Gu and Tayi (2017) develop an analytical model that considers pseudo-showrooming behaviour (inspecting a product offline followed by the purchase of a related but different product online) and reveal that retailers adopting an on- and offline channel gain profit increases when consumers are exposed to a selective set of products offline from the full online channel assortment instead of carrying the identical product in both channels. The research tackles an assortment composition problem successfully linked to a specific channel switching behaviour.

From a value co-destruction perspective, Daunt and Harris (2017) conduct a study considering the influence of product, consumer, and channel characteristics on showrooming behaviour, defined as in-store value-taking and online value co-destruction/co-creation. Rajkumar *et al.* (2020) also focus on the aspect of value in their empirical study and adopt a customer-perceived value lens (perceived showrooming value) divided into benefits and sacrifices.

From a game theoretical angle, Basak *et al.* (2017) analyse showrooming behaviour between a traditional and an online retailer and postulate that showrooming can indeed affect both retailers' profits.

Based on a qualitative study, Sit *et al.* (2018) view showrooming from a positive standpoint as opposed to the dominantly negative notion in the literature (e.g., "free riding") and propose a set of propositions from the customer's viewpoints. The interviews with customers also reveal aspects of confusion in the showrooming process, e.g., due to information overload or price inconsistencies. Price competition between on- and offline channels is the focus of the analytical study by Zhang *et al.* (2018) where the authors also consider sunk costs arising from lost conversions in the online store.

Burns *et al.* (2018) examine showrooming as a free-riding phenomenon through the empirical analysis of student showrooming behaviour. The authors emphasise the ethical aspect of the phenomenon and incorporate an “ethicality” construct into their model.

Dahana *et al.* (2018) focus on consumer characteristics that not only can explain but also how much a consumer engages in showrooming (extent of behaviour), demonstrating that especially involvement and price consciousness drive showrooming behaviour. The extent of behaviour is characterised by non-showrooming, potential, occasional, and frequent showrooming.

Kim and Park (2019) adopt the push-pull-mooring (PPM) model on consumer personality traits. Similarly, Frasquet and Miquel-Romero (2021), apply the PPM framework to understand consumer intention on competitive showrooming vs. loyal showrooming while also discussing the aspect of the wider assortment provision in the online store. While focusing on trust and satisfaction, Spaid *et al.* (2019) show that consumers’ satisfaction and trust in an online information source create a spill-over effect on satisfaction and trust toward the retailer and subsequently patronage intentions.

Schneider and Zielke (2020) conceptualise a detailed understanding of showrooming dividing the behaviour into different segments (comfort-oriented & economic, loyal, mobile economic, and conservative showroomer) based on retailer loyalty, use of in-store information, devices, place and time of the online purchase. Utilising a large customer journey dataset, Viejo-Fernández *et al.* (2020) propose that in-store mobile usage by showroomers is more likely to buy products at a higher price.

Zhang *et al.* (2020) introduce a differentiation of showrooming based on whether the consumer purchases the same or different product through the online channel after the in-store visit. Intra-product showrooming refers to the behaviour where a consumer buys the same product of a retailer whereas in inter-product showrooming the consumer buys a different or related product at the same retailer’s online store. With a focus on mobile device use in-store, Fiestas and Tuzovic (2021) investigate the in-store showrooming behaviour and introduce a framework for a mobile-assisted showrooming shopping journey. Johnson and Ramirez (2022) concentrate on millennial consumers and how they are affected by showrooming behaviour.

Studies focussing on Webrooming

A range of studies focuses on webrooming and investigates its antecedents and outcomes in diverse contexts. To begin with, Chung *et al.* (2022) compare non-webrooming with webrooming behaviour to investigate product evaluation and purchase intentions. In a series of experiments, the findings show for example that webrooming negatively influences purchase intentions due to e.g., the need for touch. Arora *et al.* (2021) adopt the theory of goal-directed behaviour and past behaviour in their study. Webrooming is oftentimes investigated related to product involvement (e.g., Aw, 2020; Aw, 2019). For example, in the empirical study by Shankar and Jain (2023) on webrooming intention in the context of luxury goods, the need for socialisation, staff assistance, and the need for touch is shown to drive the intention to switch from online to offline. Earlier, the authors did a similar study with millennial luxury shoppers (Jain and Shankar, 2022) and accounting for perceived hedonic versus perceived utilitarian value in the shopping process (Shankar and Jain, 2021). The need for touch and interaction is also emphasised in the qualitative study by Aw *et al.* (2021) who investigate the determinants for and against the adoption of webrooming behaviour, also in the case of millennial customers. This is followed by an earlier quantitative study focusing on consumer traits, channel-related factors, and smart shopping perception as antecedents of webrooming intention (Aw *et al.*, 2021). Before that study, Aw (2020) investigates webrooming intention based on the influence of product characteristics (involvement, categories), consumer traits (need for touch, interaction), and perceived usefulness of online reviews. Moreover, in the study of 2019, Aw considers webrooming costs (offline purchase effort, expected price loss) as a specific factor within consumers' channel perceptions influencing webrooming intention (consumers are unlikely to perform webrooming in case the associated costs are perceived as too high).

Other studies view consumer-related characteristics in the context of webrooming behaviour. For instance, Patel (2022) investigates the ROPO behaviour (research online, purchase offline, corresponding to webrooming) related to the perceived value of shopping in the context of the post-COVID-19 pandemic. Based on an empirical study, the author identifies the three shopper profiles as risk averters, value maximisers, and convenience seekers. Kleinlercher *et al.* (2020) organise antecedents into four groups psychographic variables, shopping motivations, and channel- and product-related variables. The authors provide support for the economic impact of webrooming evident through increased customer spending. The authors also account for assortment in the context of its attractiveness in the physical store positively associated with webrooming. Pallant *et al.* (2020) introduce the concept of "self-selection" determining the path to purchase either via research shopping (webrooming) or single-channel shopping in order to achieve purchase value. Self-selection is undergone by individuals who rather choose their own group instead of being allocated randomly, mostly under consideration of outcomes.

In terms of experiential aspects, poor experience in online shopping can lead to webrooming behaviour (Schiessl *et al.*, 2023) where channel integration perception increases the switching within the same retailer. Moreover, Manss *et al.* (2020) demonstrate that online retailers can reduce consumers' intention in webrooming by providing satisfactory aftersales service, channel-related price, and quality. In their study, the authors focus on competitive webrooming, the switching behaviour from the online channel of a retailer to the offline channel of a competitor of that retailer. Among the channel-related aspects in the research model, assortment plays a role as a factor of channel attractiveness, e.g., consumers do not switch the retailer after searching if they are pleased with the retailer's assortment. Shankar *et al.* (2021) investigate webrooming intention through online engagement evident by online search benefits. One of the benefits is proposed as a "better assortment" online compared to offline (larger assortment, use of the online catalogue, wide variety, displaying of complementary products or similar brands) thus saving time, and providing fast evaluation. Shankar (2021) also viewed convenience (time and effort consumers save while using a service) impact on webrooming intention in the banking context, an industry also exposed to channel switching behaviour.

Flavián *et al.* (2021) conduct experiments on the impact of mobile WOM while in-store in the course of webrooming demonstrating its effect on preference and choice at the store. The authors propose that this kind of behaviour represents an evolvement of webrooming behaviour. In fact, this switching pattern can be labelled as omni-shopping beyond webrooming since switching occurs more than once (**Figure 15**). Santos and Gonçalves (2019) differentiate in their study on webrooming motivations between traditional webrooming, webrooming extended by mobile devices, and "multidevice webrooming". The study proposes the significant role of mobile devices in webrooming and their impact on unrestricted physical and temporal access to information. Within experimental studies, Orús *et al.* (2019) assess how consumer online recommendations affect webrooming experience considering online, offline and mobile channels.

In another series of studies, Arora and Sahney (2017) develop a conceptual framework for webrooming behaviour grounding on the Theory of Planned Behaviour (Ajzen, 1991) and the technology acceptance model (Davis, 1989). The model was extended, used and enriched empirically in 2018 and 2019.

Flavián *et al.* (2016) demonstrate that the use of online information search increases confidence in offline purchases and thus reduces uncertainty in the buying process. Interestingly, the authors highlight in their work the information overload problem through increased information processing (Section 2.5.1) in the online channel that can lead to increased uncertainty in the buying process.

Studies on both Show- and Webrooming

Next to studies that focus solely on either show- or webrooming, the literature shows also rich contributions considering both types of channel switching behaviour as the subject of study.

Early in 2007, Verhoef *et al.* already investigate reasons for channel switching ("research shopping") with the intention of searching on one channel and purchasing on another channel before the terms show- or webrooming had been coined. The research accounts for attribute-based decision-making, the lack of channel lock-ins and, cross-channel synergies and considers assortment as one of the search- and purchase benefits in the course of research shopping. The study represents one of the grounding works of channel switching research in retailing.

Wolny and Charoensuksai (2016; 2014) discuss the mapping of customer journeys in a multi-channel context and emphasise the dynamic channel preference throughout the journey. Wang *et al.* (2016) empirically examine channel characteristics and their influence on the channels in terms of search and purchase attitudes. Kowalczuk (2018) investigates the difference between German and Polish shoppers in ROPO and reverse ROPO behaviour. In their quantitative study, Reid *et al.* (2016) focus on price sensitivity in the consumer's buying decision process across channels. Kang (2018) examines the effect of a consumer's individual characteristics on the show- and webrooming behaviour and on the intention for user-generated content creation. The study also incorporates "assortment seeking" next to other consumer characteristics (e.g., price comparison, social interaction). Assortment seeking is defined as the motivation to have access to a variety of products or brands (Verhoef *et al.*, 2007). The study hypothesises that this also holds true for channel switchers in an omnichannel environment and demonstrates that assortment seeking positively influences webrooming. The author later focuses on the characteristic of SoLoMo (social-local-mobile) and its effect on the perceived value of show- and webrooming and subsequently the intention to conduct omnichannel shopping and review sharing in the context of fashion lifestyle in a follow-up study (Kang, 2019).

Jing (2018) examine the show- and webrooming behaviour from a market perspective and develop an analytical model considering a duopoly competitive market with a traditional physical and a purely online retailer while accounting e.g., consumer search costs.

Flavián *et al.* (2019) investigate search process satisfaction while comparing show- and webrooming behaviour. The study shows that webrooming can be considered a more satisfactory switching type compared to showrooming considering consumer confidence in shopping goals. As a future research opportunity, the authors point out that not only satisfaction but also cases of dissatisfaction in the search processes should be equally investigated and highlight the information overload phenomenon as one of the possible scenarios (Section 2.5.1).

Viejo-Fernández *et al.* (2019) focus on cognitive and affective aspects that are affected by channel switching behaviour (show- and webrooming) and emphasise that show- and webrooming indeed influence satisfaction and perceived value through emotions in the buying process. Looking at the differences between show- and webrooming, Fernández *et al.* (2018) find that webrooming occurs when customers conduct a prolonged purchasing process over time focusing more on product attributes, whereas showrooming occurs in the case of higher-value products with a high price.

The Need for Touch (Peck and Childers, 2003) while shopping is at the centre of the study by Rathee and Rajain (2019). The authors show empirically that female shoppers have a higher need for touch compared to males, and that a high need for touch drives shoppers to buy in-store, whereas a low need for touch equally drives them to buy online or in-store.

Flavián *et al.* (2020) conduct an experiment in the context of the fashion industry about the effects of show- and webrooming on smart shopping perception (time, effort, money savings, correct purchase). In line with their other studies on channel switching behaviour, the authors incorporate again the argument on the information overload problem induced through increased information processing (Section 2.5.1) in the online channel. Türk (2020) provides a rich description and comparison of the show- and webrooming in her book chapter and outlines specific perceived search benefits (online and offline). In their study, Lee and Jung (2020) identify channel-hopping consumers based on their characteristics regarding shopping values, shopping behaviours, perceived benefits, and risks and classify them as hyperconnected shoppers, traditional shoppers, web shoppers, and webroomers.

Maggioni *et al.* (2020) concentrate in their empirical study on the question of whether cross-channel behaviour is intentional or not. The authors show that switching is not always intentional and that around 20% in fact are forced to switch channels. Other cross-channel behaviour is profiled as “planned” and “opportunistic”.

Applying the Push-Pull-Mooring Framework (Lee, 1966), Haridasan *et al.* (2021) show the positive influence of the extent of external information search (pull) and alternative attractiveness (push) factors on channel switching intention. Wang *et al.* (2021) examine analytically product-information disclosure decisions of on- and offline retailers.

Sahu *et al.* (2021) conduct an SLR on the determinants of the show- and webrooming based on 92 research articles and condense the findings into the three categories of antecedents, outcomes, and moderators/mediators while formulating managerial implications. Mukherjee and Chatterjee (2021) define a multi-stage decision process where at two steps a channel choice leading to show- or webrooming is conducted (information search and final purchase). The authors confirm their propositions empirically through the utilisation of a cross-sectional survey. Guo *et al.* (2022) build on the study of Wang *et al.* (2016) and examine how product attributes (informational, experiential, perceived risk) moderate the search and purchase attitudes via showrooming, webrooming, and internet or store purchase.

Also in a fashion retailing context, Truong (2021) identifies specific drivers for omnichannel shopping intention (perceived value of show-/webrooming, perceived compatibility, perceived risk) and confirms her proposition empirically. From an explorative behaviour perspective, Huh and Kim (2022) demonstrate that showroomers and webroomers possess different characteristics and are driven by different motivations.

Van Nguyen *et al.* (2022) conduct a qualitative inquiry encompassing focus groups and in-depth interviews with millennial customers to uncover customer intentions for channel switching behaviour. Among other factors, the study identifies the influence of social groups (e.g., trends, recommendations from peers) and perceived self-efficacy on the switching intention. Another qualitative study on the motivations of customers for channel switching is conducted by Roy *et al.* (2022), showing factors such as joy for discovery or the need for uniqueness influencing the perception of process or social satisfaction within cross-channel behaviour in the context of Indian customers.

Focussing on patronage intentions, Goraya *et al.* (2022) consider show- and webrooming behaviour as moderators in the relationship between channel integration constructs (perceived empowerment, assortment, benefits) and the intention for patronage from the online/offline store. The authors incorporate the construct "perceived assortment" as a mediator variable. The variable is defined as a composite perception of assortment not only accounting for the substitutive, complementary, independent nature of products typically observed in a single channel context, but also for assortment coordination across levels in an omnichannel context.

With an analytical model, Zhong *et al.* (2023) demonstrate an optimal information provision decision of an online retailer next to a rival physical store. The study operationalises consumer decision processes based on decision trees. Similarly, Jiao and Hu (2022), develop a model to examine consumers' perception of product value information and their effect on the competitive show- and webrooming. Herrero-Crespo *et al.* (2022) ground their empirical study about omnichannel behaviour intention (the intention for show- or webrooming) on the Technology Acceptance Model (Davis, 1989) and the predisposition of consumers to exploratory information seeking and acquisition in the context of fashion retailing.

Table 11: *Analytical Framework – Channel Switching Behaviour Research*

#	Author(s)	Year	CSB		Omni-channel		Methodology				Research Dom.(s)		
	Key Contributions Channel Switching Behaviour Research		Showrooming	Webrooming	Assortment	Consumer Conf.	Conceptual	Empirical	Analytical/Exp.	Prescript. Know.	CSB	CSB ∩ OCA	CSB ∩ CC
1	Chokkannan *et al.*	2023	✓				✓	✓			✓		
2	Schiessl *et al.*	2023		✓					✓		✓		
3	Shankar and Jain	2023		✓			✓	✓			✓		
4	Zhong *et al.*	2023	✓	✓					✓		✓		
5	Arora *et al.*	2022	✓				✓	✓			✓		
6	Chimborazo-A. *et al.*	2022	✓				✓	✓			✓		
7	Chung *et al.*	2022		✓			✓		✓		✓		
8	Goraya *et al.*	2022	✓	✓	✓		✓	✓	✓			✓	
9	Guo *et al.*	2022	✓	✓			✓	✓			✓		
10	Herrero-Crespo *et al.*	2022	✓	✓			✓	✓			✓		
11	Huh and Kim	2022	✓	✓			✓	✓	✓		✓		
12	Jain and Shankar	2022		✓			✓	✓			✓		
13	Jiao and Hu	2022	✓	✓					✓		✓		
14	Johnson and Ramirez	2022	✓				✓	✓			✓		
15	Patel	2022		✓			✓	✓			✓		
16	Roy *et al.*	2022	✓	✓			✓	✓			✓		
17	Van Nguyen *et al.*	2022	✓	✓			✓	✓			✓		
18	Wang and Wang	2022	✓				✓	✓			✓		
19	Arora *et al.*	2021		✓			✓	✓			✓		
20	Aw *et al.*	2021		✓			✓	✓			✓		
21	Aw *et al.*	2021		✓				✓			✓		
22	Chimborazo-A. *et al.*	2021	✓				✓	✓			✓		
23	Fiestas and Tuzovic	2021	✓				✓	✓			✓		

#	Author(s)	Year			Omni-channel		Methodology				Research Dom.(s)		
			Showrooming	Webrooming	Assortment	Consumer Conf.	Conceptual	Empirical	Analytical	Prescript. Know-	CSB	CSB ∩ OCA	CSB ∩ CC
24	Flavián *et al.*	2021		✓					✓		✓		
25	Frasq. & Miquel-R.	2021	✓				✓	✓			✓		
26	Haridasan	2021	✓	✓				✓			✓		
27	Mukherjee and Cha.	2021	✓	✓			✓	✓			✓		
28	Radzevičė and Bany.	2021	✓			✓		✓					✓
29	Sahu *et al.*	2021	✓	✓			✓				✓		
30	Schneider and Zielke	2021	✓				✓		✓		✓		
31	Shankar	2021	✓				✓	✓			✓		
32	Shankar and Jain	2021		✓			✓	✓			✓		
33	Shankar *et al.*	2021	✓				✓	✓			✓		
34	Shankar *et al.*	2021		✓	✓		✓	✓				✓	
35	Truong	2021	✓	✓			✓	✓			✓		
36	Wang *et al.*	2021	✓	✓					✓		✓		
37	Arora *et al.*	2020	✓				✓	✓			✓		
38	Aw	2020		✓			✓	✓			✓		
39	Flavián *et al.*	2020	✓	✓		✓		✓	✓				✓
40	Kleinlercher *et al.*	2020		✓	✓		✓	✓				✓	
41	Lee and Jung	2020	✓	✓				✓			✓		
42	Maggioni *et al.*	2020	✓	✓			✓	✓			✓		
43	Manss *et al.*	2020		✓	✓		✓	✓				✓	
44	Pallant *et al.*	2020	✓	✓			✓	✓			✓		
45	Rajkumar *et al.*	2020	✓				✓	✓			✓		
	... continued												

CSB = Channel Switching Behaviour; OCA = Omnichannel Assortment; CC = Consumer Confusion in Retailing; ∩ = intersection.

#	Author(s)	Year	CSB		Omni-channel		Methodology				Research Dom.(s)		
	… continued		Showrooming	Webrooming	Assortment	Consumer Conf.	Conceptual	Empirical	Analytical/Exp.	Prescript. Know.	CSB	CSB ∩ OCA	CSB ∩ CC
46	Schneider and Zielke	2020	✓				✓	✓			✓		
47	Türk	2020	✓	✓			✓				✓		
48	Viejo-Fernández *et al.*	2020	✓				✓	✓			✓		
49	Zhang *et al.*	2020	✓						✓		✓		
50	Arora and Sahney	2019		✓			✓	✓			✓		
51	Aw	2019		✓			✓	✓			✓		
52	Fassnacht *et al.*	2019	✓				✓	✓	✓		✓		
53	Flavián *et al.*	2019	✓	✓			✓	✓			✓		
54	Kang	2019	✓	✓			✓	✓			✓		
55	Kim and Park	2019	✓				✓	✓			✓		
56	Orús *et al.*	2019		✓				✓	✓		✓		
57	Rathee and Rajain	2019	✓	✓			✓	✓			✓		
58	Santos and Gonçalves	2019		✓			✓	✓			✓		
59	Spaid *et al.*	2019	✓				✓	✓			✓		
60	Viejo-Fernández *et al.*	2019	✓	✓			✓	✓			✓		
61	Arora and Sahney	2018		✓			✓	✓			✓		
62	Arora and Sahney	2018	✓		✓		✓	✓				✓	
63	Burns *et al.*	2018	✓				✓	✓			✓		
64	Dahana *et al.*	2018	✓				✓	✓			✓		
65	Mehra *et al.*	2018	✓		✓				✓			✓	
66	Jing	2018	✓	✓			✓		✓		✓		
67	Kang	2018	✓	✓	✓		✓	✓				✓	

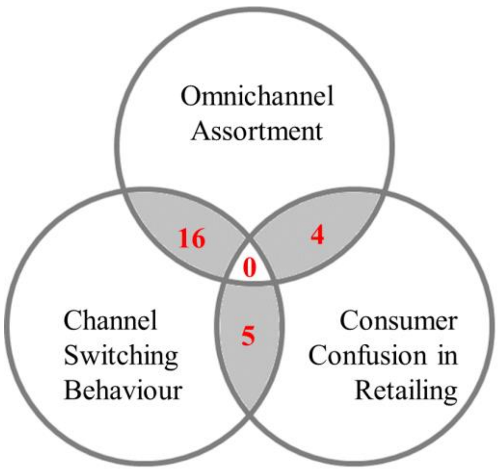
#	Author(s)	Year			Omni-channel		Methodology				Research Dom.(s)		
			Showrooming	Webrooming	Assortment	Consumer Conf.	Conceptual	Empirical	Analytical	Prescript. Know-	CSB	CSB ∩ OCA	CSB ∩ CC
68	Kowalczuk	2018	✓	✓				✓			✓		
69	Sit *et al.*	2018	✓			✓	✓	✓					✓
70	Fernández *et al.*	2018	✓	✓				✓			✓		
71	Zhang *et al.*	2018	✓						✓		✓		
72	Arora and Sahney	2017		✓			✓				✓		
73	Arora *et al.*	2017	✓			✓	✓	✓					✓
74	Basak *et al.*	2017	✓						✓		✓		
75	Brown *et al.*	2017	✓					✓			✓		
76	Daunt and Harris	2017	✓				✓	✓			✓		
77	Gensler *et al.*	2017	✓				✓	✓			✓		
78	Gu and Tayi	2017	✓		✓				✓			✓	
79	Rejón-G. & Luna-N.	2017	✓				✓	✓			✓		
80	Flavián *et al.*	2016		✓		✓	✓		✓				✓
81	Reid *et al.*	2016	✓	✓			✓	✓			✓		
82	Samuel *et al.*	2016	✓					✓	✓		✓		
83	Wang *et al.*	2016	✓	✓			✓	✓			✓		
84	Wolny and Charoen.	2016	✓	✓			✓	✓			✓		
85	Rapp *et al.*	2015	✓				✓	✓			✓		
86	Luo *et al.*	2014	✓				✓		✓		✓		
87	Wolny and Charoen.	2014	✓	✓			✓	✓			✓		
88	Mehra *et al.*	2013	✓						✓		✓		
89	Verhoef *et al.*	2007	✓	✓			✓	✓			✓		

CSB = Channel Switching Behaviour; OCA = Omnichannel Assortment; CC = Consumer Confusion in Retailing; ∩ = intersection.

2.7 Literature Synthesis

The synthesis process involves the consolidation of all studies that are positioned within the intersections of the research domains (**Figure 17**). Overall, 25 papers are retrieved from the research domains that represent related work. Remarkably, none of the 25 papers analysed is located at the intersection of all three research domains to address the problem space of the research of this thesis and thus highlight a *research gap*. Moreover, only four articles (Cakir *et al.*, 2022; Bertrandie, 2020; Bertrandie and Zielke, 2017; Ma, 2016) touch on consumer confusion in the context of omnichannel assortment. Five articles (Radzevičė and Banyte, 2021; Arora *et al.*, 2020; Flavián *et al.*, 2020; Sit *et al.*, 2018; Flavián *et al.*, 2016) are located at the intersection between consumer confusion in retailing research and the channel switching behaviour domain. The omnichannel assortment domain intersects with the channel switching behaviour one on the basis of 16 articles (Vasilyev *et al.*, 2023; Goraya *et al.*, 2022; Lo and Topaloglu, 2022; Neslin, 2022; Timoumi *et al.*, 2022; Bijmolt *et al.*, 2021; Lee and Chun, 2021; Shankar *et al.*, 2021; Kleinlercher *et al.*, 2020; Manss *et al.*, 2020; Rooderkerk and Kök, 2019; Arora and Sahney, 2018; Dzyabura and Jagabathula, 2018; Kang, 2018; Mehra *et al.*, 2018; Gu and Tayi, 2017).

Figure 17: *Studies synthesised within the intersections of the research domains*



As critically discussed in the previous sections, the characteristics of the relevant articles do provide certain contributions in the specific domains but lack addressing either an assortment integration context, a channel switching behaviour perspective, or the incorporation of the consumer confusion concept.

The research landscape along the three domains and the research gap is mapped in **Figure 18**. The landscape reveals that there is a rich discussion going on in the channel switching behaviour domain, including several studies at the intersection with the omnichannel assortment domain. In comparison, there is relatively modest discourse happening in the omnichannel assortment domain itself as well as very scarce contributions at its intersection with the consumer confusion in retailing domain. The following outlines the key findings of the review.

Omnichannel Assortment

Out of the key contributions, only 27% address strategic assortment decision problems (e.g., Ratchford *et al.*, 2023; Srivstava *et al.*, 2022; Li *et al.*, 2020). The research is dominated by analytical studies (mathematical optimisations and experiments) that address challenges from a tactical or operational level (e.g., Schäfer *et al.*, 2023; Vasilyev *et al.*, 2023; Chen *et al.*, 2022; Hense and Hübner, 2022; Marmol *et al.*, 2020). Assortment optimisation across channels is the current topical stream in the overall omnichannel assortment research. Moreover, empirical studies represent a small share among all articles (e.g., Ratchford *et al.*, 2023; Chen *et al.*, 2022; Sodero *et al.*, 2021) since not all analytical studies are grounded on empirical evidence. The need for more empirical work is also highlighted by e.g., Neslin (2022) or Bertrandie and Zielke (2017). In the discussion on consumer confusion prevention, Bertrandie (2020) highlights that decisions on the assortment represent an active influence to address this issue, highlighting the fact that retailers do have the opportunity to address the problem.

Consumer Confusion

Dominated by behavioural studies explained by the nature of the concept that is positioned within behavioural psychology and marketing, the consumer confusion research domain concentrates the research predominantly on the identification of determinants and various dimensions for antecedents. Hereby, the stream on information overload and the cognitive dimension of consumer confusion represents the largest and oldest topic of interest, followed by research on the affective dimension. Only recently, behavioural aspects receive more and more attention (e.g., Garaus and Wagner, 2019; Johnson *et al.*, 2019; Garaus and Wagner, 2016). Furthermore, the studies utilise various theories from the said disciplines (e.g., TPB, PAD, BPM). In terms of addressing consumer confusion consequences, the majority of the research incorporates constructs capturing short-term consequences (e.g., Turri and Watson, 2022; Özkan and Tolon, 2015; Wobker *et al.*, 2015; Wang and Shukla, 2013). Some studies consider both short -and long-term implications (with an increased consideration in the recent studies, e.g., Coskun *et al.*, 2019; Garaus and Wagner, 2019) while few focus solely on long-term ones (e.g., Diehl and Poynor, 2010). The financial implications of those consequences are not always addressed adequately but highlighted by

Wobker *et al.* (2015) who point out the reduced revenue at the POS due to postponement and abandonment behaviour (e.g., Mitchell and Papavassiliou, 1997) but especially due to consumer dissatisfaction and loyalty (Turnbull *et al.*, 2000; Mitchell and Papavassiliou, 1999; Foxman *et al.*, 1992; Foxman *et al.*, 1990). They also bring forward the argument of increased costs due to the need for increased service for confused consumers at the POS (Wobker *et al.*, 2015). As pointed out above, only four studies consider the consumer confusion phenomenon from an omnichannel assortment perspective (Cakir *et al.*, 2022; Bertrandie, 2020; Bertrandie and Zielke, 2017; Ma, 2016). This share represents merely 10.3% of all consumer confusion studies, highlighting the huge research gap within this intersection. Furthermore, consumer confusion studies are predominantly focused on offline channels as the setting of interest. Only a few studies view the online channel (e.g., Garaus, 2018; Li, 2017; Özkan and Tolon, 2015). From a methodological point of view, the research domain is characterised highly by conceptual and empirical studies. The empirical research is predominantly based on survey data, and only a few consider qualitative data gathering e.g., interviews. There are only a few analytical studies that approach the consumer confusion topic from an experimental or optimisation perspective (e.g., Diehl and Poynor; 2010; Matzler *et al.*, 2007). Only one study contributes to prescriptive knowledge (Buser, 2008). Overall, there are surprisingly very low contributions on how retailers can detect or mitigate the consumer confusion phenomenon.

Channel Switching Behaviour

The research domain on channel switching behaviour is characterised by a plethora of different contexts and the utilisation of various theories (e.g., TPB, TAM, S-O-R). Notable is the fact that research in the domain generally increased in the last few years, especially between 2020 and 2022. Studies on showrooming dominate the research landscape, followed by research addressing both show- and webrooming. Most of the research is conceptual and empirical in nature with rich evidence from customers or retailers where survey methods represent the majority of the data collection method of choice. Some studies do adopt a qualitative method though (e.g., Roy *et al.*, 2022; Van Nguyen *et al.*, 2022). Nevertheless, some analytical studies exist (e.g., Schiessl *et al.*, 2023; Zhong *et al.*, 2023; Mehra *et al.*, 2018). Similar to the consumer confusion domain, the majority of studies focus on determinants and behavioural motivations from a consumer point of view, neglecting a retailer-oriented view. The showrooming stream is shown from different angles, e.g., free riding (Burns *et al.*, 2018), competitive showrooming (e.g., Mehra *et al.*, 2018; Gensler *et al.*, 2017) or from unique standpoints (e.g., intra-, or inter-product showrooming; Zhang *et al.*, 2020). However, not all contributions share the same understanding that switching from the physical store to the web-shop can happen either to the same retailer or another competitive retailer. In terms of webrooming, the need for touch, and interactions are identified as the main drivers to switch channels (e.g., Jain and Shankar, 2022; Arora *et al.*, 2017). The notion of assortment in channel switching behaviour research is mostly addressed by the concept of "showrooming countering". The idea is to maintain an exclusive assortment offline to keep customers purchasing there (e.g., Kuksov and Liao, 2018; Mehra *et al.*, 2018). In contrast, consumer confusion as a concept is acknowledged while discussing the motivations of consumers who switch channels only in terms of information overload occurring through the vast information provision online (e.g., Radzevičė and Banyte, 2021; Arora *et al.*, 2017).

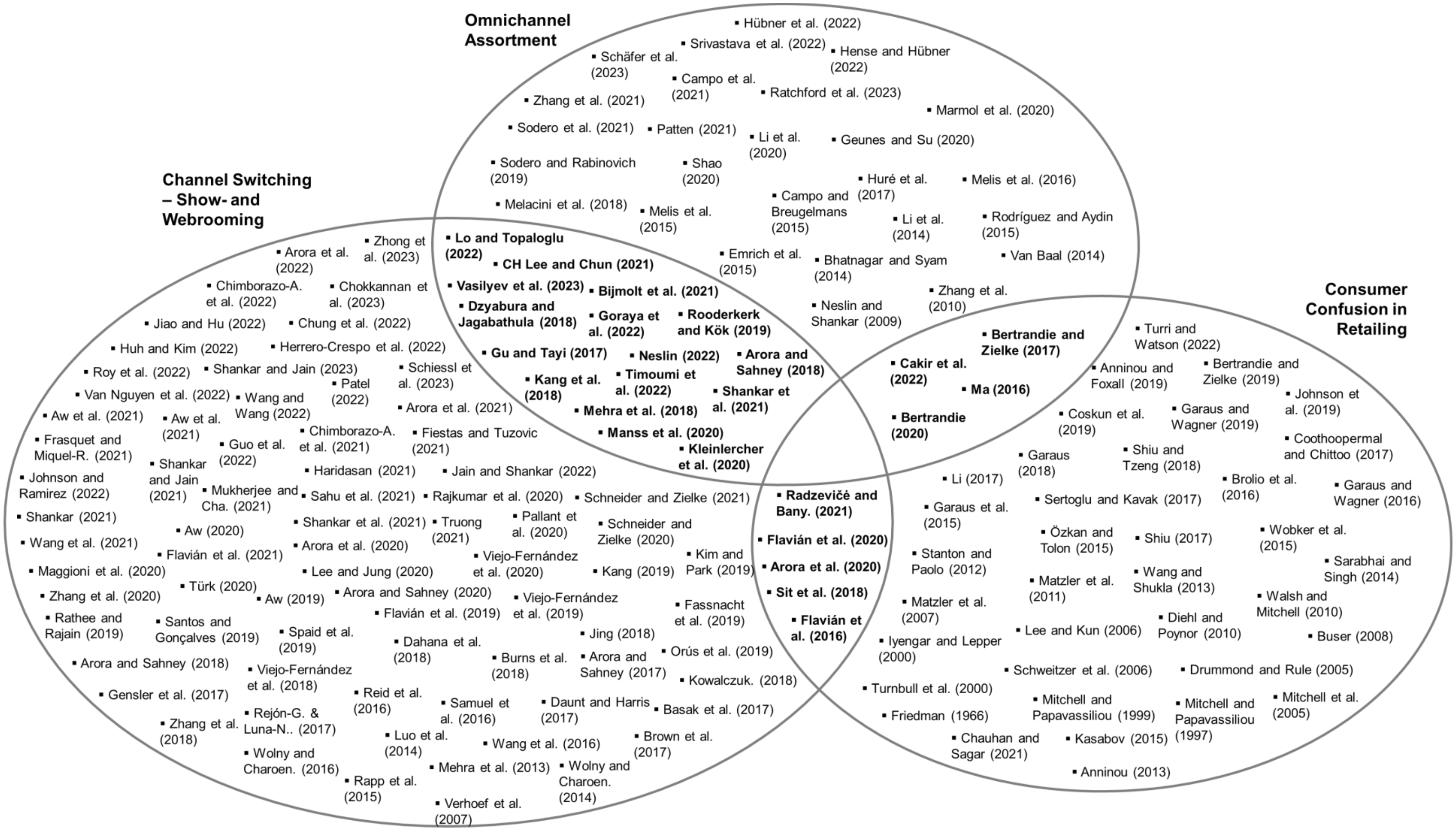
Conclusions

The outcome of the literature review reveals several shortcomings. To begin with, in literature, most of the assortment challenges in omnichannel retailing are addressed from a tactical or operational perspective, neglecting its importance on a strategic level. Secondly, most of the current research in the omnichannel assortment domain is based on analytical studies and experiments with few empirical contributions. Moreover, there are very few studies viewing consumer confusion from an omnichannel assortment perspective in general. Most of the studies are based on a single-channel view. Furthermore, no studies are viewing the relationship between omnichannel assortment and consumer confusion in retailing from a channel switching perspective despite being the primary condition triggering the phenomenon. Besides that, the majority of the omnichannel assortment and consumer confusion research is of explanatory nature: there is a huge gap in prescriptive contributions on how to align the phenomenon with strategic assortment decisions in an omnichannel retailing context. Finally, although a range of consequences of consumer confusion is addressed consistently, short- and long-term consequences of the phenomenon are not represented adequately or sufficiently in an omnichannel retailing context despite their significance.

These findings lead to the following conclusions. First, there is a need for investigating **consumer confusion from an omnichannel assortment perspective**. Second, there is a need for viewing the relationship between omnichannel assortment and consumer confusion from a **channel switching perspective**. Third, there is a need for addressing omnichannel assortment decisions from a **strategic perspective**. Fourth, there is a need for more **empirical** studies on omnichannel assortment decisions. Fifth, the consumer confusion effect represents an occurring challenge for retailers in an omnichannel context but has not been sufficiently investigated from a **managerial perspective** yet. There is a need for guidance for omnichannel retailers on how to **align strategic assortment decisions with the consumer confusion concept**. Finally, there is a need for representing **short- and long-term consequences of the consumer confusion phenomenon** in an omnichannel retailing context.

In summary, this research is addressing the relationship between strategic assortment decisions and consumer confusion, and its short- and long-term consequences from a channel switching perspective through an empirical and prescriptive study, that aims at providing a representation of the alignment of both concepts.

Figure 18: *Overview of research domains, intersections, and research gap*



2.8 Summary

Following the discussion on the problem space, relevance of the research, and the formulation of the research aim and objectives in the introductory chapter, this chapter covers the relevant theoretical background and related work of this research. It provides a systematic review of 169 papers out of the three research domains omnichannel assortment, consumer confusion in retailing, and channel switching behaviour. The SLR is effectively guided by an iterative process ensuring comprehensiveness and objectivity. The outcome of the synthesis reveals the existence of a research gap that justifies and positions the research aim of this study. The core gap is characterised by the fact that there is currently no research existing that aims at addressing strategic assortment decisions and the consumer confusion concept while considering a channel switching behaviour perspective. Moreover, it underlines the need for more empirical work in this regard. The next chapter outlines the next step in defining an appropriate research methodology for fulfilling the research objectives.

CHAPTER 3 – RESEARCH METHODOLOGY

3

"People are looking for certainty. The more complex the world becomes, the more people look for people to give them certainty and tell them what to do. During the past few years of actively thinking about this, there is one thing that I have accepted: certainty is not out there. There is not one strategy to follow, and that's OK."

— Noreena Hertz

3.1 Introduction

The previous section presented a systematic review of the relevant literature for this research and argued the research gaps. The aim of this chapter is to provide an outline and discussion of the research methodology that is chosen and applied for this study. The discussion involves the presentation of the underlying theoretical framework, the rationale for the selected methodology, its aims, phases, and the techniques and methods that are selected and applied throughout the research process. Before justifying the selected methodology, methodological requirements that are deducted from the research objectives are defined first. Thereafter, choices on the philosophical standpoint and reasoning approach for this research as well as the suitable methodologies are presented, analysed, and reflected in the selection process. For this, the "Research Onion" framework (Saunders *et al.*, 2016) is utilised. The section concludes with the presentation of the applied paradigm (Design Science Research Methodology), as well as the modelling approach of choice for the artefact (Ontology Engineering), and the empirical method of choice for externalising and incorporating practitioner knowledge (case study-based interviews and focus groups). A summary brings together the key outcomes of this chapter.

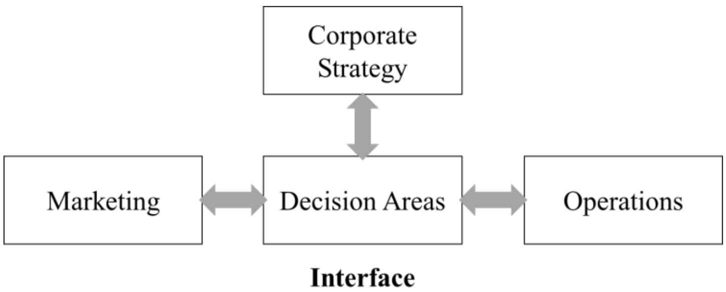
The theoretical framework of this study is presented in this section due to its explanatory power of the problem space that effectively informs the research methodology selection process, such as the appropriate philosophical standpoint, the suitable reasoning approach, as well as the notion of the interplay between behavioural and solution-oriented sciences.

3.2 Theoretical Framework – The Marketing-Operations-Interface

The MOI is a research area focusing on the alignment of *marketing* and *operations* functions within an organisation and their tensional relationship (Bijmolt *et al.*, 2021; Jose Zanon *et al.*, 2013; Piercy, 2010). The origin and motivation lie in the necessary alignment between market needs and the corresponding interpretation and adaptation of those market needs for operational activities (Jose Zanon *et al.*, 2013; Slack and Lewis, 2002). The goal of the operations department is to develop the resources and capabilities required to achieve a competitive advantage (Jose Zanon *et al.*, 2013). However, both functional areas have conflicting objectives and priorities resulting in trade-off relationships (Erickson, 2011; Tang, 2010). For instance, the market may demand a high variety and range in the offering of products where the objective is to increase sales by introducing a wide product line. However, an operations strategy usually seeks to minimise costs and maximise efficiency (Nie and Young, 1997), eventually conflicting with the marketing objectives due to high investments and an increase in complexity through the introduction of a wide product range. Companies unable to harmonize both areas perform poorly within the competition (e.g., Kang *et al.*, 2007; Gulledge, 2006) whereas counterparts with effective alignment perform superior on the market (Kathuria and Porth, 2003).

It is therefore important to achieve a balance between both functional areas by aligning them to the firm's corporate strategy and competitive advantage (Jose Zanon *et al.*, 2013; Slack and Lewis, 2002). The conflicting nature of both functional areas has led to "decision areas" where those trade-off relationships are assessed, and decisions made (**Figure 19**). According to Parente (1998), the conflicting decisions predominantly concern aspects such as target markets, product range, pricing, promotion, distribution from the marketing side and capacity, technological choice, infrastructure, and control system from the operations side (Jose Zanon *et al.*, 2013). Typical trade-offs are therefore (see Piercy, 2009, for an overview) inventory capacity levels vs. sales forecasts, customisation of products vs. standardisation, or high-quality products vs. price sensitivity on the market (e.g., De Burca *et al.*, 2004; Hill, 2000; Nie and Young 1997).

Figure 19: *Simplified representation of the MOI (adapted from Jose Zanon et al., 2013, and Tang, 2010)*



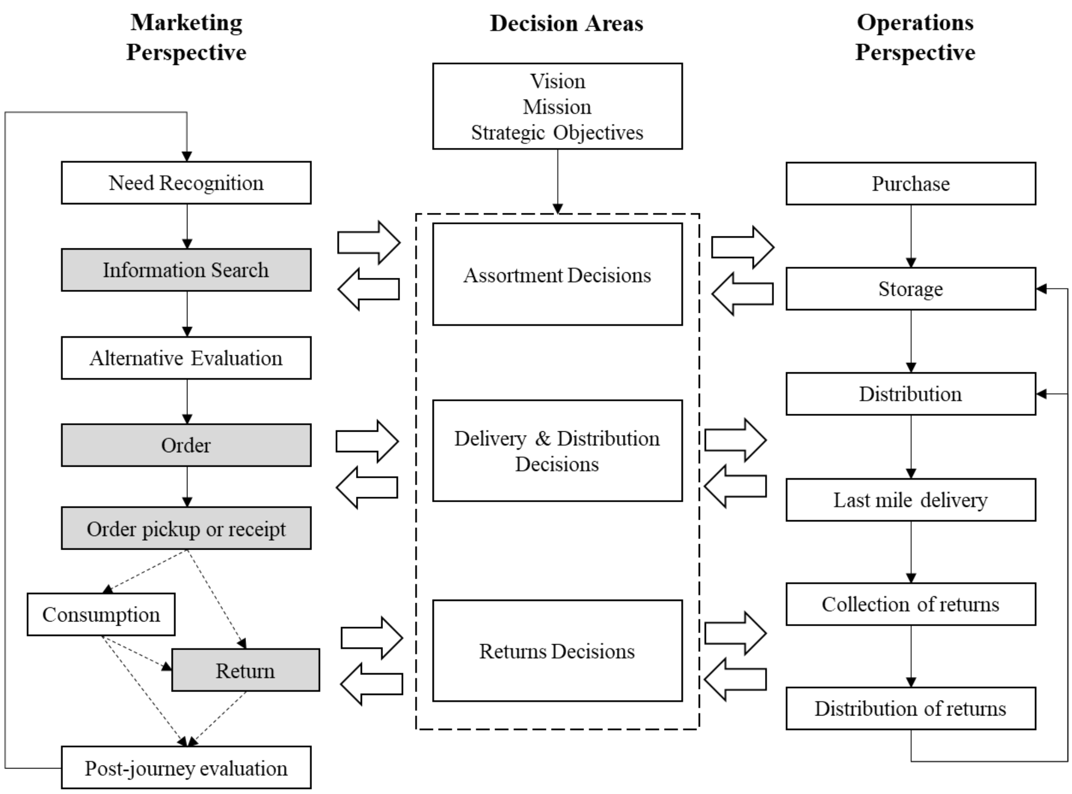
"Interface" refers hereby to interactions between departments within an organisation (e.g., Hausman *et al.*, 2002; Parente, 1998; Chen *et al.*, 1992) and represents the joint decision-making activities within the decision areas. These decisions are usually made by individuals or by a group of individuals who represent the functions, thus requiring a social interaction process to achieve "consensus". *Consensus* is a collective process of achieving an agreement between parties with different interests and views (Mintzberg *et al.*, 2020; Jose Zanon *et al.*, 2013; Andrews, 1997).

3.2.1 The Marketing-Operations-Interface in the Retailing Context

The MOI is also applied and discussed in the context of the retail industry in various studies. Marketing in Retailing is characterised by the application of the marketing function (concepts, theories, and actions) in the context of a retail organisation (Goworek and McGoldrick, 2015). The operations function in retailing is characterised by the management of e.g., the product flow, inventories, distribution, and last mile activities (Bijmolt *et al.*, 2021). For example, Yu *et al.* (2014) demonstrate, based on an empirical quantitative study on retail firms in the UK, that marketing capabilities have a significant impact on operations capabilities and operations capabilities in turn positively impact retail performance while mediating the relationship between marketing capabilities and retail performance. The study concludes with practical implications such as operational resources as significant drivers for performance and the important need to translate market needs into operational objectives. Another study presenting a case study in an SME online retailer context (Piercy, 2009) highlights the fact that successful cross-functional co-operation between marketing and operations departments can lead to superior market performance. Crucial aspects address, for example, the importance of fulfilling customer needs through operational capabilities, a long-term perspective on the benefits of in-house investments (such as own warehouses or distribution systems) that might induce significant costs from a short-term perspective first, the ability to learn from first-mover mistakes within the competition to avoid operational risks or the benefits of a shared vision statement aligning objectives of each department and thus ensuring consistency and effectiveness in resource allocation. Mollenkopf *et al.* (2011) conduct an in-depth qualitative study on a retailer to focus on returns management at the MOI as a value driver for customers. The authors argue that returns management, once recognized as a strong driver for competitiveness, can lead to higher customer value under the condition of successful functional alignment at the MOI.

Works focusing on an omnichannel retailing context are scarce. For instance, Mak (2018), views peer-to-peer crowdshipping (delivery service to online customers by in-store customers) as an interaction between different channels on the marketing side posing operational challenges for the retailer. The continuous approximation model conceptualises a price-moderated last-mile delivery process (consumers shop either on- or offline based on price perception) and shows that operational efficiency is dependent on pricing effects. The study is shedding light on how changes in the environment (adoption of crowdshipping) are challenging operational capabilities. Bijmolt *et al.* (2021) have introduced a comprehensive conceptualisation of the MOI within an omnichannel context and introduced the additional coordination requirement for channels within the MOI. The increased complexity through an omnichannel approach demands retailers not only judge alternatives to harmonize functions but also functions and channels. The detailed framework reflects the most crucial decision areas in omnichannel retailing and positions them along a customer journey and product flow perspective. The model consists of three components, comprising (1) a customer journey element (representing the retailer's marketing function, addressing *demand*), (2) the corresponding product flow (reflecting the operational function, addressing *supply*), and (3) the key decision areas in-between (assortment, distribution & delivery and returns) linking both perspectives (**Figure 20**). The interface represents a decision area where the objectives of both sides need to be addressed and coordinated and decisions to be made. All components are to be in line with business strategy and goals. The customer journey follows a path from need recognition to post-journey evaluation with information search, alternative evaluation, order, order pickup / receipt, consumption or return or consumption to return (information search, order, order pick-up or receipt and return out of the customer journey path are able to be addressed directly by the decision areas). The product flow is illustrated through the steps of purchase, storage, distribution, last-mile delivery, and collection / distribution of returns. Challenges arise at the interface (decision areas) as both functions are characterized by a different set of objectives and requirements that are not necessarily fully aligned. For example, inventory limitation to safe costs vs. high assortment variety and availability to meet customer needs: a conflicting relationship.

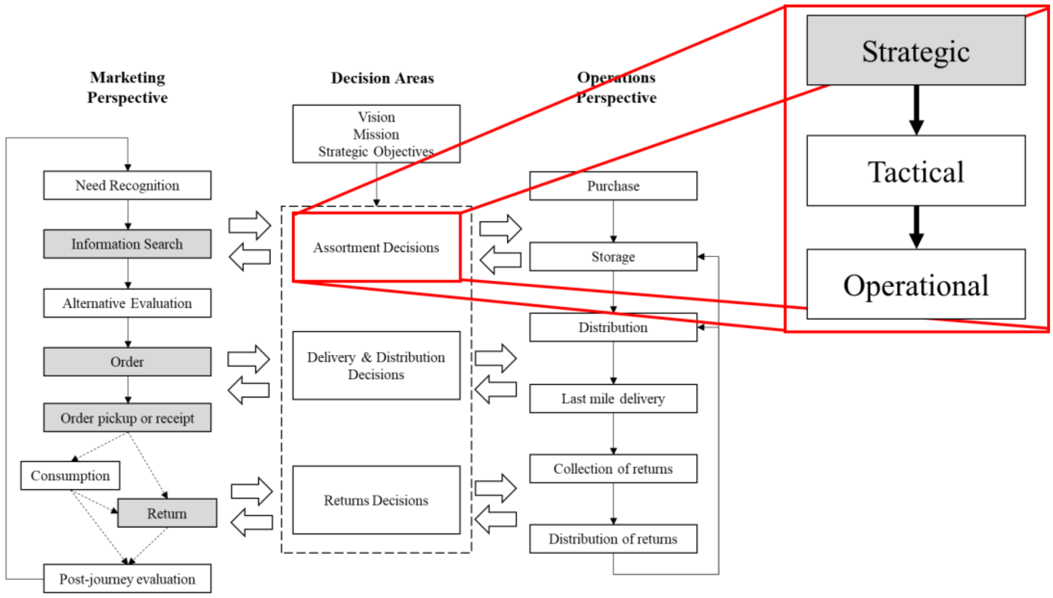
Figure 20: *Integrative MOI for omnichannel retailing (adapted from Bijmolt et al., 2021)*



3.2.2 Positioning the Research within the Marketing-Operations-Interface

The problem space of this research addresses the lack of alignment between strategic assortment decisions as understood within the assortment planning framework by Rooderkerk and Kök (2019) and the consumer confusion concept and its consequences viewed from the consumer behaviour discipline. Both concepts can be positioned within the MOI (**Figure 21**).

Figure 21: *Positioning Strategic Assortment Decisions within the MOI (source: own integration)*



Strategic assortment decisions in omnichannel retailing involve assortment decisions on the expansion and coordination of assortment across channels (Section 2.4.1). Both tasks represent decisions at the interface within the assortment decision area (Rooderkerk and Kök, 2019). Consumer confusion is a specific customer response at a specific phase within the omnichannel customer journey (Section 2.5.1). It is triggered in the information search and evaluation of alternatives activities in the pre-purchase phase of the journey when customers encounter assortment inconsistencies at the point of sale (POS) (Bertrandie, 2020; Bertrandie and Zielke, 2017; Ma, 2016; Zhang *et al.*, 2010). From a marketing point of view, a retailer should seek to prevent the occurrence of the consumer confusion phenomenon in order to avoid adverse customer responses such as purchase abandonment, purchase postponement or negative WOM (Bertrandie, 2020; Anninou and Foxall, 2019; Bertrandie and Zielke, 2017; Garaus and Wagner, 2016; Wobker *et al.*, 2015; Walsh and Mitchell, 2010; Zhang *et al.*, 2010). Thus, the prevention of the consumer confusion phenomenon as a marketing objective needs to be considered in the decision area of assortment decisions. The strategic decision on ensuring a full assortment integration, viz.

assortment on all channels is identical, can pre-empt the occurrence of the consumer confusion phenomenon and is the most plausible decision a retailer can make to ensure this. However, from the operations function point of view, full alignment of the assortment across channels represents a costly undergoing and is difficult to implement (Bhatnagar and Syam, 2014; Zhang *et al.*, 2010) thus conflicting with the marketing objective. In fact, retailers decide on asymmetrical assortment integration approaches detrimental to consumer confusion prevention in order to benefit from channel features such as the Long Tail effect. As a consequence, a clear conflicting relationship arises in the assortment decision area within the MOI.

The aim of the research is to make the relation between strategic assortment decisions and the consumer confusion concept within the MOI explicit from a channel switching perspective in order to provide informational guidance for the decision area at the interface. As outlined above (Section 3.2), the interactions between both responsible functions are undergone by individuals or by a group of individuals who represent these functions, who aim to resolve the tensions through the achievement of a consensus. The interface and its activities represent the key area where the artefact and the contributions of this research are positioned. Thus, individuals or groups at the interface are identified as the key stakeholders / domain experts for the use of the artefact. The utility of the artefact is to provide domain knowledge (concepts and their relations) for the purpose of establishing a shared understanding of the structure of the knowledge. Domain experts will be able to identify and incorporate relevant information from the artefact for their own purpose. To the best of the author's knowledge, no studies are viewing the relationship between omnichannel assortment and consumer confusion from a MOI perspective yet.

3.3 Methodological Requirements

A systematic and rigorous approach is the key to addressing the research questions and fulfilling the research objectives successfully. Research is defined as a sequence of logical steps of data collection and analysis with the aim to improve understanding of a specific issue or topic (Bell *et al.*, 2022; Creswell and Poth, 2016; Van de Ven, 2007). Correspondingly, a need for the selection of a specific framework or methodology arises. A methodology is essential to guide the researcher systematically and address the research problem efficiently (Kothari, 2004). Moreover, it provides the basis and rationale for the subsequent selection of data collection and analysis techniques or methods (Saunders *et al.*, 2016). It is essential to understand that *methods* refer to specific tools used purposefully in the research process (e.g., literature review, survey, interview) whereas a *methodology* refers to the general research strategy and the lens that outlines how the overall research is reasoned and designed (Howell, 2012). The research methodology gives the rationale for what research methods should be taken into consideration to fulfil the defined research objectives. The selection of the methodology is therefore the first critical decision on the research design a researcher needs to make. However, the existence of a plurality of different research methodologies makes it challenging to do so but at the same time indicates the vast variety and complexity of requirements researchers formulate to achieve their research goals. Consequently, this leads to the question of how the requirements for this research are specified.

The selection of an appropriate methodology for this research is determined by the following methodological requirements. The requirements are retrieved based on the nature of the problem and the research objectives as presented in Chapters 1 and 2. Firstly, and as a principal requirement, the methodology should be (1) characterised by a systematic process with guiding steps ensuring effectiveness and efficiency in the achievement of the research objectives (Kothari, 2004). This is important due to meeting validity and reliability requirements (Kumar, 2018; Creswell and Poth, 2016) and thus ensuring high-quality research outputs (Collis and Hussey, 2003). Secondly, the research problem is viewed from a socio-technical perspective and thus requires the methodology to have a (2) fit and ability to combine behavioural science aspects (truth, explanations) with aspects of problem-oriented sciences (solution design, utility-orientation). Thirdly, the methodology should be particularly suitable in the (3) generation of prescriptive knowledge (Winter and Aier, 2015; Gregor, 2006) serving not only practitioners in generating adequate solutions, but also contributing to the scientific community to inform, be utilised, or enriched in the form of further applications in the relevant domain. This is a critical requirement since the generation of prescriptive knowledge is distinct from knowledge out of descriptive, explanatory, or predictive intent (see Section 3.5). Fourthly, the ability to (4) accommodate means for collecting and combining data not only from a theoretical knowledge base but also from the field of practice is an essential requirement for the sought methodology due to the nature of the application area of the desired solution. Lastly, it should allow not only (5) to produce academic but also practical contributions in an equal manner since the research intent is also characterised by producing a solution not only for a specific problem context but for a class of problems, thus requiring generalizability to a certain extent. **Table 12** summarizes the methodological requirements.

Table 12: *Methodological requirements*

#	Requirement	Justification
1	Methodology as a systematic process	Ensuring a high-quality output, meeting validity and reliability requirements
2	Methodology capable of combining behavioural science with problem-oriented science	Socio-technical grounding of the problem
3	Methodology capable in the generation of prescriptive knowledge	The research aim is the generation of a solution generated through the development of specific prescriptions
4	Methodology capable in the collection and combination of theoretical and empirical knowledge sources	The socio-technical nature of the research problem requires the incorporation of practitioner knowledge from the application domain
5	Methodology supporting the generation of academic (rigour) and practical (relevance) contributions in an equal manner	The aim is not only to serve a specific problem but a class of problems and thus allow the formalisation of the research output

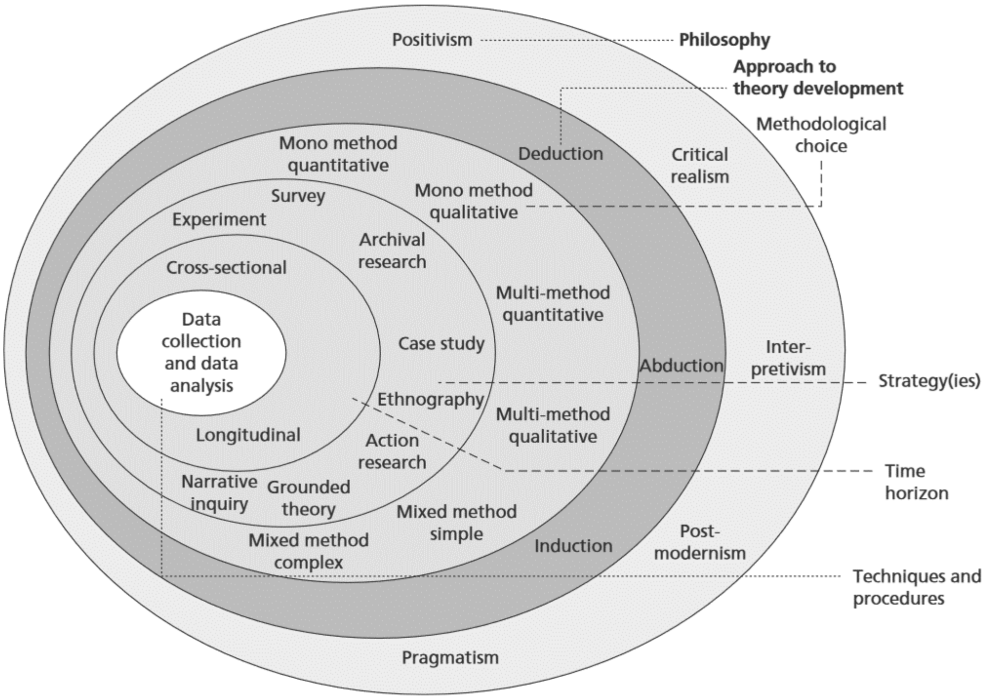
The next section systematically discusses the selection of the methodology out of the most established ones under critical consideration of the above-outlined requirements.

3.4 Methodology Selection

Saunders *et al.* (2016) provide a guide for research design choices beginning from the philosophical positioning to the selection of appropriate data collection and analysis techniques along six layers of the “Research Onion” framework (selection process from the outside to the inside) (**Figure 22**). The selection process is in line with Grix’s (2002) “building blocks” ranging from ontology, epistemology, methodology, and methods to sources in the course of research design decisions. The following will describe the choices made for this research along these layers.

The first choice describes the basic understanding of the philosophical underpinning of research and argues the choice of belief for this research. The second step deals with the research approach and the approach to theory development, illustrating the reasoning choice for this research context. These initial two choices form fundamental views and reasoning approaches critical for an effective research methodology selection in the third step. The third step then again compares the applicability of various methodologies under the consideration of the methodological requirements from the previous section and outlines the methodology of choice (research strategy). Here, the decision towards the application of “Design Science Research Methodology” is argued and described. The last step covering the rationale for the techniques and approaches used for data collection and analysis is described in Section 3.4.5.

Figure 22: *The Research Onion (source: Saunders et al., 2016)*



3.4.1 Philosophical Positioning

Before the action of research can take place, it needs to be realised that "research" can be conducted from a variety of perspectives and through the lens of various paradigms (Astley and Van de Ven, 1983). This is the result of the complexity of research studies and approaches themselves (Orlikowski and Baroudi, 1991). The underlying reason is the notion of "assumption". Every individual conducting research "assumes" certain aspects of her/his research, leading to a plurality of approaches in research. Those assumptions are shaped differently throughout research communities, accepted, and shared among them (Johnson and Christensen, 2000). Shared basic beliefs are referred to as "paradigms" and constitute a fundamental worldview (Guba and Lincoln 1994) – also labelled as "interpretive frameworks" (Creswell and Poth, 2016). The value and use of paradigms that are linked to a researcher's basic belief guide and connect to the research methodology (Arbnor and Bjerke, 2008; Guba, 1990), eventually forming the foundation for choices for the research design.

The first step, therefore, is to determine the basic assumptions I support before I make choices on the research methodology. This involves the fundamental decisions regarding *ontology* and *epistemology*. Ontology refers to "what exists", while epistemology focuses on "what human beings can know about what exists" (Huff, 2009).[3] Ontology can be divided into two extremes: "subjectivism" and "objectivism" (Holden and Lynch, 2004). Creswell describes the notion of subjectivism as knowledge being created through social and contextual understanding by independent individuals, giving meaning to their experiences (Creswell *et al.*, 2007). Reality is therefore understood as an interpretation by individuals (leading to the existence of "multiple realities"). An objectivist view, however, describes reality as existing independently from individuals (Van de Ven, 2007). The epistemological consequence for the assumption of "subjective" or "objective" is also characterised by a continuum between "interpretivism" and "positivism". Positivism (or empiricism) assumes that reality is unique and objective – the object of interest and the researcher are therefore independent of each other (Saunders *et al.*, 2016; Orlikowski and Baroudi, 1991). Interpretivism assumes that the nature of reality is constructed and multiple, thus the researcher becomes part of the understanding of reality through her/his experiences and interpretation. The conclusion is the fact that these different ontological and epistemological standpoints combined result in a variety of different paradigms (Burnell and Morgan, 1979). Since the epistemological approach is dependent on the ontological standpoint (Flowers, 2009), it is, therefore, crucial what assumptions are supported at this fundamental stage.

The nature of this research project is based on the understanding of a complex problem within an organisation. An organisation represents a social construct, created artificially (Simon, 2019). The problem of interest can be described as an interpretation of reality (mechanisms leading to consequences) and are dependent on individuals to become reality. The ontological view in this research thus seems to be grounded in subjectivism at first (leading to an interpretivistic approach). However, the research inquiry is not only aimed at understanding what meaning stakeholders of the phenomenon give (construct) to reality (and not only how reality works objectively) (Van de Ven, 2007), but *also* to create a purposeful and practical solution to address the specific problem in order to inform future practice (Saunders *et al.*, 2016; Van de Ven, 2007). The philosophy for this research is therefore positioned within the *pragmatism* paradigm. Pragmatism is an understanding of research that utilises existing theories, concepts, shared ideas and various research findings in such a way that they contribute towards actions providing practical meaning in specific contexts rather than generating abstract understandings (Saunders *et al.*, 2016). The

[3] It is important to understand that, here, "Ontology" refers to the philosophical understanding of knowledge such as the nature of being and existence, whereas "ontology" as the desired research outcome of this thesis refers to a specific socio-technical artefact capturing knowledge about specific domains.

problem-oriented paradigm acknowledges the purposeful utility of knowledge to enable successful actions and change. This also means that concepts and theories are only relevant where purposeful action is supported (Kelemen and Rumens, 2008). This is consistent with the methodological requirements of this study. This research seeks to utilise and incorporate existing knowledge (concepts, theories, evidence from practice) in such a way that a purposeful and problem-solving artefact is generated. Pragmatists value and strive for practical contributions rather than an abstract understanding of realities. Ergo, pragmatism is therefore even able to combine the subjectivist and the objectivist paradigms successfully (Saunders *et al.*, 2016; Van de Ven, 2007). The argument is that if the consequences of subjectivist and objectivist knowledge are of identical practical use, the views themselves can be viewed as identical as well (James, 1975). This research brings the purposeful nature of knowledge into the foreground independent from the epistemological approach underlying its generation and thus substantiates the pragmatic understanding and grounding for it.

To conclude, related approaches such as positivism, critical realism, or postmodernism approach can therefore be ruled out for this research. Critical realism is a philosophy viewing reality as an observable and real one and argues that the real one cannot be observed directly but is constructed by experiences and different views through observable events acting as a “filter”. For this reason, the researcher needs to understand the structures leading to those events in order to generate knowledge (Saunders *et al.*, 2016). This study considers the reality not filtered by observable events but fully constructed by observers only. I believe that organisations and the situation of the problem space are not reflecting a definite reality but are dependent on how individuals involved in this context construct it individually and socially. Similarly, postmodernism is not a supported belief for this research either since the idea of postmodernism (a view on reality as a construct based on language and power relations determining meaning and acceptance of meanings through dominant ideologies, Saunders *et al.*, 2016; Van de Ven, 2007) is not shared.

3.4.2 Research Reasoning Approach

Following the next decision stage, the approach of reasoning and theory development is the next step of choice within the research design. Particularly, it concerns whether the understanding of a theory is clear at the beginning of the research or not. Goel and Waechter (2017) describe the act of reasoning as a method to evaluate information and formulate conclusive statements that are not stated explicitly. There are three different types of reasoning: *inductive*, *deductive*, and *abductive* reasoning. Following Huff (2009), deductive reasoning is applied to studies which start with an empirical statement about a specific phenomenon. A hypothesis is then formulated to try to explain the phenomenon. With the use of observations to test the hypothesis, statements regarding the truth or untruth of the explanation are made. It follows the principle "from general to specific", meaning the context of the phenomenon is operationalised and tested with a specific observation. Typically, this approach, therefore, comes into question when the research process is grounded in a specific general theory at the beginning (e.g., a conceptual model). An inductive approach, however, follows the principle of "from specific to general" as the research starts from specific observations leading to conclusions out of common patterns. Those conclusions manifest in the development of general theories ("conceptual frameworks") (Saunders *et al.*, 2016). Abductive reasoning can be characterised as the combination of deductive and inductive reasoning (Van de Ven, 2007). This is the case when data to investigate a specific problem is collected initially to develop a theory / modify an existing one and subsequently conduct testing measures with additional data, followed by an iterative process moving back and forth from induction to deduction again repeatedly (Suddaby, 2006; Samuels, 2000). The purpose is to refine and sharpen the initial hypothesis on the problem with each iteration and eventually generate a strong theory.

For this study, abductive reasoning is the approach to the conclusion of choice. Deductive reasoning reflects assumptions which represent positivist means for obtaining knowledge as the conclusion to "truth" or "untruth" is made independent from the observer (mostly through the means of statistical inference). On the other hand, inductive reasoning follows the epistemological view of interpretivism as obtaining knowledge generated through the view of the investigator. Both approaches are not in line with this research if viewed separately and linearly. The repeated interplay between theoretical and empirical evidence is a critical aspect within a solution-oriented research paradigm and thus supports the need for an abductive reasoning approach. This research involves the investigation and iteration of research activities alternating theoretical and empirical steps to constantly refine the understanding of the problem space, with the aim to generate a strong proposition (artefact) as a response to it (Gregory and Munterman, 2011).

3.4.3 Research Methodologies

The choices of the research philosophy and the approach to research reasoning argued above guide the research design towards the appropriate research methodologies. Following the research onion structure, research methodologies are mainly clustered into qualitative, quantitative, and mixed-method ones. This section reflects upon methodologies from all three types. *Quantitative research methods* are characterised by using numeric data to investigate a phenomenon. Usually, this involves the application of statistical / mathematical analysis or algorithms to analyse and infer (Charles, 1998). It is in principle therefore strongly associated with a positivist approach but can also find application grounded in realist and pragmatist research (Saunders *et al.*, 2016; Golafshani, 2003). Typical research strategies involve surveys (questionnaires) or experiments.

Experiment: Rooted in natural sciences, an experiment methodology seeks to investigate the probability of a change in a variable causing a change in another variable (independent and dependent variable relationship) in order to conclude statements on their relationship (Saunders *et al.*, 2016). The formulation of the predictive hypothesis (null and alternative hypothesis) and the conduction in a controlled environment are the main characteristics of this approach. Research design is usually incorporating an experiment and a control group in order to determine the effect of interventions on the experiment group when compared to the control group (hence "control") (Gribbons and Herman, 1996).

An experiment is not suitable for this research since it does not seek to determine or test certain relationships between variables. In fact, this study utilises knowledge about existing relationships in order to inform the development of a solution artefact.

Survey: Similar to experiments but without the need for experimental conditions, surveys are the methodology of choice to explore and describe relationships between concepts. Usually, questionnaires are used to gather data from a certain population first and then to analyse it with statistical tools afterwards. The aim is to describe and infer characteristics of the sample on the population of interest and to conclude statements on previously formulated hypotheses about the relationships. Surveys are designed based on theories and initial assumptions and thus represent a deductive research approach ("testing").

Since the aim of this research is not to test the truth of certain theories, the survey research methodology is not considered for this research. It is not intended to seek truth for hypotheses but to utilise existing explanations of phenomena and concepts in order to inform the development of the desired solution artefact for this research.

Archival and Documentary Research: This research methodology is designed around the rich availability of archival and documentary data. Particularly driven by digitalisation and the internet, data from all around the world is now easily accessible (Saunders *et al.*, 2016). Archival and documentary data exist in multiple forms and sizes, quantitatively and qualitatively. They can document social interactions (e.g., blogs, social media content, emails), individual records (e.g., diaries, notes), company records (e.g., agendas, minutes, annual reports, contracts), sources from governmental bodies (e.g., reports, statistics), or public media (on- and offline articles, videos, documentaries). While the richness and extensive sizes of data can be favourable for research analysis, the obvious disadvantage lies in the fact that the data is of secondary nature and not purposefully created for the research aim (Hakim, 2000).

For this research, a methodical approach based on archival and documentary data is not suitable and thus is not considered. This research heavily relies on original data to be extracted from practice where the phenomenon of interest is observed.

Qualitative methods are used for inquiries of broad and thematic nature where the phenomenon is complex and entangled in contextual factors (Yin, 2017; Saunders *et al.*, 2016). Usually, the goal of qualitative methods is to identify major patterns and schemes in collected data to conclude general statements. It is therefore predominantly associated with an interpretive view of reality (Golafshani, 2003). Qualitative research can also find application in realist or pragmatist-grounded research. Typical qualitative strategies are case study research, ethnography, or grounded theory research.

Case Study Research: Yin (2017), probably the most well-known scholar advocating case study research, defines the methodology as an "empirical method that investigates a contemporary phenomenon (the "case") in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident." (p. 44). Hereby, a "case" refers to the subject of the study (e.g., individuals, groups, organisations, functions and departments in companies, or events). The main goal is to understand the observed phenomenon within its real-life context (Stake, 2013). The case can be investigated in a single format (single case study) or different contexts (multiple case studies) and can encompass not only qualitative but also quantitative, or mixed data collection and analysis techniques ensuring rich data generation (e.g., interviews, focus groups, surveys, observations). A prevalent motivation for the utilisation of case study research is explorative research aims to understand a complex problem (collecting and analysing data, theory development through pattern matching and induction, see e.g., Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Case Study Research finds application in many disciplines such as education, political science, business management, and information systems to mention a few.

The case study methodology offers a strong fit for the research aims and context of this study. Particularly, it addresses the need for the incorporation of an empirical component in the reasoning process. It offers extensive methodological instruments and procedures with a plethora of referable instances of its application in various disciplines. However, as mentioned in the discussion on the philosophical positioning of this research, the research aim of this study is not only to gather and analyse rich data from a real-life context but also to use it to develop a solution artefact aiming at addressing the problem as defined in this research. Thus, the desired methodology goes beyond the methodological scope of case study research. However, case study research finds application in this research as argued in the methodology of choice section further below due to its suitability in capturing the collaborative activities with practice.

Ethnography: Ethnography can be understood as the study of the culture or social realm of a specific group (e.g., urban lifestyle culture, specific ethnic groups, or associated subcultures). The aim is to collect data on the beliefs, values, behaviours, social life, language, rituals, etc. of the group in order to gain an understanding of how their life is shaped (Cunliffe, 2010). It is common for the investigator to live among the group of interest for the duration of the study in order to harness continuous observation and ensure the richness of data (Saunders *et al.*, 2016). Usually, the investigated group is large, and the challenge lies in getting the individuals together to interact with each other over a specific period of time. The methodology is strongly associated with an interpretivistic view of reality and is predominantly reliant on observational data as the main source of data gathering.

Ethnography can be ruled out for this research since the subject of the study is not directed towards an ethnic group. It is not the intention of this study to gather rich data on a social world nor to interpret its peculiarities of it. Although an interpretive view of reality is shared for this research under the umbrella of a pragmatist approach as well, the investigation does not only involve the generation of an understanding but also the development of a solution to a specific problem. This critical requirement clearly excludes ethnography as a suitable methodology for this research.

Action Research: The main notion of Action Research is the development of solutions to real and specific organisational problems – a collaborative and participative approach and the combination of theory and practice are the cornerstones of this methodology (Rapoport, 1970). The iterative research process in Action Research is grounded in a specific context (usually an organisation) and undergoes phases and cycles of diagnosis, action planning, action taking, and evaluation along with the collaboration between the researcher and members of the organisation. The constant reflection, change and evaluation ensure an effective way for solution development (Rapoport, 1970). The advantage is given by the fact that theoretical knowledge can be combined with rich data grounded in the practical and experiential knowledge of the practitioners (Reason, 2006). However, the downside that comes along with it is the high contextual dependency on the influencing organisation in the course of the problem-solving process (Iivari and Venable, 2009).

Action Research represents a methodology with a strong fit to the research goals of this study. It provides a method that effectively combines theoretical and practical knowledge. Moreover, the means to do so (collaboration, participation, intensity of engagement) reflect a powerful basis very suitable for this research. Furthermore, its problem-orientation and solution-seeking principle addresses the major objective of this study highly. However, the methodology is profoundly imbalanced in its focus on academic and practical contributions favouring strong contributions towards the practice. As a result, generalisability would be severely limited (Nandhakumar *et al.*, 2005). This study does not intend to confine its findings and solution to a single context but seeks to achieve a more generalisable outcome with a strong contribution to the academic community as well. Lastly, the origin of the problem space motivating this research is grounded in literature and independent practitioners, eventually stemming its basis, not from a specific single context as this is the case in Action Research. Therefore, this methodology is not considered for this research.

Grounded Theory: The development of theories is the main purpose of the application of a grounded theory methodology (Strauss and Corbin, 1997). The name is derived from the fact that the developed theory is "grounded" in a set of qualitative data generated from multiple sources (Saunders *et al.*, 2016). A major characteristic of the interpretive approach is the involvement of social actors who give meaning to the observed phenomena (Charmaz, 2006). The systematic process is structured along alternating collection and analysis steps with "coding stages" and involves the constant reorganisation of categories after each step (Strauss and Corbin, 1997).

Grounded Theory can be excluded as a suitable methodology for this research since the purpose of this study is not to develop a new theory (as understood in social sciences, see Section 3.5). In fact, the observed phenomenon is positioned within existing theories thus making the purpose of Grounded Theory impractical for this research (also referred to as the "theoretical sensitivity" problem, Saunders *et al.*, 2016).

Narrative Inquiry: The meaning of "narrative" refers to the rich description of a specific experience told by the narrator (subject), revealing a flow of interlinked events that eventually form a meaning of the story for the investigator (Coffey and Atkinson, 1996).

Narrative Inquiry is applied when the investigator is convinced that the experiences shared by the participant are richer and more meaningful if told as a coherent story rather than through mere bits of answers to a series of questions (e.g., through semi-structured interviews) (Saunders *et al.*, 2016). The methodology can be applied as a research methodology or a method within a methodology (Musson, 2004). Similar to Grounded Theory, the main goal in Narrative Inquiry is the generation of an explanation and a theory for a phenomenon of interest (although with less rigour in the analytical process). It is therefore in line with an interpretivistic and qualitative approach.

The Narrative Inquiry does not qualify as a methodology for this research. Its purpose is quite special and focused and insufficient to be considered a comprehensive research strategy. Although this research foresees the interaction with practitioners (interviews), the desired explanations and information from those would not be complex or extensive to justify a story-driven approach.

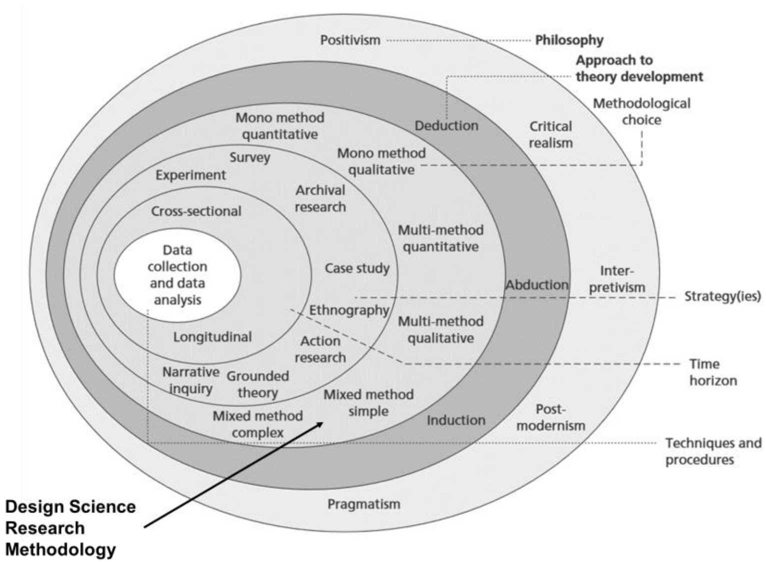
Multi- and Mixed Method Approaches

According to Saunders *et al.* (2016), both qualitative and quantitative approaches are also referred to as "mono-methods" in case only single data collection and analysis techniques are applied or "multi-method" in case more than one data collection and analysis technique is utilised. A multi-method approach has been advocated for research since the application can help to overcome weaknesses of single or mono methods (Bryman, 2006).

Next to qualitative and quantitative methods, *mixed-method approaches* are prevalent in research practice as well. A mixed-method research design is characterised by mixing qualitative and quantitative data collection and analysis techniques (Saunders *et al.*, 2016). This approach is highly associated with pragmatism and critical realism since especially the former accepts more than one philosophical standpoint for research understanding as long as it allows for purposeful solution developments (Tashakkori and Teddlie, 2010). A mixed-method approach can be applied either sequentially or concurrently. A sequential design arranges data collection or analysis techniques in a sequence whereas a concurrent design allows for the separate use of techniques in a single phase concurrently (e.g., Creswell and Clark, 2017). The following Design Science Research approach is identified as a distinctive mixed-method methodology.

Design Science Research: Among the various research methodologies analysed and discussed by Saunders *et al.* (2016), a further review of appropriate methodologies reveals the strong suitability of the Design Science Research Methodology (DSRM) for this research. Design Science (DS) positions itself as a distinctive paradigm next to natural and social sciences (Dresch *et al.*, 2015; March and Smith, 1995). Venable (2011) argues that the Research Onion does not account for DS as an approach within its layers and is therefore not illustrated in the framework. However, DS can be regarded as a distinct mixed-method methodology since the approach allows the combination of qualitative as well as quantitative strategies and methods in order to reach the research objectives. Therefore, DS can be positioned among the mixed method approaches in the methodology layer of the Research Onion (**Figure 23**). The goal of a Design Science Research (DSR) study is to construct an "artefact" as a solution that is addressing a specific need in a socio-technical context (Hevner *et al.*, 2008; March and Smith, 1995). Artefacts can be constructs, models, methods, or instantiations (March and Smith, 1995), but also design theories (Gregor and Jones, 2007). The research methodology is characterised by the interplay between behavioural science and the design and evaluation of that specific artefact, aimed at solving a particular business need (Helfert *et al.*, 2012; Hevner *et al.*, 2008).

Figure 23: *Positioning DSR within the Research Onion (adapted from Saunders et al., 2016)*



At first view, DS and its solution-oriented purpose seem very close to the traits of Action Research (AR) (Järvinen, 2007); however, it is important to understand that DS represents a paradigm whereas AR can also be applied as a method only. More importantly though, is the fact that DS seeks to produce general solutions addressing a class of problems instead of a specific organisational issue which is typical for AR as mentioned above (Iivari and

Venable, 2009), thus accentuating theoretical contributions to the scientific discourse in the problem domain.

From a research process perspective, the DSRM is composed of a set of systematically structured phases that is characterised by an iterative feature (Hevner, 2007) allowing ongoing refinement and re-evaluation steps in design and evaluation ("build-evaluate-cycle"). Various reference processes guide researchers on how to conduct a DSR project (e.g., Mullarkey and Hevner, 2019; Sein *et al.*, 2011; Baskerville and Pries-Heje, 2010; Hevner *et al.*, 2008; Gregor and Jones, 2007; Peffers *et al.*, 2007; March and Smith, 1995).

Research Methodology Selection for this Study

Based on the result of the analysis and critical reflection on the suitable methodology for this research, the *Design Science Research Methodology* is selected as the methodology of choice to guide this thesis because of the following reasons (summary):

1. DS offers a systematic process that is iterative in nature, ranging from problem definition to design and development to the communication of research results allowing constant refinement and evaluation steps in between.
2. There is a strong association between a pragmatist view of reality and DS. A pragmatist view is characterised by its problem-focus and the purposeful utilisation of existing theories and concepts in such a way that they contribute towards solution-seeking and development. This is in line with DS where design decisions for design theories are justified by existing analytical, explanatory, or predictive knowledge (Drechsler and Hevner, 2018; Winter and Aier, 2015; Gregor and Jones, 2007). The knowledge can stem from organisational behaviour, customer behaviour studies, or operations research and can justify design decisions ("justificatory knowledge", for instance, the relationship between "advertising spending" and "sales" is proven empirically to be related positively for B2C brands and thus can justify design decisions for artefacts aiming at addressing sales problems in relatable contexts). This demonstrates its strong feature in allowing an interplay between behavioural and design science as a cycle and an expression of a pragmatist approach to producing scientific knowledge (Goldkuhl, 2012).
3. DS is particularly suitable for wicked problems. A wicked problem is characterised by its confusing and indistinct nature, ambiguous formulation, complex interaction among components and unstable requirements and limitations. There is no right or wrong but better or worse (Farrel and Hooker, 2013; Pries-Heje and Baskerville, 2008; Conklin, 2005; Rittel and Weber, 1973). This corresponds to the

understanding of solution design in DS: it is aimed to produce a better solution than existing ones provide instead of striving for the ideal solution. This is owed to the understanding of problems in DS: unstable, contradictory, hard to identify and complex interrelationships among components.

4. DS aims to produce prescriptive knowledge (PK). PK informs on how to do something through explicit prescriptive information, e.g., methods, techniques, or principles of form and function (Drechsler and Hevner, 2018; Winter and Aier, 2015; Gregor, 2006). This is in contrast to theory understood in natural and social science disciplines where a descriptive, explanatory, and/or predictive feature is the major characteristic of "theory".
5. Obtaining practical knowledge is a fundamental requirement in DS since the practice serves as the field of relevance not only for (1) sourcing relevant problems but also (2) assessing proposed solutions within its environment (Hevner, 2007).
6. The methodology offers a strong fit to mixed methods: the process allows the embedment of various ranges of qualitative and quantitative techniques and tools as they fit the research objectives, independent from the epistemological character of the applied techniques. For example, the application of a case studies (Yin, 2017).
7. DS is in line with abductive reasoning as it is able to successfully combine deductive and inductive reasoning along its phases, e.g., the characterisation of a specific problem followed by its validation through the application of practitioner interviews in the initial phase.

3.4.4 Time Horizon

The decision on the time horizon of the study also represents an important element in the methodology since the researcher can choose whether she/he is interested in conducting the study in a cross-sectional or longitudinal manner. Cross-sectional studies focus on the phenomenon of interest at a certain point in time, whereas a longitudinal study investigates change related to the problem over time (Saunders *et al.*, 2016). This study captures knowledge at several points in time and is thus characterised as adopting a longitudinal perspective.

3.4.5 Data Collection and Analysis Techniques

The subsequent and final step in the process of designing the research is the selection of data collection and analysis techniques. In general, the following data collection techniques are differentiated (Bell *et al.*, 2022; Yin, 2017; Creswell and Poth, 2016; Saunders *et al.*, 2016).

Interviews: This type of data collection technique represents a social interaction based on a conversation (Warren and Karner, 2015; Rubin and Rubin, 2011), where knowledge is constructed between an interviewee and interviewer (Brinkmann and Kvale, 2015). Interviews allow to generate rich empirical data (Eisenhardt and Graebner, 2007). The most common interview types are (Yin, 2017; Creswell and Poth, 2016; Saunders *et al.*, 2016; Fontana and Frey, 2005; Weiss, 1995):

- **Structured interviews** (conducted by the use of a complete, preprepared and -structured script which does not allow any improvisational action during the interview; the scripts are referred to as standardised questionnaires, described further below),
- **Semi-structured interviews** (incomplete script with some preprepared questions allowing some improvisations such as omitting questions or new questions based on the development of the discussion),
- **Unstructured interviews** (unguided, unstructured, and informal conversation allowing in-depth discussions and exploration of aspects in non-specific, general topics of discussions; the interviewee can speak freely with no limitations to topic boundaries), and
- **Group interviews** (two or more participants are interviewed at once; use of structured, semi-structured, or unstructured approach).

One specific and well-known form of group interviews is referred to as focus groups which are discussed further below. The choice of the interview type depends on the research purpose and aims, e.g., unstructured interviews in particular but also semi-structured interviews are suitable for explorative goals, whereas structured interviews fit more to descriptive and explanatory studies. However, semi-structured interviews can also assist in understanding relationships between concepts (Saunders *et al.*, 2016). Correspondingly, in view of the analysis of interview data, structured interview data are usually analysed quantitatively due to their highly standardised structure whereas semi-structured and unstructured interviews can be analysed with qualitative means (Saunders *et al.*, 2016; King, 2004). Due to its efficiency in externalising rich empirical data, interviews represent a fundamental piece in the set of data collection techniques for this research. Especially in the context of a case study approach, the use of interviews is central to gathering practitioner knowledge. The feature of semi-structured interviews allowing improvisational leeway to some extent ensures flexibility in uncovering and externalising practitioner knowledge and experience in an effective way. Moreover, in the initial phase of this research, interviews with practitioners have been conducted as means of validation for the problem statement (Section 6.2.1). However, due to the circumstances at the time of data collection (the pandemic situation in 2020 and 2021 in Ireland), all interviews have been conducted remotely via the online conference tool "Microsoft Teams" (Section 4.2.1 and 5.2.1).

Questionnaire: This type of approach is generally understood as all data collection techniques in which individuals are asked to provide responses to the same set of predetermined questions (de Vaus and de Vaus, 2013) and represents the most common technique in survey research designs (Saunders *et al.*, 2016). Questionnaires are especially efficient in the collection of responses from a large sample that can be analysed in a quantitative manner (Saunders *et al.*, 2016) and are understood as standardised and fully structured scripts in an interview context (Fontana and Frey, 2005). However, it is important to note that they work best with questions that are standardised and will likely be interpreted in the same way by all respondents (Robson, 2002). Therefore, they show a particular fit for descriptive (e.g., examination of different expressions of phenomena) or explanatory research (examination and explanation of relationships between concepts of interest, e.g., cause-effect relationships) (Saunders *et al.*, 2016). Questionnaires can also be used in experiments and case study research jointly, e.g., complementary to in-depth interviews (Saunders *et al.*, 2016). This research applies a questionnaire-based data collection approach in the initial phase (Braun *et al.*, 2021; Krosnick, 2018) as well as for means of evaluation (Section 6.2.1).

Focus groups: Stemming from social sciences to study ideas and opinions in a group setting (Morgan, 1996), a focus group is defined as a moderated group interview focusing on a particular topic (e.g., product/service or challenge) (Saunders *et al.*, 2016). Unlike a generic group interview, a focus group has a focus on a particular topic with an emphasis on the interaction in the group (Carson *et al.*, 2001). Thus, the role of the moderator is to promote interaction among the participants and keep the discussion focused within the boundaries of the topic of interest (Saunders *et al.*, 2016; Stewart and Shamdasani, 2014). This ensures sharing of different opinions without any pressure on meeting a consensus (Krueger, 2014). The composition of the group is usually constituted of participants who have certain characteristics and relation to the topic such as expertise or experience (Krueger, 2014).

Focus groups represent a suitable data collection technique in DS (Tremblay, 2010) due to flexibility (open format appropriate to handle a wide range of design topics and domains), direct interaction with respondents (strong link to domain experts and potential artefact users allowing refinement and clarification of e.g., design issues), large amounts of rich data (the focus groups generates a large amount of qualitative and quantitative data, allowing deep understandings), and connections to other respondent's feedback (the group setting facilitates interactions allowing the emergence of ideas and opinions otherwise hard to uncover in individual interview situations) (Stewart and Shamdasani, 2014). Due to its strong suitability and the fit to its purpose in generating explorative data out of the participant's knowledge and experience, thus meeting the methodological requirement in combining theoretical and practical data generation, focus groups are applied as a data collection technique in this research. For the same reason as stated above, the focus groups have been conducted remotely via the online conference tool "Microsoft Teams" (Section 4.2.1).

Observation: Angrosino (2007) defines observation as a qualitative data collection approach where a phenomenon is observed and recorded in the field set by an observer. Hereby, the observations are linked to the research purpose and questions (Creswell and Poth, 2016). Its origin is stemming from the social and anthropological sciences where the researcher aims at participating in the lives and activities of research subjects, usually attempting to become a member of the group, organisation or community, in order to understand the roots of behaviour (Saunders *et al.*, 2016; Delbridge and Kirkpatrick, 1994). Observation can be conducted through complete participation, participation as an observer, observation as a participant, or a complete observer (Creswell and Poth, 2016; Johnson and Gill, 2010). Analysis of observational data is usually conducted in conjunction with the observation itself. This means, choosing certain events or aspects of the observation data to realign observational activities towards these (Saunders *et al.*, 2016). This analytical technique, known as *analytic induction*, might lead to constant reshaping or refinement of hypotheses, concepts or constructs throughout the observation process. Other than that, practical analysis techniques such as the utilisation and analysis (pattern identification, linking content data to outcomes) of coding schedules. For this research, observation in the context of a case study is applied. Specifically, the observation complements the set of data collection techniques conducted within a case study setting since it can reveal new dimensions and aspects in the course of the inquiry (Yin, 2017). The real-life context allows the direct observation of the organisational setting and participants dealing with the phenomenon of this research. This is in line with ensuring data collection for case studies via the single source of evidence principle (Yin, 2017).

Next to the primary data collection techniques, there is also the possibility of collecting and analysing **secondary data** to achieve research goals. It is characterised by not being original or generated within the research process but resulting from past data in the course of different studies and purposes ("second-hand" data). Secondary data can be of a quantitative or qualitative type and depending on its nature classified into "documentary" sources (written materials such as any company databases, emails, memos, websites, diaries or existing interview transcripts, or non-written materials such as media, voice or video recordings), "multiple" sources (area-based such as country reports, government publications, or time-series based such as industry statistics/reports), and sources based on surveys (census-based such as census on employment or population, regular surveys such as government spendings, trends, or ad hoc surveys) (Saunders *et al.*, 2016). This research does not utilise secondary data for solution development.

Data Analysis

Based on the type of data collected, a principal distinction between quantitative and qualitative data is made (Saunders *et al.*, 2016). Quantitative data is referred to as any type of data that is of numerical nature or can be quantified in order to answer research questions, whereas qualitative data is characterised by non-numerical data or data that is not quantified. Based on Dey (2003) and Healey and Rawlinson (1994), Saunders *et al.* (2016) differentiate both types from a meaning, collection, and analysis perspective. The meaning of quantitative data is derived from numbers and its collection usually results in numerical and standardised data whereas qualitative data is expressed through words and its collection requires classification into categories due to non-standardised data. From an analysis perspective, diagrams and statistics are typical means to represent quantitative data whereas qualitative data analysis usually results in conceptualisations. In this research, quantitative data collection is carried out on the basis of a survey with retail practitioners. The online questionnaire aims at measuring evaluation criteria with the use of a 7-point Likert scale, thus producing quantified data (Section 6.2.1). Simple descriptive analysis is applied (frequency counts and distributions via diagrams) since the aim of the data collection is not explanation or inference (e.g., Fowler Jr, 2013; Blaikie, 2003). Similarly, a systematic literature review (Section 2.3), diagrams (bar charts) and tables for simple frequency counts and distribution analysis are applied. However, in terms of qualitative data, a range of different collection methods as mentioned above that produce qualitative data are applied (exploratory survey, interview data, focus group data, observational data). For the analysis, a general three-step approach consisting of preparation and organisation (e.g., transcription), coding (e.g., themes building), and representation of data (e.g., via figures, tables, discussion) is applied (Creswell and Poth, 2016). Specifically for the coding part, Thematic, as well as Template Analysis, are applied. Both approaches are related to each other and established techniques in qualitative data analysis. For the interviews with practitioners (**Appendix F-1**), Thematic Analysis is applied since it allows the identification of patterns across the different interviewee data. Braun and Clarke (2012) define the approach as "*… a method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a data set*." (p. 57) and propose a six-step approach with (1) data familiarization, (2) initial coding, (3) themes searching, (4) themes reviewing, (5) theme definition and naming, and (6) reporting. Hereby, "codes" refer to the "building blocks" of the analysis and provide a label for data pieces that are deemed relevant to the research question, whereas "themes" are actively generated throughout the analysis process and represent a patterned response or meaning within the data (Braun and Clarke, 2006). For the interviews and focus groups within the case study approaches of this research, Template Analysis (King, 2012; King, 1998) is utilised due to its strong suitability in capturing and organising themes. Unlike Thematic Analysis, pre-coded themes that are identified by the researcher serve as a template in the analysis process. This is deemed effective since the basis for the interviews and focus group sessions within the case studies of this research is grounded on pre-classified terms and concepts from the literature that serves as codes in the template (Section 4.3). However, the codes can be amended anytime throughout the analysis process (King, 2012).

From a practical point of view and to ensure rigour and transparency, different computer-aided qualitative data analysis software can be used for the analysis process, e.g., Atlas.ti, HyperRESEARCH, MaxQDA2, NVivo, QDA Miner, or QSR N6 (Saunders *et al.*, 2016). For the analysis of qualitative data of this research, the software NVivo is used due to its availability within this research project.

3.5 Application of the Design Science Research Methodology for this Research

The goal of this research is to design and develop a model capable of representing the alignment between strategic assortment decisions and the consumer confusion concept from a channel switching perspective in omnichannel retailing. Established that the most appropriate methodology is identified as the DSRM as discussed in the previous section, this section focuses on the application of the paradigm for this research. Before outlining the research process in detail, a discussion on the intended theory output of this study needs to be determined. *Theorizing* is an activity to initiate scientific discovery (Swedberg, 2012). In view of the desired research output and the nature of the scientific discovery for this research, the generation of prescriptive knowledge, and theorizing on *how the output can be designed* establishes the fundamental character of the sought theory. This is distinct to theories emerging out of descriptive, explanatory, or predictive intent typically applied in natural and social sciences which seek to theorize on "what, how, why, when, and what will be" intentions.

Following Gregor (2006) and Winter and Aier (2015), fundamentally a theory can be distinguished between the following five main types:

- **Theory for Analysis**: A basic theory with descriptive intent on the phenomenon that does not go beyond its analytical character (e.g., a taxonomy). It informs about "what is" and there are no statements on the mechanisms such as causal relationships or predictions. It usually precedes other theory types when the phenomenon is new and is characterised by limited knowledge about it.
- **Theory for Explanation**: A theory for understanding that is able to provide explanations for the observed phenomenon and to answer not only "what" it is, but also "how", "why", and "when" it occurs (e.g., a model linking certain consequences to strategic decision-making). However, testable propositions are not provided, nor it aims to predict something.
- **Theory for Prediction**: A type of theory that not only states "what" it is but is also able to state "what will be" under the condition of certain requirements to occur. It usually comes along with testable propositions but merely provides causal explanations as justification (e.g., a model that can predict performance outcomes out of certain strategic decisions based on empirical observations).
- **Theory for Explanation and Prediction**: A theory combining explanatory and predictive theory features to state "what", "how", "why", "when", and "what will be". It has testable propositions, and causal explanations, and provides predictions (e.g., a model able to explain the success factors for omnichannel retailing allowing the prediction of omnichannel performance based on the proposed causal relationships). This type of theory represents the most common type in natural and social sciences.

- **Theory for Design and Action**: This theory informs on "how to do" something. It provides explicit prescriptions on how to construct an artefact (e.g., methods, techniques, design principles) that is aimed at solving certain problem classes within organisations.

The research objective for this research can be identified as a theory for "Design and Action". It intends to provide explicit prescriptions on how to design an artefact that is aimed at solving the identified problem. The DSRM is capable of producing such a result. The principles of the methodology lie in the notion of designing, building, and evaluation cycles as introduced by Hevner (2007).

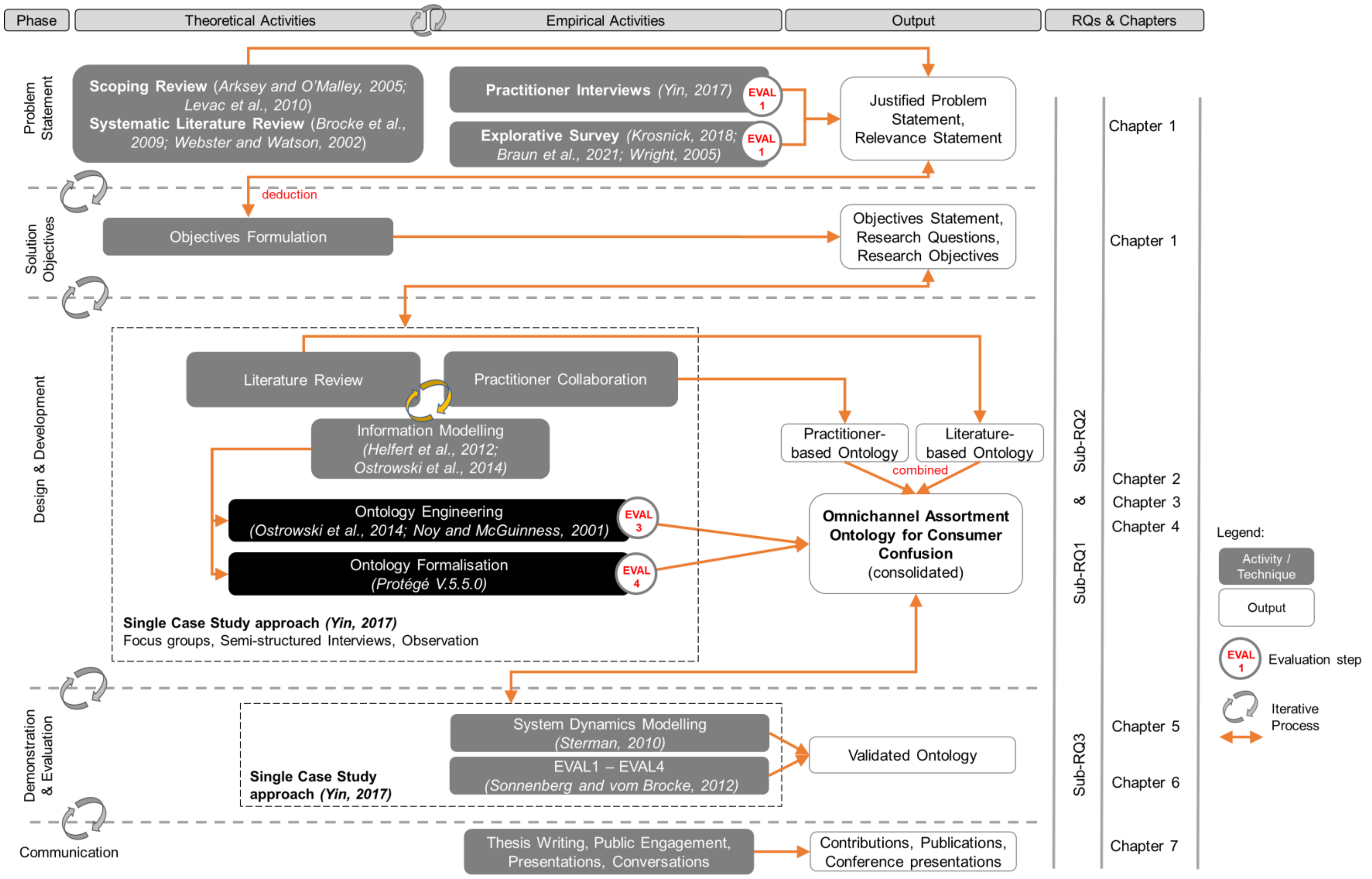
Until today, a range of different reference processes and frameworks to conduct a DSR project has been introduced. The established ones are from e.g., Nunamaker *et al.* (1990), Walls *et al.* (1992), March and Smith (1995), Gregor and Jones (2007), Peffers *et al.* (2007), Carlsson and Sawy (2008), Hevner *et al.* (2008); Kuechler-Jr. and Vaishnavi (2008), Offermann *et al.* (2009), Baskerville and Pries-Heje (2010), and Ostrowski *et al.* (2014). Characteristic for all processes is a sequential process that embodies the three-cycle view of build-design-evaluate. Approaches that combine AR with DSR also emerged recently with Action Design Research (Sein *et al.*, 2011) and elaborated Action Design Research (Mullarkey and Hevner, 2019). However, the DSR process for this study is adapted from Peffers *et al.* (2007) due to a strong fit in meeting the methodical requirements.

Research Process for this Thesis

An overview of the research process is provided in **Figure 24**. The overview is structured along the DSR phases (Problem Statement, Solution Objectives, Design & Development, Demonstration & Evaluation, and Communication) and research activities are divided into "theoretical" and "empirical" tasks. This structure is chosen to account for the nature of the research inquiry in adopting and combining theoretical and empirical sources for knowledge generation. Theoretical activities are characterised by research steps and findings that are literature-based (theory-informed) or on a purely conceptual basis and do not involve any input from practice (e.g., literature reviews, conceptual framework development, hypothesis development, logical reasoning) whereas empirical activities are centred around the generation and use of empirical data and the interaction with practitioners from the research problem domain (e.g., analysis of company data, practitioner interviews, focus groups, observation, demonstration). The research process also accounts for the iterative aspect of DS evident through (1) iterative cycles between the DSR phases (highlighted by the grey cycle symbols), and the (2) two-sided arrows within the research activities/research outputs. Since evaluative activities are not isolated and are usually not entirely conducted at the end of the DSR process, each phase involves a specific evaluation activity to validate interim research outputs (e.g., validation of the problem statement, validation of ontology design specifications). These activities are highlighted by "EVAL#" icons with sequential numbering following the evaluation logic EVAL1 to EVAL4 as proposed by Sonnenberg and vom Brocke (2012) and developed in Chapter 6. The overview also highlights which phases address the research questions of this research and the corresponding chapters the activities are presented and discussed in.

The following sections outline the description of the DSR phases, and the methods / techniques selected and applied. Thereafter, Chapter 4 presents the execution steps in detail and focuses on the Design and Development phase of the research process.

***Figure 24:** Research process of the thesis*



3.5.1 Phase: Problem Statement & Motivation

This step covers the systematic process of the identification, evaluation, and formulation of the identified problem space for this research. Applied techniques in this phase encompass a scoping review, a systematic literature review, practitioner interviews and an exploratory survey, leading to the formulation of a justified problem and relevance statement.

Initially, a *scoping review* was conducted in 2019 to investigate the research areas, streams, and boundaries of the omnichannel retailing domain (22 key papers analysed in-depth, see **Table 41** in **Appendix A-1** for a list of articles). Scoping reviews are a valid and useful technique to utilize at the beginning of a research project (Armstrong *et al.*, 2011) as its purpose is focused on the breadth rather than the depth of a topic (Rumrill *et al.*, 2010). It also proves to be suitable for reviewing emerging topics (Levac *et al.*, 2010) since this was the case of the omnichannel retailing research domain, which emerged arguably first in 2012 (Mirsch *et al.*, 2016). The scoping review allows us to (1) familiarize ourselves with the research domain, key terms and definitions, (2) explore the extent of literature as well as existing research streams, (3) assess the opportunity and value of different research directions as well as identify relevant research gaps, and (4) ground the base for further planning of the research (Levac *et al.*, 2010; Arksey and O'Malley, 2005). The synthesis reveals that the relation between omnichannel assortment integration (as an instance of channel integration) and consumer confusion induced by customers' channel switching behaviour (as an instance of customer experience) represents a relevant but wicked problem. A subsequent *systematic literature review* (Webster and Watson, 2002) allowed to gain a deeper insight into the current state-of-the-art of the research problem and investigate existing solutions to the problem statement given above (Chapter 2). Findings show advances and limitations in the problem context and thus identify research gaps and potential contributions relevant to this research.

To reflect and validate the problem statement, two separate evaluation activities have been conducted thereafter. The evaluation activities are part of the evaluation strategy discussed in Chapter 6. *Practitioner interviews* (EVAL1.1) with two different retailers confirm the existence and relevance of the research problem as well as the lack of awareness for linking the consumer confusion phenomenon to strategic assortment integration decisions (details see Chapter 1 and **Appendix F-1**). Practitioner interviews are a suitable method to investigate and externalise expert knowledge from the application domain of the artefact (Yin, 2017; Creswell and Poth, 2016). An explorative online survey on European retailers complements the findings and substantiates the relevance of the research (EVAL1.2). Please see Section 1.5 and **Appendix F-2** for details on the survey design and results.

In general, a problem space can be positioned on different *levels*, e.g., on an organisational, group, industry, or individual level (Van de Ven, 2007) – this depends predominantly on the focus and context of the observed challenge. For this study, the problem is situated at an organisational level (retail company) and examines a problem that emerged within an omnichannel context. As described in Section 3.2.2, the problem of strategic assortment decisions and its relationship with the consumer confusion concept can be positioned within the MOI framework highlighting an organisational strategic decision-making problem. The *stakeholders* of the problem are represented by the retail organisation itself and decision-makers on a strategic management level. As outlined in Section 3.2.1, omnichannel assortment integration represents a strategic decision linked to corporate strategy, marketing and operations, addressed by individuals in a social interaction of "decision agreement". The proposed solution concept finds its utilisation within this process.

3.5.2 Phase: Objectives Statement

The next phase links the problem statement to an objective statement by deducing solution characteristics from problem characteristics. The deductive process (Hevner and Chatterjee, 2010; Peffers *et al.*, 2007) helps to define those requirements that are necessary to be addressed by the solution design to ensure its fitness to the problem and its characteristics ("goodness criteria"). The objective of the DS study is then formalised with research objectives and research questions. This step is described in Chapter 1 with the conclusion of the aim of this research defined as follows:

The design and development of a model that aligns and integrates relevant knowledge on strategic assortment decisions, consumer confusion, and its link to short- and long-term consequences, from a channel switching behaviour perspective at the Marketing-Operations-Interface in an omnichannel retailing context.

Justification and Formulation of Design Requirements

The rationale for the derivation and justification of the design requirements (DR) for this research is composed of considerations elicited by (1) the requirements from the problem space and (2) the requirements from the theoretical framework. The DRs from the problem space embody the necessary features of the artefact that address the needs as expressed by the problem characteristics whereas the DRs from the theoretical framework address the characteristics and needs from the envisioned application domain of the artefact and represent the fit to the MOI framework (Section 3.2.2). The DRs are defined as follows (**Table 13**).

Solution Space Design Requirements. To begin with, the main characteristic of the solution is to represent the alignment between strategic assortment decisions and the consumer confusion concept in omnichannel retailing (DR1). This requires incorporating and mapping all relevant concepts and their relationships with each other. Correspondingly, the relevant concepts stemming from the domains of omnichannel assortment decisions (DR2), consumer confusion (DR3), its consequences (DR4), and channel switching behaviour (DR5) represent necessary elements that need to be incorporated into the artefact. "Relevancy" means that the concepts are associated with the alignment between strategic assortment decisions and the consumer confusion concept and are thus critical to be addressed.

Design Requirement 1: The artefact is required to provide a representation of *the alignment between strategic assortment decisions and the consumer confusion concept*. This feature represents the key characteristic of the artefact critical in addressing the research problem. Omnichannel retailers are confronted with channel switching behaviour bringing a new dimension to the consumer confusion phenomenon. Previous literature investigated the phenomenon from a single-channel perspective (e.g., Garaus and Wagner, 2019; Wobker *et al.*, 2015; Walsh and Mitchell, 2010; Mitchell *et al.*, 2005; Turnbull *et al.*, 2000). However, in an omnichannel environment, the effect is not aligned to assortment decisions in conjunction with a channel switching perspective yet. Therefore, the artefact is required to establish and represent this alignment in order to provide guidance for omnichannel retailers dealing with the occurrence of the consumer confusion phenomenon in an omnichannel context.

Design Requirement 2: The artefact is required to provide a representation of all *relevant concepts and relations from the omnichannel assortment knowledge domain*. Omnichannel assortment represents the structural characteristic of a retailer that potentially induces the consumer confusion phenomenon. Assortment inconsistencies arise when an integration approach is applied that does not provide full integration of the assortment across channels (Bertrandie, 2020; Bertrandie and Zielke, 2017). Different configurational designs are possible to shape omnichannel assortment (Rooderkek and Kök, 2019; Emrich *et al.*, 2015). Omnichannel retailers are required to address the various facets of omnichannel assortment decisions in order to relate the impact on the consumer confusion phenomenon. Therefore, the ability to represent all relevant concepts and relations from the omnichannel assortment decision domain is a key requirement for the artefact to satisfy.

Design Requirement 3: The artefact is required to provide a representation of all *relevant concepts and relations from the consumer confusion knowledge domain*. Within this research, consumer confusion represents the phenomenon that results from assortment inconsistencies across channels. In order to address the phenomenon accurately, it is necessary to address its antecedents, dimensions, and consequences (Chauhan and Sagar, 2021; Garaus and Wagner, 2016; Walsh and Mitchell, 2010; Walsh *et al.*, 2007; Mitchell *et al.*, 2005; Mitchell and Papavassiliou, 1999) and how they are linked to strategic assortment decisions. The artefact is required to capture these elements to establish the alignment to the components of omnichannel assortment decisions.

Design Requirement 4: The artefact is required to provide a representation of all *relevant concepts and relations from the channel switching behaviour knowledge domain*. Channel switching behaviour is the main characteristic of omnichannel customer behaviour (Goraya *et al.*, 2022; Van Nguyen *et al.*, 2022; Kang, 2018; Verhoef *et al.*, 2015) that potentially leads to the occurrence of the consumer confusion phenomenon from a customer journey perspective. Different types (showrooming, webrooming) are characterised by different customer journey paths that need to be captured in order to relate them to the occurrence of the phenomenon. Without channel switching behaviour, customers would not come across assortment inconsistencies across channels.

MOI Framework Design Requirements

The application domain of the desired artefact is characterised by an interface between two organisational functions where an individual or a group of individuals is/are to resolve conflicting relationships between the objectives of the two functions. Therefore, the artefact utility is to inform these individuals by providing explicit information on the concepts and their relations. Concludingly, the artefact should provide a fit to the framework elements by identifying all concepts to which component of the MOI framework they are associated with (DR5). Moreover, it is important to consider the alignment of the MOI to the corporate strategy as it is an important element within the framework (Section 3.2.1). The link is usually established through a performance perspective in order to evaluate the decisions from a corporate strategy point of view (DR6).

Design Requirement 5: The artefact is required to identify to *which component of the MOI framework the concepts are associated with*. All concepts that are represented within the artefact should provide a distinctive informational property on where to position it within the MOI. In order to support and inform decision makers at the MOI accurately, all represented concepts need to be classified along the key elements "marketing function", "operations function", "decision area" or "corporate strategy" adequately.

Design Requirement 6: The artefact is required to provide a link of the alignment between strategic assortment decisions and consumer confusion to the corporate strategy at the MOI from a *performance perspective*. Decision-makers at the MOI seek to achieve a balance between the functional areas of marketing and operations. They accomplish this by aligning them to the firm's corporate strategy (Jose Zanon *et al.*, 2013; Slack and Lewis, 2002). A performance perspective is one of the critical dimensions of alignment with the corporate strategy (Sombultawee and Boon-itt, 2020; Sombultawee and Boon-Itt, 2018) and is necessary to link the consumer confusion consequences to financial and non-financial expressions for the firm. Thus, the basis for the link is the identification of relevant performance measures quantifying and indicating progress (Melnyk *et al.*, 2014; Neely *et al.*, 1995).

Table 13: *Design requirements*

#	Design Requirement
DR1	The artefact is required to provide a representation of the alignment between strategic assortment decisions and the consumer confusion concept from a channel switching behaviour perspective.
DR2	The artefact is required to provide a representation of all relevant concepts and relations from the omnichannel assortment knowledge domain.
DR3	The artefact is required to provide a representation of all relevant concepts and relations from the consumer confusion knowledge domain.
DR4	The artefact is required to provide a representation of all relevant concepts and relations from the channel switching behaviour knowledge domain.
DR5	The artefact is required to identify which component of the MOI framework the concepts are associated with.
DR6	The artefact is required to provide a link of the alignment between strategic assortment decisions and consumer confusion to the corporate strategy at the MOI from a performance perspective.

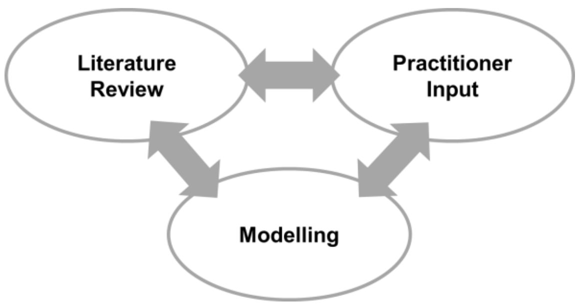
Inefficacy of Current Solutions

In view of the research problem and the derived DRs above, existing solutions do not provide the features required to address the problem adequately as discussed in Section 2.7. For example, the series of experiments conducted by Bertrandie and Zielke (2017) covers the relationship between assortment integration types with the consumer confusion phenomenon. However, a channel switching point of view is not incorporated nor does the study involve empirical data from either side (consumer or retailer). Additionally, the work is not intended to be comprehensive in capturing all confusion dimensions evident by considering a cognitive and affective perspective but neglecting a conative dimension in the research model. Lastly, the research intent aims at explanatory outcomes rather than the provision of a prescriptive knowledge output aiming at solving a specific problem. The research is part of the dissertation of Bertrandie (2020). Another component of her dissertation and published by Bertrandie and Zielke view the consumer confusion issue from a pricing integration perspective (Bertrandie and Zielke, 2019). The research design is similar to the previous work (2017) adopting a series of experiments, thus entailing the same limitations as the previous study. In terms of other works, they merely cover the confusion phenomenon from a discussion point of view, e.g., in the course of literature reviews (e.g., Neslin, 2022; Rooderkerk and Kök, 2019; Zhang *et al.*, 2010) or from an information overload perspective only (e.g., Garaus, 2018; Li, 2017; Özkan and Tolon, 2015).

3.5.3 Phase: Design and Development

The design and development phase constitutes the very essence of the design science research methodology. Next to the general approach applied for conducting this phase (Information Gathering and Modelling Framework, a method that reciprocally influences literature review, practitioner inputs, and modelling activities, **Figure 25**), major aspects here are represented by the role of justificatory knowledge in making design decisions, the representation of the alignment of the concepts through an ontology and ontology engineering. In the following, each aspect is described in detail.

Figure 25: *Main activities for information gathering and modelling (adapted from Ostrowski et al., 2014)*



The Role of Justificatory Knowledge in Design Decisions

Justificatory knowledge, also referred to as “Kernel Theories” (Walls *et al.*, 1992) or “Reference Theories” (Gregor and Hevner, 2013) is the body of knowledge encompassing those concepts, constructs, and theories that can inform design decisions on the elements and mechanisms that justify the proposed design intent. They can explain why the designed solution has certain features and why it works. Justificatory knowledge can be of descriptive or explanatory nature and is therefore usually provided by contributions from the natural and social sciences (Gregor and Hevner, 2013). For example, the description of the types of channel switching behaviour ("show"- and "webrooming", e.g., Kang, 2018, Section 2.6.1) can justify the incorporation of both concepts in the construction of e.g., a CRM system for omnichannel retailing that aims at attributing consumer profiles with a certain channel switching behaviour characteristic. Another example is the differentiation between financial and non-financial performance measures in retailing (Cakir et al., 2019) which can inform how to generally classify retail performance outputs in a scorecard model. However, the justification can also stem from knowledge retrieved from organisations and the experience of practitioners (e.g., knowledge externalised through interviews, customer surveys, sales data, or simple observations) and the situational problem domain in general (Gregor and Jones, 2007). The utilisation of justificatory knowledge in the design and development phase of a DSR project embodies the interplay between knowledge from behavioural and problem-oriented intention in DS. In view of the RQs of this study, Sub-RQ1 represents the retrieval of justificatory descriptive knowledge on the required *concepts* and constructs for the design and development phase, whereas Sub-RQ2 reflects the justificatory explanatory knowledge on the required theories and mechanisms that provide the rationale and explanation on how to *relate* those concepts and constructs to each other so that an integrated view is realised. This research is informed by justificatory knowledge from the domains of omnichannel assortment, consumer confusion, channel switching behaviour, and retail performance.

Representing the Alignment between Strategic Assortment Decisions and the Consumer Confusion Concept

The notion of alignment for this research is understood as "*... the degree to which the needs, demands, goals, objectives and/or structures of one component are consistent with the needs, demands, goals, objectives, and/or structures of another component.*" (Nadler, 1983, p. 119.). Hereby, the emphasis lies on the structure with its elements. Considering the intention of representing the knowledge of alignment, a need for adequate technique arises. It appears plausible to use a *knowledge representation* technique that meets these requirements. Knowledge representation refers to the discipline to capture the meaning of concepts, properties, and relationships of specific knowledge domains. Oftentimes individuals and organisations possess varying requirements and context on the same subject matter leading to a lack of a shared understanding of a specific domain (Uschold and

Gruninger, 1996). Ontologies as a way of representing knowledge can help to overcome this shortcoming (Mika and Akkermans, 2004).

Design of an Ontology as the Technique of Choice for Alignment Representation

An *ontology* represents a valid and appropriate representation technique for knowledge. Ontologies are explicit and formal specifications of shared conceptualisations (Borst *et al.*, 1997; Gruber, 1993) that can help to (1) share and structure a common understanding of the information of a specific domain, (2) allow the reuse of domain knowledge, (3) explicate domain assumptions, and (4) analyse domain knowledge (Noy and McGuiness, 2001). Based on these characteristics, an ontology developed in this research would provide an explicit and formal representation of the domain knowledge relevant to capturing omnichannel assortment, consumer confusion, its consequences, and channel switching behaviour which can be exchanged between domain experts. It is important to differentiate between ontologies as understood in the philosophical discipline (Section 3.4.1) and ontology artefacts understood as shared conceptualisations used within this research. One of the well-known works adopting an ontology approach in business and IS research is the Business Model Ontology developed by Osterwalder (2004) which evolved to the popular Business Model Canvas framework (Osterwalder and Pigneur, 2010) with a wide and successful application in the business domain today. Moreover, different ontologies have been used in retailing research so far (e.g., Madsen, 2021; Madsen and Petermans, 2020; Pal, 2018; Wally *et al.*, 2015; Davou and Idrus, 2013; Becker *et al.*, 2008). It is essential for the use of ontologies that the right concepts of interest and their relations are captured. The construction of the ontology, therefore, requires systematic guidance on how the design and development phase can be executed in a valid and reliable way. This is undergone through ontology engineering.

Ontology Engineering

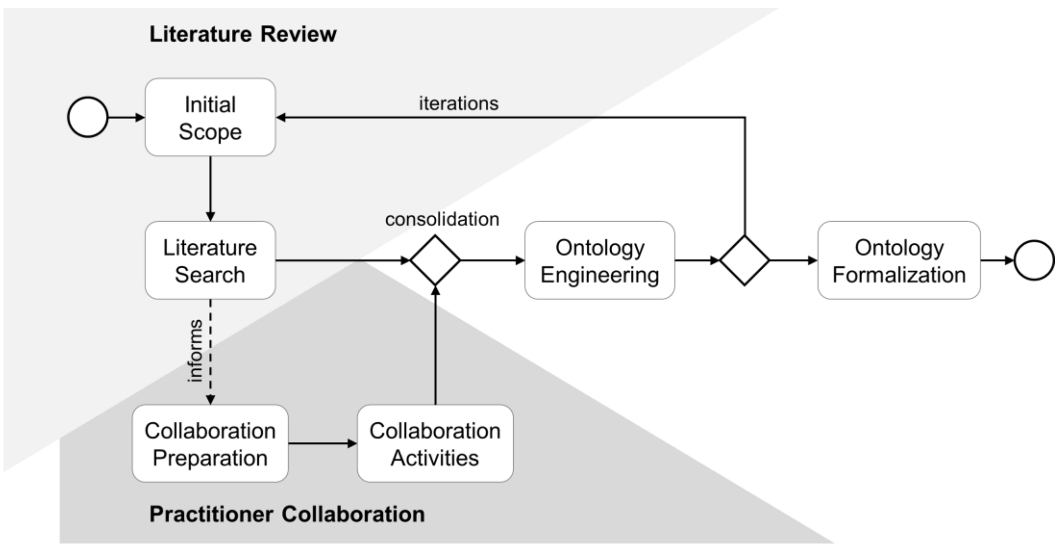
The design and development of the sought artefact demand the application of an appropriate *Ontology Engineering* method. Ontology engineering represents the systematic method of the construction of an ontology (Fernández-López, 1999). Following Helfert *et al.* (2012) and Ostrowski *et al.* (2014), the design and development activities are effectively guided by the *Information Gathering and Modelling Reference Framework* and substantiated by its three main activities (1) Literature Review, (2) Practitioner Collaboration, and (3) Information Modelling. Helfert *et al.* (2012) argue that these tasks form the core design activities suitable for the design and development phase in DSR projects. The information-gathering step is related to answering Sub-RQ1, whereas Sub-

RQ2 relates to the modelling step of the framework. The method entails an ontology engineering process and thus effectively links the design and development phase of the methodology with a modelling technique aiming at constructing the desired artefact. Moreover, Sub-RQ2 relates to semantic normalisation where heterogenous knowledge pieces that are related to each other are clustered (Mika and Akkermans, 2004).

The Information Gathering and Modelling Reference Framework

The framework provides two distinctive processes (referred to as "source processes") aiming at collecting, analysing, and consolidating information on the research objectives (a simplified version that is based on Ostrowski *et al.*'s framework (2014) is provided in **Figure 26**). These two processes are represented by a *literature review* and *practitioner collaboration* activity. Each activity results in its own findings first but is analysed and consolidated thereafter. The combined data from both source processes form the knowledge base in a comprehensive and representable way for domain experts – this is conducted through a third activity: *Information Modelling* (IM). In this research, IM is undergone through the application of Ontology Engineering (Section 4.3). The knowledge base (ontology) serves as a knowledge repository of structured information capturing the concepts and their relations necessary for the alignment of strategic assortment decisions, consumer confusion, its consequences, and channel switching behaviour. The framework is in line with the engaged scholarship approach as proposed by Van de Ven (2007) which underlines the participative character with practitioners for knowledge retrieval.

Figure 26: *Information Gathering and Modelling Reference Framework (based on Ostrowski et al., 2014)*



Source Process 1 – Literature Review

The literature review activity gives account to the necessity of collecting and analysing the existing relevant literature on the research objective (initial scope development, search for materials). It is crucial to review relevant studies that support answering Sub-RQ1. The systematic approach is mainly served by the insights generated by the SLR conducted and described in Chapter 2. On the basis of 169 articles screened and analysed, the outcome of this sourcing process is composed of the concepts and constructs of the domains "omnichannel assortment", "consumer confusion in retailing", "consumer confusion consequences", and "channel switching behaviour" that are merged to form the literature-based ontology on omnichannel assortment integration and consumer confusion. For formalisation and visualisation purposes, *Protégé*, a knowledge management software for ontologies that is widely used (Gennari *et al.*, 2003) is utilised in its latest desktop version 5.5.0 (Stanford University, 2019), effectively representing the consolidated knowledge as required to answer Sub-RQ2.

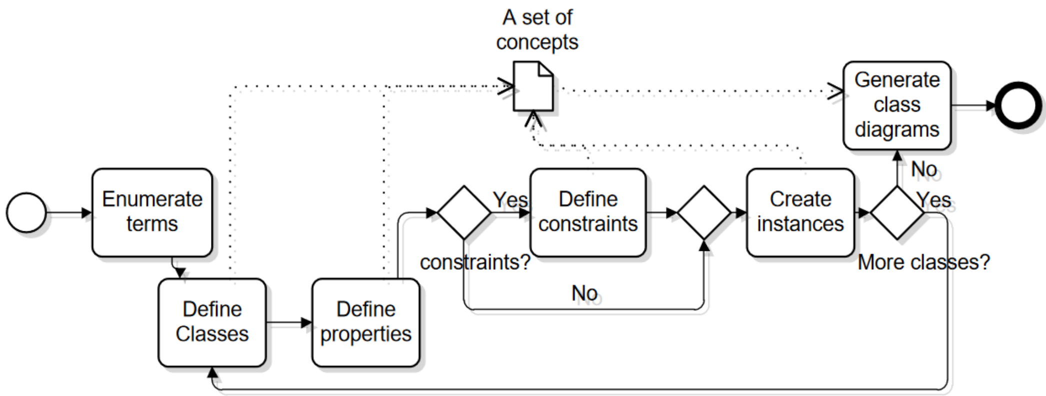
Sources Process 2 – Practitioner Collaboration

The idea of sourcing information from practitioners lies in the fact that practitioners possess expertise and knowledge based on their experience and interaction within the problem domain therefore potentially relevant and invaluable for the research. Based on a collaborative engagement, an industry perspective on the problem space and an agreement on the information base are pursued. The relation between source processes 1 and 2 is given through the fact that the outcome of the former can be utilised to prepare for the sourcing process of the latter. However, it should be noted that the collaboration with the industry partner should be treated as unbiased and open-minded and thus any biasing elements disclosed in the engagement. This assumption gives the sourcing process a minor sequential character in the initial iteration. The collaboration is organised along a collaboration engineering approach that helps to structure the engagement with the practitioner in a systematic way. The collaboration for this inquiry is framed within a case study approach with focus groups and interviews as data collection methods (Section 4.2.1). The outcome is represented by practitioner-informed knowledge of strategic assortment decisions aligned to consumer confusion from a channel switching perspective, constructed and visualised as an ontology via Protégé.

Information Modelling

The modelling step constitutes the actual construction activity and is represented by ontology engineering. Ontology engineering is the process of architecting an ontology representing the relevant knowledge of the problem domain of interest considering specific semantics. Generally, an ontology shows how the relevant field of knowledge is configured and that this knowledge reflects shared conceptualisations to be used (Mizoguchi, 2003; Gruber, 1993). The goal is the provision and representation of all relevant concepts and their relations as required by the research objectives and scope. This research follows the adapted ontology engineering process by Helfert *et al.* (2012), and Ostrowski *et al.* (2014) which is based on the work of Noy and Tu (2003) (**Figure 27**) but also provides additional details regarding the decisions along the construction steps made (domain and scope, retrieval of terms, class hierarchy development, properties, and instances).

Figure 27: *Ontology engineering process (source: Ostrowski et al., 2014)*



The process starts with the (1) *enumeration of relevant terms*, that is the collection of all associated descriptions and names in the domain. In this research, the collection of all terms is a result of the combination of a list from the practitioner and literature side. The terms are translated into “classes” that represent the concepts of the domains (Noy and McGuiness, 2001). During this process, terms with synonyms (e.g., “channel hopping” synonym for “channel switching” or “emotional” for “affective”) are consolidated into one term that is represented and most established in the relevant research domain. Noy and McGuiness (2001) suggest answering four questions to determine the domain and scope of the ontology. The first question asks for the *domain* to be covered, followed by the question *about what the ontology is going to be used for*. The third question is *for what types of questions the information in the ontology should provide answers to*. The final question concerns the ontology user and asks *who will use and maintain the ontology*. For this research, the domain is the knowledgebase of the intersection between strategic assortment decisions, consumer confusion, its consequences, and channel switching behaviour. The purpose is the representation of the alignment between these domains in order to provide informational assistance for decision-makers responsible for strategic assortment decisions at the MOI in omnichannel retailing. The ontology is supposed to answer questions on the concepts (e.g., "What are the short-time consequences of consumer confusion?") and relational questions such as "What is the relation between concept X and concept Y?". Domain experts from practice (decision-makers in strategic assortment decisions at the MOI in omnichannel retailing) as well as from academia (researchers in the domain of omnichannel assortment and consumer confusion) are the relevant target group making use of the ontology. After the domain scope is determined, the next step involves the (2) *definition of a class hierarchy*. Here, the terms are grouped into concepts that are organised into a superclass-subclass hierarchy with the rule of inheritance prescribing:

"*If class A is a superclass of class B, then every instance of B is also an instance of A*" (Noy and McGuiness, 2001, p. 8).

For example, "Assortment Coordination" is a superclass of "Assortment Integration Type", prescribing that every instance of "Assortment Integration Type", e.g., "Full Assortment Integration" is also an instance of "Assortment Coordination". Three approaches can be applied to define the class hierarchy (Uschold and Gruninger, 1996): a top-down approach (from general to specialised concepts), a bottom-up approach (from specific to general concepts), and a combined approach (definition of most prominent concepts first to generalise/specialise as deemed appropriate after). For this research, the combined approach is applied due to the prominence of certain terms that serve as a starting point for the class hierarchy (e.g., "channel switching as a subclass of "Omnichannel Customer Journey"). Following the development of the class hierarchy, (3) *properties* and (4) *constraints* are defined and assigned to each class. However, not every class possesses explicit properties (Noy and McGuiness, 2001). Lastly, (5) *instances* of those properties are created allowing capturing different potential instantiations of the classes and providing examples. Properties (attributes) are used to describe the internal structure and relations of a class that are inherited by the subclasses (Noy and McGuiness, 2001). For example, subclass "Asymmetric Integration Type" is characterised by the property "Integration Type" with the three possible values "Type A", "Type B", and "Type C" (string type). These values describe the different expressions an asymmetric assortment integration type can possess ("facets of properties", Noy and McGuiness, 2001). Constraints address the range of values for a property, e.g., the “Degree of Assortment Overlap” is set to have a %-value between 0 and 100 for its property “degree” (integer type). The former example is set to have a limit of three possible expressions for asymmetrical assortment integration. Not every property needs to be assigned constraints though. Instances represent individual expressions of the possible attributes and characterise a “case”. For example, an omnichannel retailer coordinates its assortment across channels through decisions on the assortment integration level by deciding on the degree of assortment overlap with 64%.

For visualisation and formalisation purposes, the ontology is represented by a class diagram.

In the course of the design and development phase, three different ontologies will be generated throughout the information-gathering and modelling activities. During the ontology engineering process, several design iterations are conducted based on the data collection sequence (Section 4.2.1). Applied data collection methods are two focus groups, five expert interviews, and observations.

Formalisation of Knowledge

Formalisation is the process of ensuring that the produced design knowledge can be shared and reused within the research community or practice by using a formal representation (Mika and Akkermans, 2004). It ensures that the outcome is free of ambiguity and allows for replication. For this research, the representation and formalisation are done via the OWL language visualised with Protégé. OWL (Web Ontology Language) is a standardised knowledge representation language suitable for representing ontologies (W3C, 2012) that are built on the basis of RDF (Resource Description Framework) (W3C, 1999).

3.5.4 Phase: Demonstration

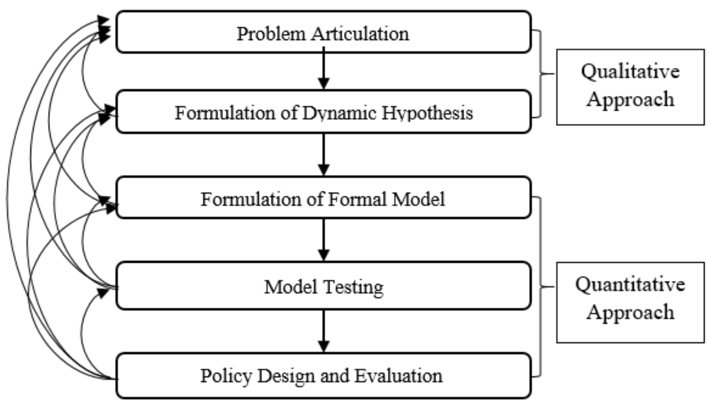
For demonstration and evaluation purposes, the omnichannel assortment ontology for consumer confusion is instantiated through a system dynamics model that is based on a retailer case study of a retail company with a different organisational context. The procedure for the demonstration and the evaluation strategy is presented in Chapter 5 and 6. The aim is to prove how well the artefact shows its fitness in meeting the goodness criteria (as defined in Section 1.3) in a real-life case (e.g., Peffers *et al.*, 2012). For this, System Dynamics (SD) modelling is utilised. SD represents a simulation technique able to assist decision-makers in grasping the behaviour of complex systems over time. It allows testing and assessment outcomes of system interventions (Sterman, 2010). It also accounts for complex loop effects to capture reinforcing or balancing changes of value over time.

SD is an established method utilised in the field of management and engineering. However, the construction of the SD model with variables and linkages requires relevant domain knowledge encompassing relevant concepts and their relations addressed in the model problem. The following describes the key characteristics and steps of SD development.

System Dynamics Modelling

Originally developed to understand and study complex non-linear systems and feedback control in the fields of engineering and science, SD is applied widely in different disciplines today. Especially in management and information systems, SD has been established as a vital method to represent complex systems and assess dynamic behaviour over time in order to assist decision-makers (Sterman, 2010). Various modelling steps have been introduced in the literature that provide guidance on how to develop an SD model (e.g., Akkermans and Van Oorschot, 2018; Sterman, 2010; Richardson and Pugh, 1997; Roberts *et al.*, 1997; Wolstenholme, 1990). Following Sterman's (2010) method as the most established and widely used process, the development of an SD model is undergone through five major steps, starting from (1) Problem Articulation, (2) Dynamic Hypothesis Formulation, (3) Simulation Model Formulation, (4) Model Testing, and (5) Policy Design and Evaluation, covering a whole process from the identification of the problem boundaries to the development of policies.

Figure 28: *System Dynamics Modelling steps (based on Sterman, 2010, and Akkermans and Van Oorschot, 2018)*



The process is characterised by possible iterations after each step ensuring the refinement of the model. Akkermans and Van Oorschot (2018) suggest a two-step approach for SD modelling, distinguishing the sequential steps through a qualitative and quantitative component. Beginning with the qualitative stage, the main goal is to elicit mental models from the decision-makers to construct the perceived relationships between relevant constructs and develop causal loop diagrams (Cakir, 2020). Stage 2, the quantitative stage, is represented by the formalisation of the model and testing using company data (Akkermans and Van Oorschot, 2018). Akkermans and Van Oorschot's modelling approach corresponds to Sterman's approach but reflects a less structured modelling process with fewer steps. However, both processes and their steps follow the same main goals of SD and can be mapped to each other (**Figure 28**).

Process of the Artefact Instantiation through SD Modelling

Based on the problem identified within the case study context, the static view of the ontology is converted into a dynamic model through the mapping of the concepts and their relationships in steps (1) and (2). In step (3), the model is formalised into a simulation model. The formalisation of the SD model is undergone via the use of the Software Vensim® PLE in version 9.3.2 (Ventana Systems, 2022). Steps (4) and (5) are outside of the scope of the demonstration phase and are subject to be followed independently from the thesis.

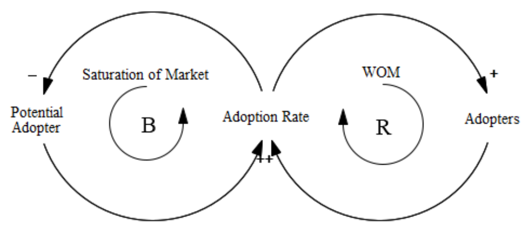
1. Articulating the Problem

The first step defines the problem of interest. According to Sterman, a clear purpose is the most crucial element for a successful modelling undertaking (Sterman, 2010). The scope and boundary of the problem should provide the criteria for what to cut out and what to consider in the model. This means relevant concepts and variables should be identified accordingly. Specifying the time horizon is the second critical characteristic to consider while framing the dynamic problem. Dependent on the problem context, a time horizon of days, months, weeks, and years are typical in retail contexts. In the case study, a time horizon encompassing a 12-month cycle is used since it represents a typical financial year of a retail company.

2. Formulating a Dynamic Hypothesis

The activity on the development of the dynamic hypothesis is the process of developing a conceptual model that describes the problem behaviour considering its dynamic nature. This is the phase where relevant concepts and relations from the ontology are introduced into the model, representing causal relationships and other associations. Mental models play a substantial role in providing the rationale and elements of the conceptual model. For communication and visualisation purposes, the dynamic system can typically be represented by causal loop diagrams (CLD) and stock and flow diagrams (SFD). CLDs explicitly represent causal links among variables (arrows). They emphasise the feedback structure of the system and follow specific conventions. Variables are connected via arrows indicating the causal link, the direction and the polarity of the influence (positive (+) or negative (-)). This visualisation represents the typical causal mechanism between dependent and independent variables. Moreover, CLDs entail *loops* which account for the feedback effect between variables. Two different types of loops can be distinguished by loop identifiers (circulating arrow, clock- or counter-clockwise) that are positioned in the corresponding feedback circle: a positive loop (reinforcing, labelled with the letter "R"), or a negative loop (balancing, labelled with the letter "B"). A simple CLD is shown in **Figure 29**. It demonstrates two loop effects. The first one (reinforcing) shows that the variable "Adoption rate" increases the number of the variable "Adopters" which again increases the "Adoption rate", labelling the loop "Word of mouth" (WOM), that is, the more adopters speak positive about the product, the higher the adoption rate. However, the second loop, a balancing one, acts in the opposite direction by decreasing the pool of potential adopters with each increase in the "Adopter" variable. "Potential adopters" serve as a supply of adopters.

Figure 29: *Example of a Causal Loop Diagram (source: own illustration)*



SFDs focus on the physical structure of CLDs and account for accumulations in stocks (such as product inventory or assortment size) and flows (the rate of increase or decrease in stocks, e.g., investments, expenditure). The mathematical representation for the stock-flow mechanism corresponds to the following (1) integral and (2) differential equations (Sterman, 2010):

$$Stock(t) = \int_{t_0}^{t} [Inflow(s) - Outflow(s)]ds + Stock(t_0) \quad (1)$$

With

- *Stock(t)* = state of the stock at time t
- *Stock(t_0)* = state of the stock at time 0 (initial stock level)
- *Inflow(s)* = inflow / increase of stock at any time s
- *Outflow(s)* = outflow / decrease of stock at any time s

Consequently, the net rate of the stock change (derivative) can be expressed by:

$$\frac{d(Stock)}{dt} = Net\ Change\ in\ Stock = Inflow(t) - Outflow(t) \tag{2}$$

Mathematical equations for balancing and reinforcing loops can be expressed followingly (based on Sterman, 2010):

- Reinforcing Loop:

$$Y = \int_{t_0}^{t} (X + \cdots)dt + Y_{t_0} \tag{3}$$

- Balancing Loop:

$$Y = \int_{t_0}^{t} (-X + \cdots)dt + Y_{t_0} \tag{4}$$

With

- *Y* = dependent variable Y (e.g., "sales")
- *X* = independent variable X (e.g., "marketing expenditure")
- t, t_0 = time, at time 0
- Yt_0 = initial stock level at time 0
- if *X* increases (decreases), e.g., "expenditure in marketing", then *Y* increases (decreases), e.g., "sales" // in the case of accumulations, *X* adds to (subtracts from) *Y*

The demonstration will utilise CLDs for step 2 and SFDs for step 3.

3. Developing the Simulation Model

This activity is dedicated to the testing of the dynamic hypothesis and involves translating the conceptual model into a formal system with specified equations and parameters (formalizing the conceptual model). A quantitative representation of the model is the result. For this, Vensim® PLE, a software for SD modelling is utilised (Ventana Systems, 2022).

4. / 5. Testing and Policy Design

Testing and Policy Design is the activity of the refinement and formulation of decision rules for the model. However, both steps are not part of the demonstration and evaluation activity of the instantiation since they represent tasks outside of the research scope.

Suitability of Ontologies Informing System Dynamics Modelling

Ontologies are suitable reference frameworks informing the development of SD models as demonstrated by various studies. For instance, Hajiheydari and Zarei (2013) refer to the well-known Business Model Ontology developed by Osterwalder (2004) in order to retrieve information for the construction of a stock and flow diagram representing a dynamic business model system of a case study company. Variables and behaviour are informed by the nine building blocks for business modelling (Value Proposition, Target customer, Distribution channel, Relationship, Value configuration, Core competency, Partner network, Cost Structure, and Revenue model) and the business logic of the case company. The authors use Vensim® PLE for formalisation and simulation purposes. Similarly, Moradi *et al.* (2019) refer to an ontology embodying quality compliance checking mechanisms for urban private constructions in Iran (Moradi *et al.*, 2018) in order to identify relevant terms that constitute the intended CLD design, along with relations and axioms. The authors first develop a descriptive model consisting of the relevant variables and relations representing critical mechanisms which subsequently are translated into a CLD. Earlier studies such as from Church *et al.* (2007) on managerial planning and control or Loucopoulos and Prekas (2003) on requirements engineering follow similar approaches in utilising ontologies for SDM.

System Dynamics Case Study of this Research

One retailer has been approached and invited to address their challenge of tackling the alignment problem between omnichannel assortment decisions and the consumer confusion phenomenon at the MOI. The retailer confirms to experience the phenomenon and seeks guidance on how to capture relevant variables to assess the impact of consumer confusion while deciding on strategic assortment decisions in a specific problem case (Section 5.2.1), thus providing an ideal case for the application of the ontology to demonstrate how knowledge from the ontology can be retrieved and used in an SD model aimed at solving a problem located at the MOI. Within this process, the ontology serves as a knowledge reference to inform the construction of the SD model.

A case study proves to be suitable for the sourcing of data in the course of SD modelling (Dhirasasna and Sahin, 2019; Akkermans and Van Oorschot, 2018; Sterman, 2010; Luna-Reyes and Andersen, 2003). By interviewing all relevant actors in the system (also touching multiple levels and tapping outside the boundary of an organisation, e.g., customers) rich data can be generated. At the same time, interviews, especially, semi-structured interviews prove as a viable method for externalising mental models and extracting causal structures for the models.

System Dynamics and Design Science Research

SD has been an established modelling approach within the DSRM. Various studies utilise SD in the design & development but also in the evaluation stage of DS projects (e.g., Herrera *et al.*, 2021; Nitsche *et al.* 2021; Akkermans *et al.*, 2019; Möllers *et al.*, 2017). The studies argue the strong suitability of SD modelling in a DS research context since it reflects the nature of DS: "*... a simulation modeling approach that focuses on the dynamic and reciprocal interaction of variables over time, SD appears to have a special capability to bridge the different knowledge and causality concepts of science and design.*" (Akkermans and Romme, 2003, p. 7).

3.5.5 Phase: Evaluation

The evaluation of the artefact is conducted based on an evaluation strategy conceptualised following the evaluation framework by Sonnenberg and vom Brocke (2012). The framework proposes four evaluation activities ("EVAL1" to "EVAL4") conducted along the DS cycles and differentiated by "ex-ante evaluation" and "ex-post evaluation" phases from a timing perspective. Ex-ante evaluation is executed before the construction of the artefact (e.g., design specifications only), whereas ex-post evaluation is undergone after the artefact is constructed (Sonnenberg and vom Brocke, 2012; Venable *et al.*, 2012; Pries-Heje *et al.*, 2008). Chapter 6 provides a detailed outline of the evaluation strategy, evaluation steps, evaluation criteria, evaluation methods, and evaluation results.

3.5.6 Phase: Communication

As a crucial part of a DS project, communication is essential to disseminate aspects of the project within the wider research community (Gregor and Hevner, 2013). For this research, different means of dissemination activities have been used while progressing along the DS phases. Next to scientific publications, research components have also been presented at conferences, at practitioner workshops, addressed at discussions and shared on various social media channels. The targeted audiences are predominantly positioned within the retail, management, and IS disciplines.

3.5.7 Utilisation of Case Studies within the Design Science Project

Section 3.4.1 elaborates on the philosophical grounding of this research and the rationale for the adoption of a pragmatist view. A research project grounded in a pragmatist view is predominantly concerned with focusing on the utility, usefulness, and contribution to practice (Goldkuhl, 2012) – independent from the particular ontological or epistemological approach. This means that methodological concepts and theories are only relevant where purposeful action is supported (Kelemen and Rumens, 2008). This is consistent with the methodological requirements of this study (Section 3.3). Therefore, multiple methods are oftentimes possible and appropriate within one study (Saunders *et al.*, 2016). This DSR adopts case studies (Yin, 2017) within (1) the design and development, and (2) the demonstration and evaluation phase reflecting the pragmatist's view from a multi-method perspective applied in the DSRM (Section 3.4.3). Case studies are particularly suitable for providing a real-world context for the application and ex-post evaluation of the artefact (Peffers *et al.*, 2012; Venable *et al.*, 2012; Hevner *et al.*, 2008). However, the use of case studies can also be very valuable in the design and development phase / ex-ante evaluation (Costa *et al.*, 2016).

Single Case Study Approach in the Design & Development Phase

As part of the Information Gathering and Modelling process in the design and development phase, a holistic single case study (Yin, 2017) is applied to frame and capture the context and the collaborative activities with practice. A single case study was selected since the quality of the extracted data from single cases tends to be richer and thus superior to multiple cases (Yin, 2017; Siggelkow, 2007; Dyer Jr. and Wilkins, 1991; Eisenhardt, 1991). The organisation for this study is represented by a medium-sized omnichannel retailer experiencing the phenomenon of consumer confusion while adopting an assortment integration type C. The engagement with the retailer lasted for several months effectively characterising the case study type as being of *longitudinal* nature (Yin, 2017). Three different points in time have been occasions where data collection was conducted (although changes between the points in time are not the focus of the study). Moreover, the case qualifies as a *critical case* since the opportunity to collaborate with the company and the situational context is considered unique (Yin, 2017). The data collection techniques are represented by focus groups and interviews with a total of five different individuals from the top and middle management (Section 4.2.1). Moreover, observational data has been collected for triangulation purposes (Yin, 2017; Runeson and Höst, 2009). A case study protocol is utilised to guide the data collection throughout the collaboration (Yin, 2017).

Single Case Study Approach in the Demonstration Phase

A separate case study is used in the course of the demonstration step of this research to instantiate the artefact in a real-world context. The case study offers a different context to prove the utility of the artefact under different conditions. For data collection, semi-structured interviews are the primary source for knowledge retrieval in the case study. A case study protocol is utilised to guide the data collection throughout the demonstration phase (Yin, 2017).

3.6 Validity and Reliability

Research validity and reliability are two critical aspects addressing the rigour of research. In general, *validity* refers to the quality of the research process and the trustworthiness of the research findings (Gilbert *et al.*, 1998), and is defined as the degree to which results are interpreted in an accurate way, whereas *reliability* addresses the quality of the repeatability of the methods and techniques utilised to replicate the same findings (Creswell and Poth, 2016). Validity is an important and applicable aspect in DSR projects (e.g., vom Brocke *et al.*, 2020; Larsen *et al.*, 2020; Lukyanenko *et al.*, 2014) and is predominantly addressed through the evaluation activities (Venable *et al.*, 2016; Dresch *et al.*, 2015). However, the case study approach plays a significant role in this research with applications in two distinct phases where data collection is carried out (design and development, evaluation phase). Therefore, in addition to the evaluation activities, additional validity and reliability checks for case study applications are adopted for this research. Based on the works of Cook and Campbell (1976) and Campbell and Cook (1979), Eisenhardt (1989), Yin (1994), Yin (2017) and Gibbert *et al.* (2008) provide arguably the most established framework for validity and reliability measures within the case study research. The validity of case study research can typically be addressed through the three dimensions of *construct validity*, *internal*, and *external validity*.

Construct Validity

Within the research process, construct validity refers to the quality of how well a relevant concept is operationalised and is therefore particularly important in the data collection phase (Denzin and Lincoln, 2008; Gibbert *et al.*, 2008). In other words, construct validity captures to what extent the study is able "to investigate what it claims to investigate" while avoiding subjectivity. It is therefore important to eliminate any influence of subjectivity in the data collection procedure in case study research (Yin, 2017). Traditionally, construct validity stems from an experimental demonstration of how well a construct is measuring what it claims to measure (Brown, 2000). Means to ensure construct validity are the consideration of *multiple sources for evidence* (adoption of different angles to view the case context by utilising different data collection methods and sources), establishing a *chain of evidence* (demonstrating a clear path from the research questions to the conclusions so the reader can reconstruct the process), and *reviewing case study reports by key informants* (to confirm findings and conclusions from the data collection by key participants that inform the case study) (Yin, 2017; Gibbert *et al.*, 2008). This research adopts all three measures to ensure construct validity since all three measures are applicable based on the case study application.

Internal Validity

Internal validity refers to the causal relationships of variables and addresses to what extent the researcher is able to provide plausible causal arguments that defend the research findings (Yin, 2017; Gibbert *et al.*, 2008). Although internal validity is a critical validity dimension in explanatory research only based on inferences, it can also be addressed within case study research to some extent in the data analysis phase through inference-making of events that supposedly result from non-observable events (theory building) (Yin, 2017). For this, Yin (2017) advises applying *pattern matching/explanation building* (matching patterns to alternative ones reported by other authors or predicted ones, building an explanation based on the case data, similar to "theory triangulation" as proposed by Gibbert *et al.* (2008), consideration of *rival explanations* (in order to consider alternative influences based on alternative explanations while making inferences), or the use of *logic models* (a complex form of pattern matching with several cause-effect chains). Although the key intent of the case study adoption within this research is focussed on knowledge retrieval from practitioners instead of theory building, inferences play also a role in the abductive process when encountering novel insights from the case data (concepts, relations, properties of concepts) that require explanation. On top of Yin's propositions, Gibbert *et al.* (2018) suggest outlining a *clear research framework* that explains variable relations. This is in line with the concept of the "kernel theory" within DS (e.g., Gregor and Hevner, 2013). While a clear research framework serves as a reference for explanations within the case study context, kernel theories (or justificatory knowledge) represent those concepts and theories that can inform design decisions on the elements and mechanisms that justify the proposed design intent. They can explain why the designed solution has certain features and why it works (Section 3.5.3). These kernel theories are utilised and presented throughout the design and development phase. For this reason, the concept of showing a clear research framework and pattern matching is adopted for internal validity measures.

External Validity

External validity (synonymous with "generalisability") indicates whether the research findings are generalisable beyond the setting they are grounded on (Yin, 2017; Gibbert *et al.*, 2008). In contrast to *statistical generalisation* where conclusions about a population are made based on inferences, qualitative research in general and case study research in particular address the issue of generalisation based on *analytical generalisation* (Yin, 2017). Analytical generalisation concerns the generalisation from empirical observations to theory instead of a population (Yin, 2017). To achieve generalisability, it is recommended to either apply *cross-case analysis* (Eisenhardt, 1989) on the basis of a multiple-case approach (replication logic, Yin, 2017) or to *use theory* in a single case study approach (Yin, 2017). Generalisability in DS is concerned with the utility of the produced artefact (design knowledge) in other problem contexts (Venable, 2006), and can be referred to as its "projectability". An artefact is *projectable* to new research contexts and goals that ground on the context and goals of the original research project(s) (Baskerville and Pries-Heje, 2019; Baskerville and Pries-Heje, 2014) and can be characterised as low in the case when the original work grounds on a very specific context allowing restricted reuse or high when more general applications of the artefact are supported (vom Brocke *et al.*, 2020). As this research seeks to develop a design entity entailing design knowledge subject for projectability, this research adopts an analytical generalisation for design knowledge projectability as a measure for ensuring external validity. The projectability is addressed through the demonstration of the final artefact which is based on a different problem context (Section 3.5.4). Moreover, the *formalisation* of the design knowledge via the use of Protégé ensures a common language for ideal reuse and distribution within the research and practice community.

Reliability

Reliability is concerned with the ability to produce the same results and conclusions when the research is conducted again later by a different researcher. Therefore, the goal is to reduce errors and bias in the study, as well as increase transparency and replicability by documenting each procedure and technique applied in the research process (Yin, 2017; Gibbert *et al.*, 2008). A major tool to ensure reliability in case study research is the use of a *case study protocol* to make each step explicit as well as the use of a *case study database* that collects all relevant materials relevant for the conduction of the case study research (Yin, 2017; Gibbert *et al.*, 2008). In the context of DSR, reliability should especially be evident through the documentation and explication of design decisions in the course of the design and development phase. For this research, reliability is ensured through the utilisation of a systematic approach in the literature review process (Section 2.3), the use of case study protocols (ensuring replication of the data collection procedures), the maintenance of case study databases (secure storage of original case study data), the use of guides in the data collection phases (question routes, interview guides, observation guide), the transparent processing of transcript data (via the NVivo software, template and thematic analysis approaches), and the explicit documentation of design decisions in the design and development phase. Lastly, the seminal work of Hevner *et al.* (2008) provides a set of guidelines that are denoting the notion of understanding, execution, and evaluation in DS research. The guidelines are reflected in the DSR design for this study to further support its reliability (**Appendix B**). The decisions on addressing the validity dimensions and reliability of this research are summarised in **Table 14**.

Table 14: *Summary of validity and reliability measures of this research*

Aspect	Description	Measures adopted for this research
Construct Validity	How well is the study investigating what it claims to investigate?	• Multiple sources of evidence (Yin, 2017; Yardley, 2015; Patton, 2014) • Chain of evidence (Yin, 2017) • Review of case reports by informants (Yin, 2017)
Internal Validity	How well is the research able to provide plausible causal arguments that defend the research findings?	• Use of pattern matching / explanation building and a clear research framework (Yin, 2017) • Kernel theories (Gregor and Hevner, 2013)
External Validity	How well are the research findings generalisable beyond the setting they are grounded on?	• Analytical generalisation (Yin, 2017) • Demonstration (Peffers *et al.*, 2007) for design knowledge projectability (vom Brocke *et al.*, 2020; Baskerville and Pries-Heje, 2019; Baskerville and Pries-Heje, 2014) • Formalisation of design knowledge (Protégé)
Reliability	How well can the research findings be reproduced by another researcher? How transparent and replicable are the procedures and techniques?	• Systematic literature review process (Brocke *et al.*, 2009; Webster and Watson, 2002) • Case study protocols (Yin, 2017) • Case study databases (Yin, 2017) • Focus group questioning routes (Stewart and Shamdasani, 2014) • Interview guides (Yin, 2017) • Observation guide (Yin, 2017) • Transcript processing (NVivo Software) • Template Analysis (King 2012, King, 1998) • Thematic Analysis (Braun and Clarke, 2012) • DSR Guidelines (Hevner *et al.*, 2008)

3.7 Summary

In this chapter, DSRM as the appropriate research methodology for this research is argued along with the proposition of the theoretical framework “Marketing-Operations-Interface” where the problem space is positioned. The rationale for the decisions is grounded primarily in the philosophical positioning within a pragmatism view and an abductive reasoning approach. The phases of the DSR process are applied and contextualised for this research encompassing a range of different data collection and analysis methods underlying the pragmatist nature of this research (surveys, semi-structured interviews, focus groups, observation), as well as design requirements that represent the necessary solution characteristics to be entailed by the artefact. The design and development phase within the DSR process is grounded on a case study approach allowing the retrieval of rich empirical data. For demonstration and evaluation purposes, a System Dynamics approach is chosen based on a separate case study representing an instance of the problem statement. The time horizon for this research is determined as being longitudinal due to the collaborative aspect with a practitioner that occurs within a certain period. The key decisions within this chapter are summarized in **Table 15.**

Table 15: *Methodology selection summary*

Stage	Decision	Justification
Theoretical Framework	• Marketing-Operations-Interface (Bijmolt *et al.*, 2021; Jose Zanon *et al.*, 2013; Piercy, 2010; Tang, 2010)	• Strong explanatory fit to the research problem
Research Philosophy	• Pragmatism (Saunders *et al.*, 2016; Kelemen and Rumens, 2008; Van de Ven, 2007)	• Need for a pragmatist view on the research problem • Not limited to a single ontological and epistemological view
Reasoning Approach	• Abductive Reasoning (Gregory and Munterman, 2011; Van de Ven, 2007; Suddaby, 2006; Samuels, 2000)	• Not limited to a purely inductive or deductive reasoning approach • Iterative cycles shifting from inductive to deductive reasoning for refinement and validation purposes
Methodology	• Design Science Research Methodology (Peffers *et al.,* 2007) with case studies (Yin, 2017)	• Strong fit to pragmatists' approach • Strong fit to problem-solving objective • Strong fit abductive reasoning approach • Able to combine knowledge generation from practice and theory equally as well as to produce contributions for both fields
Time Horizon	• Longitudinal Study (Yin, 2017)	• Collaborative engagement with the case study company is not conducted at a specific point in time but at several points in time
Data Collection Techniques	• Semi-structured interviews (Yin, 2017, Creswell and Poth, 2016) • Focus groups (Krueger, 2014; Tremblay *et al.*, 2010) • Explorative survey (Braun *et al.*, 2021; Krosnick, 2018) • Quantitative survey (Fowley Jr, 2013) • Observation (Yin, 2017; Creswell *et al.*, 2016)	• appropriate for data collection requirements within this research • ensuring problem domain relevance through the involvement of individuals as domain experts
Data Analysis Techniques	• Descriptive Statistics (Fowler Jr, 2013; Blaikie, 2003) • Thematic Analysis (Braun and Clarke, 2012) • Template Analysis (King, 2012; King, 1998) • NVivo Software	• Appropriate for data analysis requirements within this research

The key characteristics of the applied DSR for this research are summarized with the use of the DSR Grid proposed by vom Brocke and Maedche (2019). The grid consists of six components intended to summarise DSR projects based on the outline of the problem, the research process, the solution proposal, input knowledge, relevant concepts, and the output knowledge in a compact way (**Figure 30**).

Figure 30: *Design Science Grid applied for this research*

Problem	**Research Process**	**Solution**
The need for the alignment of strategic assortment decisions with the consumer confusion concept from a channel switching perspective in omnichannel retailing.	Design and Development, Ontology Engineering, Literature Review, Explorative Survey, Practitioner Interviews, Case Study, Semi-structured Interviews, Focus groups, Demonstration and Evaluation	Ontology representing the alignment between strategic assortment decisions and consumer confusion from a channel switching perspective.
Input Knowledge	**Concepts**	**Output Knowledge**
Consumer Confusion Theory, Assortment Integration Types in Omnichannel Retailing, Channel Switching Behaviour, Omnichannel Performance	Omnichannel Assortment, Assortment Integration, Strategic Assortment Decisions, Consumer Confusion, Channel Switching Behaviour, Ontology	Ontology as Solution Entity, Design Theory on how to construct a domain ontology to align strategic assortment decisions with consumer confusion from a channel switching perspective.

CHAPTER 4 –

DESIGN AND DEVELOPMENT

4

"Further, science is a collaborative effort."

— John Bardeen

4.1 Introduction

The previous chapters outline the problem space, the related state-of-the-art in literature, and the research methodology for this research. Based on the research problem and the research gaps, the Design Science Research Methodology with appropriate research techniques is argued and selected. This chapter is dedicated to the execution of the research methodology in detail and presents the design and development of the Omnichannel Assortment Ontology for Consumer Confusion. In the first instance, the case study context is described in detail. Thereafter, the design and development phase applying the Information Gathering and Modelling Framework along its steps, iterations, and outcomes, is explained. The chapter concludes with a presentation of the consolidated ontology and a summary recapitulating the essence of this chapter.

4.2 Case Study Company

The case study partner for the collaboration activities is a medium-sized retail company operating in Ireland and active in the market for high-quality gifting. It was established over 50 years ago and is one of the largest retailers specializing in high-quality Irish design products today. The retailer employs over 350 people and has built a strong relationship with Irish designers and suppliers. Throughout the years, the company established a relatively large and loyal customer base. The customer-centric company generates yearly revenues of around 50 million € with a web-shop (established in 2012) and 17 stores across Ireland. The retailer is providing over 40,000 individual SKUs (stock-keeping units) across 16 departments ranging from jewellery, and pottery, to clothing and wellness products and has adopted an asymmetrical assortment integration with the majority of its SKUs offered on the web-shop (integration type B). Its value proposition is centred around the offering of high-quality products and a strong customer experience delivery:

> *"Every decision we make is based on whether it's going to add customer experience and if the customer is going to come back to us."* (CEO)

Especially its outstanding in-store experience through means of atmospherics and interaction with knowledgeable sales staff offers extraordinary shopping experiences for its customer base. While facing dramatic changes in the retail industry (digitalisation, changing consumer behaviours, competitors from the online world, COVID-19 pandemic), the company is in the phase of becoming an omnichannel retailer as part of its "digital growth strategy" with major milestones for digital transformation. A key objective is the realisation of channel integration for both on- and offline channels in order to provide a seamless customer experience to their customers. Assortment integration represents an important task in the course of this undertaking. Initial discussions with the top management revealed that the consumer confusion phenomenon resonates with their experience with customers and is considered an ongoing challenge in becoming an omnichannel retailer:

> *"… yeah, we do experience that. Yeah, because we're offering over 12,000 items on our web-shop which is quite high. …, we have a lot but obviously it's not available in all our stores, yeah."* (Retail Manager)
>
> *"Customers are coming in looking for a specific item that's only available on our website."* (Retail Manager)
>
> *"You see the people that walk in the door with their phone in their hand with a picture, show you something that they want. You'll often see that. … Where they come straight and say, "have you got this", you know, and they're looking for something specific."* (Retail Manager)

The company is structured along various functions: Strategy, E-Commerce (web-shop), Marketing, Retail Management (physical stores), IT, and Finance / Accounting. Beyond that, the large-scale project "Digital Growth" is active since 2018 with dedicated sub-projects and initiatives around company-wide digitalisation objectives concerning new digital channels, data integration, social media analytics, digital loyalty programmes and related projects (see also Cakir *et al.*, 2021). The retailer qualifies as a *critical case* (Yin, 2017) for collaborative activities for the following reasons:

1. The retailer follows an omnichannel approach
2. It is observed that customers switch channels during a shopping journey
3. The consumer confusion phenomenon is apparent and perceived as a challenge
4. Assortment integration decisions are an essential task on a strategic level at the MOI
5. The company seeks to identify the concepts between strategic assortment decisions and consumer confusion occurrence to capture the extent of the potential consequences of the phenomenon

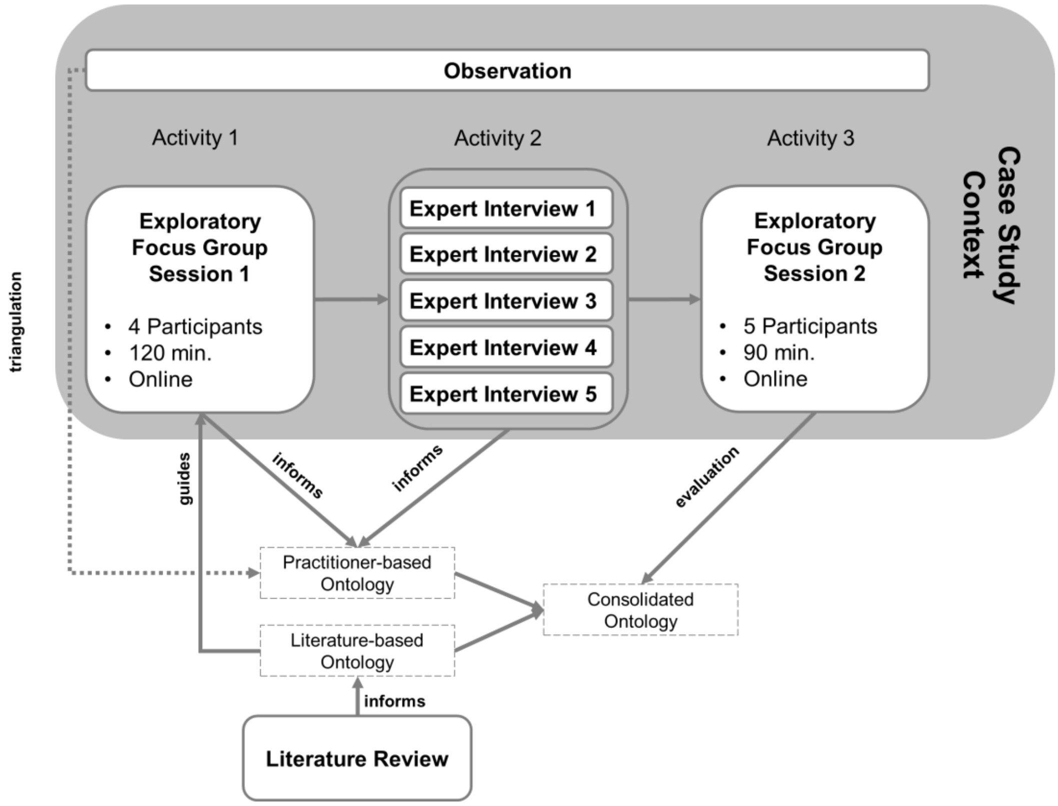
Overall, the collaborative activities and data collection encompass two focus group sessions, a series of five individual expert interviews, and observations (web-shop visit, visit at the physical retail store, and social media presence). The participants are top management representatives from different departments with different backgrounds.

4.2.1 Data Collection Techniques and Procedure

The data collection strategy for the design and development phase of this research is guided by a case study protocol (**Appendix C-1**) and encompasses two focus group (FG) sessions, five qualitative (semi-structured) interviews with experts, and the inclusion of observation data following the single source of evidence (the retail company) principle (Yin, 2017). The first stage involves the initial contact with the case company, introduction of myself, and the communication of the research background and intent. This is followed by the gathering of evidence (Stage 2) to judge whether the company is suitable for the research intent (Stage 3). The evidence is based on publicly available information such as the company website as well as its store presence. However, prior engagement with the case company based on research projects outside of this thesis provided sufficient information on the suitability of the company. Upon acceptance of the company as a suitable case (based on the five criteria mentioned in the previous section), a follow-up meeting with the representative is made (Stage 4), presenting the data collection methods and sequence, as well as agreeing on the details regarding the recruitment of suitable participants within the company (based on purposive sampling), and relevant dates and format for the data collection. Stage 5 initiates the data collection phase as outlined in **Figure 31** until Stage 8. Finally, in Stage 9, the case report is generated and communicated to the representative of the case company.

The first data collection activity is represented by the first FG aimed at retrieving initial substantial knowledge addressing Sub-RQ1 and Sub-RQ2 and more specifically by the practitioner source process in the ontology engineering step (Section 3.5.3). Thereafter, in addition, individual semi-structured interviews with practitioners are conducted in order to externalise in-depth expert knowledge in a face-to-face format. The practitioners are represented by the individuals within the first FG. The approach to have an FG first and individual interviews afterwards in a sequence is deemed appropriate since each participant owns individual expertise and experience on the research topic that can be retrieved best via separate face-to-face interviews instead of interruptions in the FG. In the last step, a second FG is conducted with the purpose of evaluating the consolidated ontology (EVAL3.1). The ontology itself is constructed through the combination of practitioner- and literature-informed ontologies. The literature-informed ontology serves as a guide for the first FG (high abstraction applied). In parallel, supporting sources in the form of observational data (web-shop and store visits) complement the data sources. The utilisation of supporting data sources is in line with the multiple sources of evidence principle (triangulation; Yardley, 2015; Patton, 2014) according to Yin (2017) in order to increase overall data quality compared to using only one single source of evidence (Yin *et al.*, 1985). Moreover, the case study approach intends to capture the phenomenon of interest in its real-life context (Yin, 2017), meaning depicting the contextual characteristics as best as possible through additional data sources.

Figure 31: *Data collection activities and procedure in the Design and Development Phase*

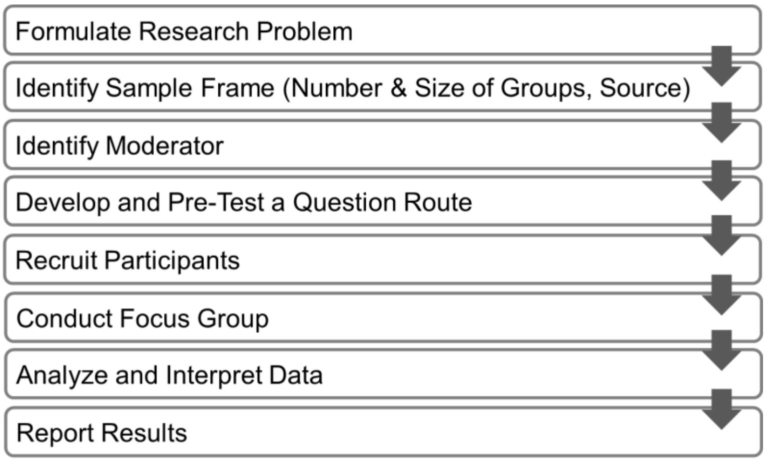


Each data collection activity is described in the following paragraphs in detail. Prior to any data collection activities, ethics approval required for data gathering that include human participants has been sought and approved by the Maynooth University Ethics Committee. Information and consent forms have been developed, distributed to every participant, and signed. The whole process is designed under ensuring the anonymity of the company as well as the individuals involved in the data collection process. No personal data is addressed as the research level ranges around an organisational context. Data is treated confidential (no names are identified) and hard copies are stored in a locked cabinet at the researcher's place with encryption, accessible only by the author.

Focus Groups

As stated in Section 3.4.5, within the information-gathering process, FGs represent a viable method to extract data from the experience and expertise of the practitioners. The interaction among participants and the focus on a clearly defined area of interest allow for the generation of rich data in a group discussion (Stewart and Shamdasani, 2014). This research incorporates two FG sessions with members of the organisation into its data-gathering process in the Design and Development phase. For this, the FG approach for DS projects proposed by Tremblay *et al.* (2010) is applied (**Figure 32**). Both FGs have been conducted digitally in an online format (Stewart and Shamdasani, 2017) due to the circumstances at the time of data collection (the pandemic situation in Ireland in 2020 and 2021). The following paragraphs outline and argue decisions in the steps in detail and elaborate on the peculiarities of online FGs.

Figure 32: *Focus group steps (source: Tremblay et al., 2010)*



Research Problem. The content and topic of discussion in the FGs are directly derived from Sub-RQ1 and Sub-RQ2 of this study (Section 1.4). The FGs are a component of the Ontology Engineering process of the practitioner side as conducted in Section 4.3.2. In line with Tremblay *et al.* (2010), thus the purpose of the FGs and the aim of the ontology engineering process correspond to an *explorative* FG. This is motivated by seeking incremental improvements in the artefact design (Hevner *et al.*, 2008; Kuechler and Vaishnavi, 2008; Hevner, 2007; Markus *et al.*, 2002) rather than demonstrating the use of the artefact in a confirmatory FG. For the first FG, a highly abstracted version of the literature-informed ontology (with the intent to avoid bias) is presented to initiate the discussion.

Sample. Literature suggests conducting FGs until no new insights emerge (Krueger and Casey, 2002). For DS projects, Tremblay *et al.* (2010) recommend conducting at least one pilot FG and at least two exploratory and confirmatory FGs. The number of explorative FGs for this research is set to two with the first one in collecting, practitioner-based data (along with expert interviews as described below) to be incorporated into the ontology engineering process, and the second one acting as ex-ante evaluation of the consolidated ontology (Section 6.2.1). Confirmatory FGs are omitted due to opting for a separate case study in the course of the evaluation strategy instead. An informal pilot FG has been conducted with peer students from the field of omnichannel retailing to optimize timing and questioning routes (Tremblay *et al.*, 2010). In General, an ideal number of participants per FG is defined between the range of 3 to 12 individuals (Brandtner *et al.*, 2015; Krueger, 2014) but depends on the topic of discussion and the intended dynamics in the interaction (smaller groups require more interaction whereas larger groups can lead to so-called "social loafing"; Morgan, 1996). Tremblay *et al.* (2010) suggest not conducting FGs with more than six participants in DS projects since the subject matter is typically more complex than traditional ones, e.g., due to the demonstration/use of an artefact. Given the complexity of this research (collaborative design activities that go beyond mere data collection) and the intention to facilitate relatively more interaction within the group to generate rich data, the number of participants is set to one individual per field of expertise based on the initial literature-informed four ontology themes. This also supports construct validity aspects due to the participants viewing the same context from different perspectives and backgrounds. The ontology themes corresponding to areas of expertise and experience are defined as (1) strategy (accounting for strategic assortment decisions in omnichannel retailing), (2) marketing (accounting for the consumer confusion phenomenon), (3) omnichannel marketing (accounting for the channel switching behaviour), and (4) finance (accounting for the performance component of the ontology), effectively determining a group size of 4 in the first FG. These themes are mapped accordingly to individual experts (E) from the company (E1 to E4). For the second FG, an additional expert has been recruited based on the discussions in the first FG. The expert is the project manager of the digital strategy project of the retailer and is qualified in the fields of channel integration, channel hopping, and assortment management across channels (E5) thus able to connect each domain from his point of view. The final list of participants is shared in **Table 16**.

A need for an alignment of the participants with the DS research topic (Tremblay *et al.*, 2010) is ensured through their different fields of expertise and background. Initial discussions reveal that all candidates are familiar with omnichannel retailing, assortment decisions and the consumer confusion phenomenon, possess knowledge and experience relevant to the ontology construction and qualify as potential user groups of the intended solution artefact.

Table 16: *Overview of focus group and expert interview participants in the case study*

Expert (E)	Position	Background	In Focus Group (FG)
E1	Director Strategy and E-Commerce	Responsible for group strategy and business development. Directing e-commerce division. 7 years with the company. Directly involved in strategic assortment decisions. Prior roles involve being a group financial controller at the company.	FG1, FG2
E2	Marketing and Retail Management	Deputy Head of Retail, 13 years in the company, experience in retail management and marketing, store management, involved in key assortment decisions for all store locations. Cross-functional involvement in major operational activities (inventory, HR, marketing).	FG1, FG2
E3	Marketing Manager	CRM, Loyalty Programme Manager, 3 years at the company, background in marketing. Involved in strategic assortment decisions.	FG1, FG2
E4	Finance / Accounting	Head of Finance and Accounting, 5 years at company, expertise and experience in strategic financial planning/budgeting, financial controlling, management accounting, financial analysis & forecasting, etc.	FG1, FG2
E5	Digital Strategy Project Manager	3 years project manager role at the company, experience in digital retailing, expertise in omnichannel integration, omnichannel technologies, retail assortment	FG2

Moderator. Since the role of the moderator can be complex (Tremblay *et al.*, 2010), Krueger (2014) suggests skills such as respecting participants equally, clear communication abilities (orally and verbally), control of personal views and being friendly and humorous. Moreover, for DS projects, an understanding of the artefact is essential (Tremblay *et al.*, 2010). For this research, an experienced moderator knowledgeable in the field of omnichannel, assortments, and channel integration has been selected.

Questioning Route. The questioning route (or agenda) is the set and sequence of questions for the FG and is critical in setting the direction of the group discussion (Stewart and Shamdasani, 2014). Tremblay *et al.* (2010) suggest starting with presenting the motivation for the artefact along with examples of the intended use of it, followed by detailed descriptions of the design and use and finishing with a particular task where the participants are asked to utilise or evaluate the artefact. The authors further emphasise the strong fit of the "rolling interview guide" concept to be particularly suitable for exploratory FGs. A rolling interview allows the refinement of the script based on the outcome of the first FG that is updated and ready to be utilised for the next FG. Following Brandtner *et al.* (2015), the questioning routes for this research are designed based on the principles of supporting the moderator, providing freedom for improvisation, use of open-ended questions, and focusing on asking questions only (avoiding answers or any input). The questioning route for the first FG is conceptualised around 4 main categories (introduction, motivation and background, ontology themes, and closing) with a total of 12 questions, including 2 questions for EVAL2.1 (Section 6.2.1). The second FG covers 3 main categories (introduction, evaluation, closing) with 4 questions and one instruction (EVAL3.2). Both guides are directly linked to the research objectives and the ontology engineering process as outlined in Section 3.5.3. The questioning routes are provided in **Appendix C-2** and **Appendix F-4**. The quality of the documents was tested with peer students in the course of the pilot FG.

Participant Recruitment. The recruitment of the candidates took place in the course of contacting the retail company directly (Stage 1 of the case study protocol). Being acquainted with the Strategy Director of the company based on previous research projects, the inquiry to conduct FGs with the company was first communicated formally via email in early 2020 and discussed in a remote call shortly afterwards (pandemic-related challenges prevented in-person appointments in Ireland in 2020). After the acceptance by the company, relevant candidates have been identified together with the Strategy Director through "purposive"- non-probability sampling allowing the best fit for exploratory research needs (Saunders *et al.*, 2016).[4] All individuals have been contacted right after being formally and officially invited to partake in the FGs. For the second FG, an additional expert has been invited based on the recommendations and outcome of the first FG. After reaching an agreement on the dates, both FG sessions have been scheduled and conducted accordingly (Stage 4 of the case study protocol).

Focus Group Conduction. For this research, the FGs have been conducted digitally in an online format (Stage 5 and Stage 8 of the case study protocol) due to the pandemic circumstances in Ireland in 2020 (lockdowns throughout the year 2020)[5]. Prior to the session, consent forms and information statements have been distributed to each participant. Both FGs have been conducted on the basis of Microsoft Teams (FG1 lasted 120 min., FG2 was conducted within 90 min., without recording audio/video but activating the automated transcript generator for both sessions, creating a transcript report for each session). However, contrary to former literature suggestions that virtual FG meetings not being desirable, FGs conducted digitally in an online format show peculiarities that can be of advantage (Stewart and Shamdasani, 2017). **Table 17** shows a comparison of the

[4] This implies that the chosen sampling method does not correspond to one that would be appropriate for statistical inference.
[5] E.g., https://www.irishtimes.com/news/health/coronavirus-schools-colleges-and-childcare-facilities-in-ireland-to-shut-1.4200977.

advantages and disadvantages of the conduction of traditional (in-person) FGs versus online FGs (conducted digitally).

Table 17: *Traditional vs. online focus group discussions (source: own comparison)*

	Traditional Focus Groups (Stewart and Shamdasani, 2017; Woodyatt *et al.*, 2016; Krueger, 2014; Stewart and Shamdasani, 2014; Liamputtong, 2011)	Online Focus Groups (McDaniel and Gates, 2018; Stewart and Shamdasani, 2017; Woodyatt *et al.*, 2016; Zwaanswijk and van Dulmen, 2014; Reid and Reid, 2005; Oringderff, 2004)
Advantages	• Face-to-face • Visual cues • Social aspect • Flow in discussions	• Flexibility in scheduling / coordination • Space independent (e.g., different countries) • Familiar environment at home or office • Greater anonymity • Greater ability to contribute (psychological distance) • Absence of visual distractions • Cost-savings (no travel)
Disadvantages	• Tedious recruiting and scheduling (long process) • Protection of anonymity • Presence of recording instruments • Expensive (e.g., covering travel costs, equipment, etc.) • Bound to time and space • Regional bias	• Inconsistent flow • Moderation needs to be more proactive, secure in tech • Lack of nonverbal cues • Technological limitations of the online environment • Participant access to digital technology • Potential low data quality

For instance, online FGs offer great flexibility in scheduling and coordination of the session due to them being independent of space (allowing practically worldwide participation). This is rather disadvantageous in traditional FGs because of being bound to time and space (and thus having potentially a certain regional bias in addition). On the other hand, traditional FGs offer advantages such as visual cues during discussions and the general social aspect of meeting face-to-face. Another advantage of conventional FGs is the flow of the discussion as being more fluid and natural. Online FGs are troubled with the absence of these advantages, leading potentially to inconsistent flow and a lack of nonverbal cues during the discussions, demanding a more proactive role of the moderator. Moreover, participants require to have access to and be proficient in using the appropriate technology. Then again, traditional FGs can be tedious and expensive in the recruiting process compared to online recruitment. Some participants might be distracted by recording instruments or be more conscious of protecting their anonymity compared to an online environment where a candidate can opt for audio-only for example. For this research project, the disadvantages of the conduction of the online FGs have not been significant due to (1) the insignificant role of non-verbal cues (knowledge extraction is at the centre of the discussions), (2) the proficiency in the conference software of all attendants, and (3) the proactive, experienced moderation skills of the moderator who is accustomed to chairing, presenting and moderating in online environments. Concordantly, the potential low data quality output of the online FGs has been avoided successfully to a great extent. Both online FGs have been conducted successfully without any technical disruptions.

Data Analysis. After the conduction of the FGs, generated data is subject to be analysed. Due to the FGs being a qualitative research approach in nature (Section 3.4.5), Template analysis is applied (King, 2012; King, 1998). Details are provided in the following Section 4.2.2.

Reporting Results. The statements from the data analysis are consolidated, structured, and processed in the design decisions within the ontology engineering process (Section 4.3.2). The results of the first FG provide substantial practitioner information on how to construct the desired ontology from a practitioner's point of view whereas the second FG contributed to the evaluation of the consolidated ontology. Both reports have been communicated to the participants where the report on the first FG was provided before the second one took place. The overview of the consolidated results and the corresponding design actions and interventions (literature- and practitioner-based) is provided throughout the design and development process in Section 4.3.

Semi-Structured Expert Interviews

In the second data collection activity, 5 individual interviews with experts are undergone (Yin, 2017; Creswell and Poth, 2016) (Stage 6 of the case study protocol). The participants are represented by the individuals who attended the first FG (**Table 16**). The purpose of the individual interviews is to retrieve additional focused knowledge based on the special expertise of the expert that can be utilised in the ontology engineering process on top of the FG results. All interviews were recorded via the transcript feature of MS Teams and lasted on average around 45 min. each. As outlined in Section 3.4.5, semi-structured interviews are characterised by the utilisation of an incomplete script allowing flexibility for improvisations such as new, follow-up questions. The script, referred to as the interview protocol, is designed following the guidelines proposed by Yin (2017) and Creswell and Poth (2016) (**Appendix C-3**). The rationale for the selection of the experts is based on the recruitment rationale outlined above in the FG discussion.

Observation

In addition to the FGs and expert interviews, observation (OB) as a type of data collection is adopted. This approach complements the set of data collection techniques conducted within a case study setting since it can reveal new dimensions and aspects in the course of the inquiry (Yin, 2017).

The specific rationale for adopting observation within the case study is to gather evidence that reflects the link between strategic assortment decisions and the consumer confusion concept on the basis of a real-world example. For this, two customer journeys (show- and webrooming) are undertaken by myself, taking the role of a customer. This is in line with Yin (2017) on collecting further evidence through casual observation and with Creswell and Poth (2016) on observing own (researcher) behaviour while visiting “sites”. The subject of the observation is the flagship store on the one hand and the web-shop of the case company on the other hand reflecting the configuration of the strategic assortment decision on assortment integration. The idea is to draw the alignment from the perception of assortment to the experience of assortment inconsistencies across these two channels based on these two simulated customer journeys. Data from the observation has been recorded via notes and self-memos.

Observation 1 (Showrooming): this customer journey simulates a visit to the flagship store first, followed by a visit to the webshop. For this, 10 different products in the physical store have been chosen randomly to check their availability on the web-shop afterwards. However, only 5 products could be identified on the web-shop.

Observation 2 (Webrooming): Likewise, this customer journey simulates a visit to the web shop, followed by a visit to the flagship store of the case company. Also here, 10 different products (that are also different to the first observation), have been chosen randomly to check their availability in the flagship store afterwards. However, only 3 products could be identified in-store.

4.2.2 Data Analysis

Template Analysis for FGs and interviews is applied for the data analysis procedure. An initial template was developed containing literature-informed categories translated into high-order and lower-order codes. This was proven convenient as the intended ontology hierarchy has a strong suitability in informing the template structure. The high-order codes are represented by the specific knowledge domains (omnichannel assortment, consumer confusion, channel switching behaviour, retail performance) whereas the lower-order codes reflect the ontology aspects and components (classes, relations, properties, constraints, instances).

However, the first template version was revised after the first FG session based on the findings in that session: during the exchange in FG1, it became evident to divide the lower order code “properties” into the codes “properties” and “instances” to provide a clearer distinction between these two components of the ontology. No other codes have been eliminated or added after the expert interviews or the second FG. Also, no changes to the template hierarchy were made. Lastly, no further merging or separation of codes was necessary. The final template structure is shown in **Appendix C-4**.

Within each data collection session (FG1, expert interviews 1-5, FG2), the template was used and populated. The collected data was then processed after each session with NVivo allowing refinement after each session. This procedure created seven different populated templates throughout the data collection phase (FG1 template, one template each for the expert interviews 1 to 5, and FG2 template).

4.3 Construction of the Ontology

Noy and McGuinness (2001) emphasise the consideration of reusing existing ontologies and refining and extending existing sources for the domain and tasks of interest before developing a new ontology. This is in line with the proposition of vom Brocke *et al.* (2020) stating that DSR in general shows very low reuse of existing contributions from other DS projects. However, a review of existing ontology solutions on omnichannel assortment yielded unsatisfactory results. For instance, the ARTS (Association for Retail Technology Standards) "Operational Data Model" (ODM)[6] that identifies, defines, and describes retail entities and relationships on the basis of a retail enterprise information architecture model is still subject to be extended by "merchandising budgeting", "assortment planning", or related features that would have been relevant for this study: "*It does not provide data structures for merchandise budgeting, open to buy, allocation and assortment planning and related planning and control functions. These are areas that will be explored and developed in future extensions to the data model.*" (ARTS, 2017). Moreover, the presence of the ARTS website makes the impression that the data model is discontinued, and the above-stated intention is not followed.[7] More importantly, though, it does not account for an omnichannel perspective regardless.

With regards to similar academic works that could potentially inform this study, Davou and Idrus (2013) introduce an ontology-based generic template for retail analytics that aims at predicting the customer lifetime value of customers within CRM applications. However, an assortment or omnichannel view is not part of the research scope. Other contributions focus solely on a single channel, for example, offline channels (e.g., Madsen and

[6] https://www.omg.org/retail-depository/arts-odm-73/.
[7] The initiative was introduced by the National Retail Federation (NRF), USA. However, the NRF seems to not have any affiliation with the ARTS project as the URL links to the NRF websites do not work anymore.

Petermans, 2020) or online channels (e.g., Alaa *et al.*, 2021; Pal, 2018) and have unrelated research scopes and contributions. Therefore, for this research, it is decided to develop a whole new ontology.

The construction of the omnichannel assortment ontology is guided by the Information Gathering and Modelling Framework (Ostrowski *et al.*, 2014; Helfert *et al.*, 2012) and starts with the gathering of information and modelling of the literature-informed ontology, followed by the construction of the practitioner-informed ontology. Thereafter, both artefacts are consolidated and the result forms the "Omnichannel Assortment Ontology for Consumer Confusion", combining knowledge from literature and practice. For formalisation purposes, the ontology is visualised via Protégé. The following sections describe each step of the construction in detail. To guide the development process, an Ontology Requirements Specification Document (ORSD) as proposed by Suárez-Figueroa *et al.* (2009) is utilised (**Table 18**).

A high-level model of the ontology structure is provided below (**Figure 33**). It consists of the four main domains that are linked to each other subject to be represented in detail. The high-level view serves as a mental model for the construction of the ontology.

Figure 33: *High-level model of the ontology*

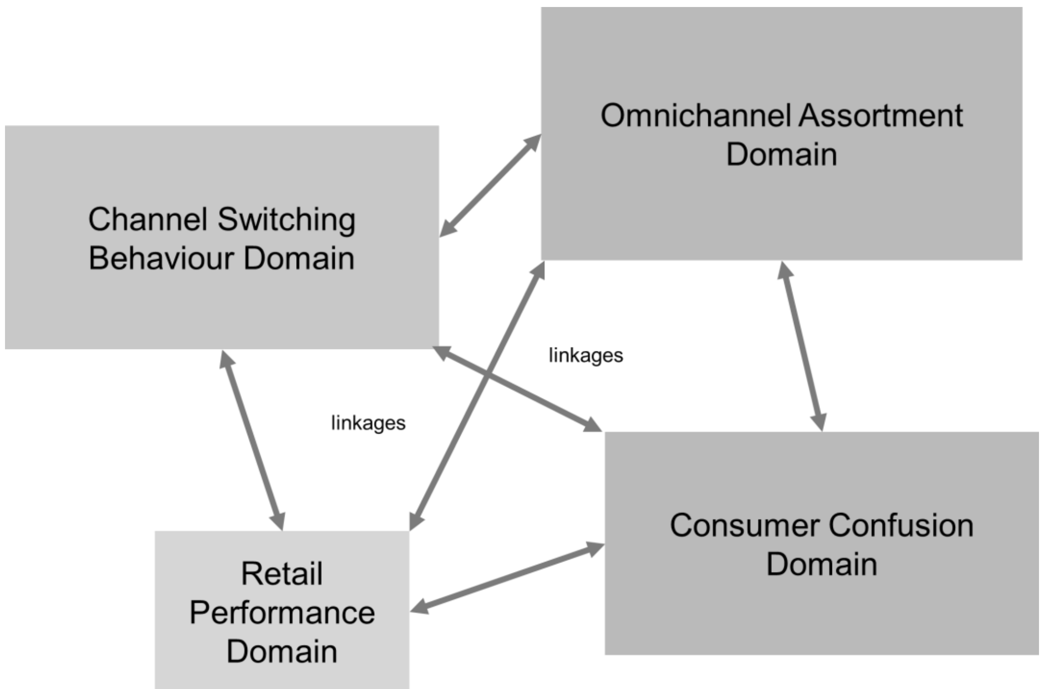


Table 18: *Requirements specification document for the ontology development*

Omnichannel Assortment Ontology for Consumer Confusion Requirements Specification	
1. Purpose	The purpose is to provide a representation of the alignment between the domains “strategic assortment decisions”, and “consumer confusion”, its link to short- and long-term consequences, and “channel switching behaviour” in the Marketing-Operations-Interface in an omnichannel retailing context.
2. Scope	The focus and boundary of the ontology are relevant concepts and relations from the omnichannel assortment domain linked to the concepts and relations of the domains “consumer confusion”, “channel switching behaviour”, and “retail performance”.
3. Implementation Language	The ontology is to be implemented and visualised in Protégé via OWL.
4. Intended End-Users	The general user group of the ontology is identified as domain experts in the field of omnichannel assortment decisions who are differentiated as follows: • User Type 1: Domain experts from the retail industry. Practitioners in retailing who are responsible for decision-making processes at the Marketing-Operations-Interface of omnichannel retailers who require informational guidance on the alignment between assortment decisions and the consumer confusion phenomenon. • User Type 2: Domain experts from the retailing research domain. Researchers who are conducting research in the area of omnichannel assortment.
5. Intended Uses	• Knowledge retrieval: Search for concepts and their relations from the domain of omnichannel assortment decisions, consumer confusion, channel switching behaviour, and retail performance. • Knowledge retrieval: Search how different concepts can be expressed. • Knowledge retrieval: Search how the alignment between the domains is established.
6. Ontology Requirements (based on the DRs outlined in Section 3.5.2)	• The ontology is required to provide a representation of the alignment between strategic assortment decisions, the consumer confusion phenomenon, and channel switching behaviour. • The artefact is required to provide a representation of all relevant concepts and relations from the omnichannel assortment knowledge domain. • The artefact is required to provide a representation of all relevant concepts and relations from the consumer confusion knowledge domain. • The artefact is required to provide a representation of all relevant concepts and relations from the channel switching behaviour knowledge domain. • The artefact is required to identify which component of the MOI framework the concepts are associated with. • The artefact is required to provide a link of the alignment between strategic assortment decisions and consumer confusion to the corporate strategy at the MOI from a performance perspective.
7. Pre-Glossary of Terms	• List of enumerated terms.

4.3.1 Literature-based Ontology

The literature-based ontology represents the first artefact intended to be combined with the practitioner-informed ontology. This section explains the steps along the ontology engineering process as described in Section 3.5.3 (enumeration of terms, the definition of classes, properties, constraints, the creation of instances, as well as the formalisation and visualisation via a class diagram). Following Hense and Hübner (2022), for the whole construction phase, it is assumed that there are two channel types only: physical (offline) and digital (online) channels. Moreover, multiple switching behaviour (Section 2.6.1) is not regarded to reduce complexity in the course of ontology construction. Lastly, to address DR5, each class has been assigned the corresponding key function within the MOI framework (“marketing function” (MF), “assortment decision area” (DA), or “corporate strategy (CS)).

(1) Enumeration of Terms

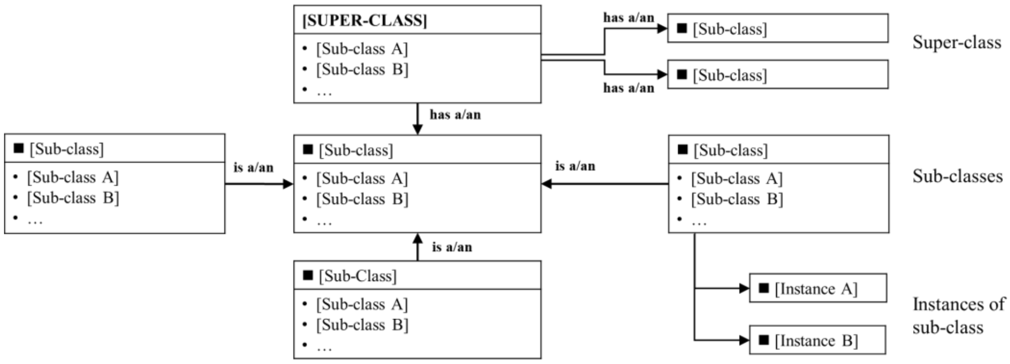
The boundary for the identification of relevant terms of the problem domain is primarily specified by the relevant literature as portrayed in Chapter 2 and outlined in Section 3.5.3. This involves the major concepts of omnichannel assortment (decisions), consumer confusion, and channel switching behaviour in omnichannel retailing. However, an additional literature review is conducted to account for the knowledge requirements based on DR6 to align consumer confusion consequences to retail performance. **Appendix D-1** provides an overview of the conducted SLR on retail performance. The subsequent steps on the modelling presented in the next sections triggered several iterations back to the ontology construction. Overall, the relevant domains revealed over 110 different terms. Noy and McGuiness (2001) point out that the ontology should not contain all the possible information about the domain(s). The authors suggest not to specialize (or generalize) more than is required for the intended application. Therefore, the enumerated terms capture a detail-range between the notion of strategic decisions (abstract high-level descriptions) and strategic actions (concrete execution of strategic elements) for the concepts. For example, the decision on assortment expansion can be executed by the introduction of an online assortment via a mobile app channel where a separate detailed breakdown of mobile app channel varieties (e.g., web shop in a generic browser vs. original app) is not captured since this information would not add significant value to the ontology.

(2) Definition of Classes

The main concepts from the problem domain and literature forming the classes are represented by “omnichannel assortment”, “omnichannel customer journey”, “consumer confusion”, and “retail performance” (**Table 20**). These concepts serve as super-classes, organised into 4 clusters representing the domains that are linked to various sub-classes. These sub-classes possess again subclasses and instances of subclasses, eventually forming a hierarchy of classes. An example structure is provided in **Figure 34**.

The rationale for the design decisions for each domain is discussed below. In the following, classes are identified as concepts that are expressed in *italic* and capitalised format in the text.

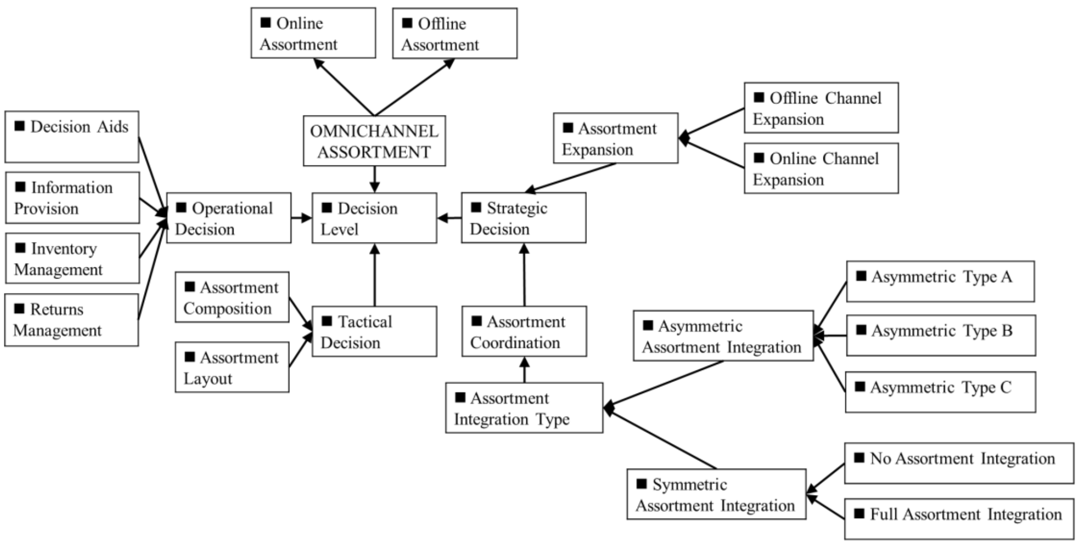
Figure 34: *Class hierarchy structure*



Omnichannel Assortment Domain

The class *Omnichannel Assortment* represents the core of the ontology and is primarily justified by Rooderkek and Kök's conceptualisation of assortment challenges in omnichannel retailing (2019) representing a central work in the omnichannel retailing domain (see Section 2.4.1) and addressing DR2. It is defined as a concept capturing the omnichannel assortment structure and the assortment decisions across channels at the MOI of a retailer to ensure a seamless customer experience across all consumer touchpoints. It is therefore clearly positioned in the "assortment decision area" within the MOI. Relevant deduced subclasses are identified as *Decision Level*, *Offline Assortment*, and *Online Assortment*. The sub-classes are primarily informed by the works of e.g., Emrich *et al.* (2015), Bertrandie and Zielke (2017), Bertrandie and Zielke (2019), Bertrandie (2020), Berry *et al.* (2010), Zhang *et al.* (2010), Konus *et al.* (2008), Goersch (2002), and Hense and Hübner (2022). The subclass *Decision Level* captures organisational decision levels for omnichannel assortment decisions at the MOI through the subclasses *Strategic Decision*, *Tactical Decision*, and *Operational Decision*. This is justified by the fact that a distinction between decision levels is necessary since the potential occurrence of the consumer confusion phenomenon is primarily induced by strategic assortment decisions that determine the assortment integration type (Rooderkerk and Kök, 2019). The incorporation of the tactical and operational levels serves as complementary elements to provide the holistic extent of the omnichannel assortment domain but is not further followed due to the focus and scope of the ontology (strategic perspective only). The decision levels can be broken down into concrete actions with *Assortment Coordination* and *Assortment Expansion* as further subclasses of strategic assortment decisions, *Assortment Composition* and *Assortment Layout* as subclasses of tactical assortment decisions, and *Decision Aids*, *Information Provision*, *Inventory Management*, and *Returns Management* as subclasses of operational assortment decisions (Rooderkerk and Kök, 2019). To ensure consistency in the hierarchical structure, the subclasses of the class *Assortment Integration Type* (subclass of *Assortment Coordination*) have been organised into *Symmetric* and *Asymmetric Assortment Integration* on one hierarchical level (siblings). The former represents a deliberate design decision as an addition to this study since the literature explicitly provides the asymmetric concept and term only (Rooderkerk and Kök, 2019; Emrich *et al.*, 2015). With this, the assortment integration types *Full Assortment Integration*, *No Assortment Integration*, as well as *Asymmetric Type A* to *Type C* can be classified as being either symmetrical or asymmetrical while ensuring coherence at the hierarchical level. The classes *Offline* and *Online Assortment* represent the subclasses that reflect the structural composition of omnichannel assortment channels where decisions from the MOI are reflected and applied on. The literature-informed *Omnichannel Assortment* class hierarchy is illustrated in **Figure *35***.

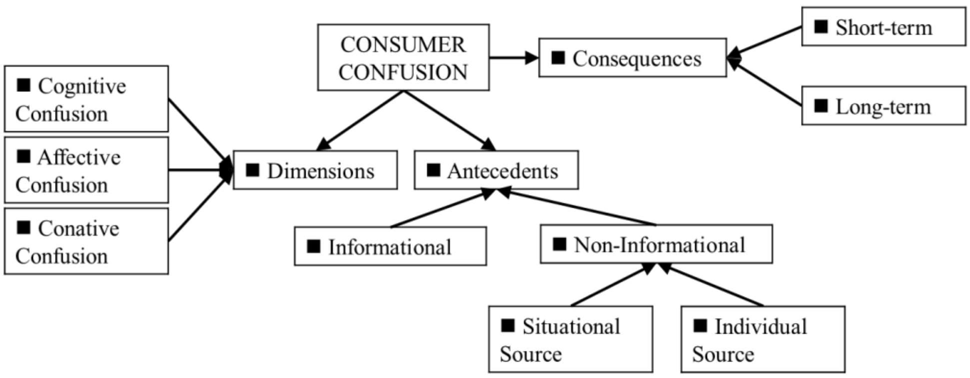
Figure 35: *Literature-informed class hierarchy on "Omnichannel Assortment"*



Consumer Confusion Domain

The superclass *Consumer Confusion* captures the consumer confusion concept, its *Dimensions*, *Antecedents*, and *Consequences*, defined as its subclasses, addressing DR3. This structure is justified by the contents found and analysed in the literature review (Section 2.5.1). Consumer confusion is understood as a negative customer reaction such as irritation, frustration, or annoyance resulting from experiencing inconsistencies and unexpected challenges while shopping and can be defined as an "aversive consequence of a retail situation." (Anninou and Foxall 2019, p. 140). For the use in the ontology, the consumer confusion concept is defined as the state of mind of a customer showing irritation, frustration, or annoyance resulting from experiencing assortment inconsistencies across channels of an omnichannel retailer. It is a concept positioned within the "marketing function" at the MOI due to its customer-focused basis. The *Dimensions* of the consumer confusion concept constitute the various expressions of the confusion (cognitive, emotional, and behavioural) and consists of the three subclasses *Cognitive Confusion* (e.g., Bertrandie, 2020; Bertrandie and Zielke, 2019; Bertrandie and Zielke, 2017; Schweizer *et al.*, 2006; Mitchell *et al.*, 2005; Mitchell and Papavassiliou, 1999), *Affective Confusion*, (Bertrandie, 2020; Bertrandie and Zielke, 2019; Bertrandie and Zielke, 2017; Mitchell *et al.*, 2005; Mitchell *et al.*, 2004), and *Conative Confusion* (Shiu, 2017; Matzler *et al.*, 2011; Walsh *et al.*, 2007; Mitchell *et al.*, 2005; Turnbull *et al.*, 2000; Mitchell and Papavassiliou, 1999; Mitchell and Papavassiliou, 1997), triggered by a range of different sources, structured along *Informational* (Chauhan and Sagar, 2021; Ebina and Kinjo, 2019; Broilo *et al.*, 2016; Tjiptono *et al.*, 2014; Walsh and Mitchell, 2010; Fasolo *et al.*, 2009; Mitchell *et al.*, 2005; Iyengar and Lepper, 2000; Foxman *et al.*, 1990), *Individual and Situational* (Chauhan and Sagar, 2021; Garaus and Wagner, 2016; Foxman *et al.*, 1990) antecedents (the individual and situational antecedents are organised under the *Non-Informational* antecedent subclass to ensure hierarchical consistency). The consequences are organised along a time perspective based on the structure discussed in the literature review (Section 2.5.1) and encompass *Short-term* and *Long-term Consequences* (**Table 8**). The financial implications of these consequences are captured via a linkage to the retail performance domain (based on Wobker *et al.*, 2015). The literature-informed *Consumer Confusion* class hierarchy is illustrated in **Figure 36**.

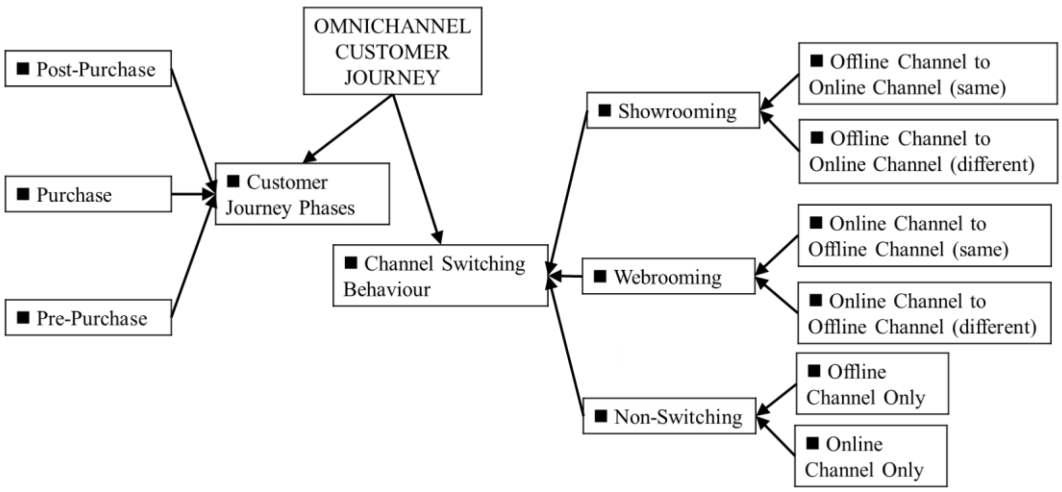
Figure 36: *Literature-informed class hierarchy on "Consumer Confusion"*



Omnichannel Customer Journey

In view of DR4, to incorporate relevant concepts from the channel switching behaviour domain, a decision has been made to create the class of *Omnichannel Customer Journey* which reflects the domain of knowledge on channel switching behaviour but also customer journey phases capturing the situation where the switching behaviour occurs. Additionally, through the adoption of the concept of the customer journey phases, the superclass is in line with the same marketing-related component of the MOI designed from a customer journey perspective (Bijmolt *et al.*, 2021). Relevant sub-classes are therefore defined as *Customer Journey Phases* (Bijmolt *et al.*, 2021; Herhausen *et al.*, 2019; Lemon and Verhoef, 2016; Butler and Peppard, 1998; Howard and Sheth 1969) with the subclasses *Pre-Purchase*, *Purchase*, and *Post-Purchase*, and *Channel Switching Behaviour* (Van Nguyen *et al.*, 2022; Schneider and Zielke, 2021; Hsiao *et al.*, 2012) broken down into the subclasses *Showrooming* (Aw, 2020; Flavián *et al.*, 2020; Kang, 2018), *Webrooming* (Aw *et al.*, 2021; Kang, 2018; Flavián *et al.*, 2016), and *Non-Switching* (Neslin, 2022; Timoumi *et al.*, 2022). The superclass is also acting as the critical link effectively establishing the alignment between omnichannel assortment and consumer confusion as required by DR1 (Section 4.3.3). A relevant subclass for *Showrooming* has been classified as *Offline Channel to Online Channel* based on (1) the *same retailer* or (2) two *different retailers*, accounting for the notion of loyal and competitive showrooming as discussed in Section 2.6.1 (Frasquet and Miquel-Romero, 2021). Equally, *Online Channel to Offline Channel* capture *Webrooming* behaviour on the basis of (1) the *same retailer* or (2) two *different retailers* (Manss *et al.*, 2020; Genlser *et al.*, 2017). The type *Non-Switching* is accounting for the behaviour of staying in the same channel for the whole customer journey process and correspondingly exhibits the subclasses *Offline Channel Only* and *Online Channel Only*. The literature-informed *Omnichannel Customer Journey* class hierarchy is illustrated in **Figure 37**.

Figure 37: *Literature-informed class hierarchy on "Omnichannel Customer Journey"*



Retail Performance

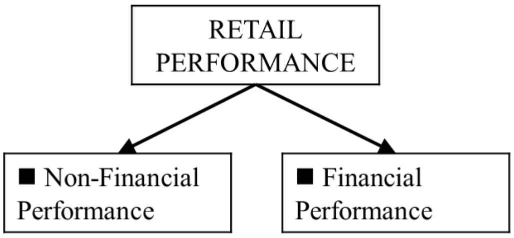
Retail Performance is incorporated into the ontology due to the reason of establishing a link between consumer confusion consequences and the corporate strategy component at the MOI (DR5). The super-class is divided into the subclasses of *Financial-* and *Non-Financial Performance* used to capture performance expressions out of the consumer confusion consequences (Cakir *et al.*, 2019). A literature review on common metrics applied in retailing has been conducted to inform this domain. Generally, in order to manage a business effectively and efficiently, the concept of performance measurement is utilized (Melnyk *et al.*, 2014). This is done through measures quantifying and indicating progress and actions (Neely *et al.*, 1995). Hereby, indicators can be distinguished by their measurability between financial and non-financial measures (Cakir *et al.*, 2019) (**Table 19**). Measures are considered as a financial metric in case of their financial nature or can be measured directly on a monetary basis. For example, 'revenue' can simply be broken down to 'price multiplied by goods sold'. On the other side, non-financial measures are often described as abstract objectives and comprise intangible, nonmonetary and, in many cases, complex goals such as 'customer experience', 'customer loyalty' or 'customer satisfaction'. They are difficult to measure because of their multidimensional nature (Kranzbühler *et al.*, 2018; Lemon and Verhoef, 2016) and are not able to be captured fully by current accounting measures (Ittner and Larcker, 1998). Nevertheless, they are also relevant to evaluate decisions at the MOI and to formulate necessary goals for retailers.

Table 19: *Classification of performance metrics (source: Cakir et al., 2019)*

Measurability	Management Level	Metric Example
Financial	Strategic	Retailer's Shareholder Value (e.g., Kashmiri *et al.*, 2017)
	Operational	Cross Space Elasticity & Shelf Space (e.g., Schaal and Hübner, 2018)
Non-Financial	Strategic	Customer Satisfaction, Customer Loyalty, and Service Quality (e.g., Lin *et al.*, 2016)
	Operational	Purchase Likelihood (Ho *et al.*, 2014)

A further distinction can be made between strategic and operational measures. If used at the top management decision level only, measures are considered strategic indicators and are characterized by their long-term scope (e.g., year-to-year revenue growth, market share, employee size, change in profitability between periods, etc.). Strategic measures are abstract and viewed as independent from industry (Zentes *et al.*, 2017) to allow suitable performance comparison between companies for shareholders. Operational indicators can be summed up as measures for evaluating day to day progress of actions such as in inventory management (e.g., stock accuracy, shelf capacity), fulfilment (delivery times, order times, etc.) or store metrics (store profit, salesperson net profit, etc.) (Gunasekaran *et al.*, 2001) as well as metrics used in an e-commerce context (conversion rates, web visits, cost per click, etc.) (Tsai *et al.*, 2013). The classification is shown in **Table 19**, along with examples. **Appendix D-1** provides a rich overview of strategic and operational metrics organised into financial and non-financial indicators. The literature-informed *Retail Performance* class hierarchy is illustrated in **Figure 38**.

Figure 38: *Literature-informed class hierarchy on "Retail Performance"*



The details of the above-constructed classes are summarized in the following **Table 20**.

Table 20: *Definition of literature-informed classes*

Superclass	DR	MOI	Description	Literature source (key)
Omnichannel Assortment	DR1, DR2	DA	Class capturing the concepts in an omnichannel assortment that embodies its decision levels and channel structure.	Schäfer *et al.* (2023); Ratchford *et al.* (2023); Hense and Hübner (2022); Bertrandie and Zielke (2019); Rooderkerk and Kök (2019); Bertrandie and Zielke (2017); Ma (2016); Emrich *et al.* (2015); Zhang *et al.* (2010)
Consumer Confusion	DR1, DR3, DR6	MF	Class capturing the consumer confusion concept, its dimensions, antecedents, and consequences.	Chauhan and Sagar (2021); Bertrandie (2020); Bertrandie and Zielke (2017); Garaus and Wagner (2016); Wobker *et al.* (2015); Anninou (2013); Walsh and Mitchell (2010); Mitchell *et al.* (2005); Mitchell and Papavassiliou (1999); Turnbull *et al.* (2000)
Omnichannel Customer Journey	DR1, DR4	MF	Class capturing the concepts of customer journeys in the context of omnichannel retailing. Represents the umbrella concept for channel switching behaviour.	Neslin (2022); Van Nguyen *et al.* (2022); Timoumi *et al.* (2022); Aw *et al.* (2021); Bijmolt *et al.* (2021); Frasquet and Miquel-Romero (2021); Schneider and Zielke (2021); Aw (2020); Flavián *et al.* (2020); Manss *et al.* (2020); Herhausen *et al.* (2019); Kang (2018); Genlser *et al.* (2017); Lemon and Verhoef (2016); Flavián *et al.* (2016); Hsiao *et al.* (2012); Butler and Peppard, (1998)
Retail Performance	DR1, DR6	CS	Class capturing financial and non-financial performance indicators in retailing.	Cakir *et al.* (2019); Kranzbühler *et al.* (2018); Lemon and Verhoef (2016); Melnyk *et al.* (2014); Ittner and Larcker (1998); Neely *et al.* (1995)

DR = Design Requirement; DA = Decision Area; MF = Marketing Function; CS = Corporate Strategy.

(3) Definition of Properties and Constraints

Properties are applied where possible and purposeful and constraints where necessary. Property types are distinguished between the types *String* (alphanumeric text), *Number* (numeric value), and *Instance* (a property defined as an instance represented by another class). Moreover, properties can have more than one value assigned (multiple cardinalities) where appropriate (Noy and McGuiness, 2001). Constraints on the properties of classes are determined by their theoretical basis naturally (e.g., decision levels on omnichannel assortment decisions are currently limited to three different types of decisions as per the state of knowledge in omnichannel assortment research). Moreover, Noy and McGuinness (2001) suggest not containing all the possible properties but limiting the integration based on the aim and scope of the ontology. In the ontology, there are no properties defined for the subclasses of tactical and operational assortment decisions since they represent concepts out of the scope of the study as stated above.

Omnichannel Assortment Properties and Constraints

For the subclasses *Offline* and *Online Assortment*, string properties are applied to allow (multiple) instantiations as expressions of off-/online assortments. An *Offline Assortment* can be instantiated in different physical *store types*, e.g., the assortment of a brick & mortar (B&M) store, flagship store, shop-in shop, outlet store, etc. Literature provides classifications of retail format types (e.g., Deloitte, 2022; Shi *et al.*, 2018; Levy *et al.*, 2012). However, to reduce complexity in the ontology, two types are applied as properties: "B&M Store" type covers the conventional offline physical store types whereas "other" is addressing any other type (shop-in shop, outlet store, etc.). Similarly, *Online Assortment* (string) can be instantiated as a "Web-shop Assortment", "Mobile Shop Assortment", "Social Media Shop Assortment", or "other" covering other digital shops (e.g., PlayStation Store, app stores of mobile phones). The subclasses *Online* and *Offline Channel Expansion* (*Assortment Expansion,* Rooderkerk and Kök, 2019) can be instantiated via the *instances* of the on- and offline assortment under the relationship "creates" (e.g., online channel expansion is realised through the creation of the instance "Mobile Shop Assortment") to emphasise the execution character of the decision. The values are mapped accordingly. Similarly, the subclasses of *Symmetric Assortment Integration* and *Asymmetric Assortment Integration* are assigned the properties of offline assortment and online assortment each to instantiate them via the instances of the on- and offline assortment as *offline* and *online store types*, e.g., a full assortment integration is evident by a web-shop assortment and a

B&M store assortment that are identical to each other. The properties and constraints are outlined below (**Table 21**).

Table 21: *Literature-informed Omnichannel Assortment properties and constraints*

Class	Property	Type	Constraints	Values	Literature source (key)
Offline Assortment	Store Type	String	2 (multiple)	"B&M Store Assortment"; "other"	Deloitte (2022); Shi *et al.* (2018); Levy *et al.* (2012)
Online Assortment	Store Type	String	4 (multiple)	"Web-shop Assortment"; "Mobile Shop Assortment"; "Social Media Shop Assortment"; "other"	
Offline Channel Expansion	Store Type	Instance	2 (multiple)	Offline Assortment Instances	Rooderkerk and Kök (2019)
Online Channel Expansion	Store Type	Instance	4 (multiple)	Online Assortment Instances	
Full Assortment Integration	Offline Store Type	Instance	2 (multiple)	Offline Assortment Instances	Bertrandie and Zielke (2019); Rooderkerk and Kök (2019); Bertrandie and Zielke (2017); Emrich *et al.* (2015)
	Online Store Type	Instance	4 (multiple)	Online Assortment Instances	
No Assortment Integration	Offline Store Type	Instance	2 (multiple)	Offline Assortment Instances	
	Online Store Type	Instance	4 (multiple)	Online Assortment Instances	
Asymmetric Type A	Offline Store Type	Instance	2 (multiple)	Offline Assortment Instances	
	Online Store Type	Instance	4 (multiple)	Online Assortment Instances	
Asymmetric Type B	Offline Store Type	Instance	2 (multiple)	Offline Assortment Instances	
	Online Store Type	Instance	4 (multiple)	Online Assortment Instances	
Asymmetric Type C	Offline Store Type	Instance	2 (multiple)	Offline Assortment Instances	
	Online Store Type	Instance	4 (multiple)	Online Assortment Instances	

Consumer Confusion Properties and Constraints

The properties of the consumer confusion *Dimensions* are linked to the antecedents of the consumer confusion with the association "*cause*" (type: instance; with the values "Informational" and "Individual and Situational") (Chauhan and Sagar, 2021; Garaus and Wagner, 2016; Anninou, 2013; Walsh and Mitchell, 2010; Mitchell *et al.*, 2005). Properties of the subclasses *Information Overload*, *Information Similarity*, and *Information Ambiguity*, as well as *Situational* and *Individual Source* are defined as *triggers* (type: string, multiple sources possible) to reflect the main source of the antecedent characteristics that cause confusion. Here, the trigger "Inconsistencies between offline and online assortment" as an instance for the *Information Overload* subclass is added since "*When confronted with comparing assortments in different channels, the amount of information to be processed should be lower if assortments contain the same products because comparison is facilitated.*" Bertrandie and Zielke (2017, p. 439). However, it is argued that this also holds true in view of the experience of inconsistencies in information processing as captured by the ambiguity dimension of confusion. Therefore, the instance is also added to the *Information Ambiguity* subclass. The triggers are provided by Chauhan and Sagar's (2021) overview of the different sources including the addition described above (**Table 22**).

Table 22: *Antecedents of Consumer Confusion (adopted from Chauhan and Sagar, 2021)*

	Subclass	**Triggers as property values**
Informational	Information Overload (6)	The volume of sources, increasing choice sets, stimuli variety, product proliferation, increased number of product features or attributes, and *inconsistencies between offline and online assortment* (Bertrandie and Zielke, 2017; Zhang *et al.*, 2010; Neslin and Shankar, 2009)
	Information Similarity (7)	Perceived product similarity, stimulus similarity, country of origin/source, packaging, colour, design, labelling and physical characteristics imitation
	Information Ambiguity (10)	Stimuli complexity or conflict, inconsistency of information, fuzzy or misleading advertising, lack of clarity in marketing communications, conflicting or false claims, inappropriate product positioning, product newness and complexity, non-transparent pricing, tariffs and discounts, *inconsistencies between offline and online assortment*
Non-Informational	Individual Source (10)	Cognitive style, decision-making style, brand experience, involvement in the purchase, awareness, loyalty, motivation, tolerance, need for cognition, learning history
	Situational Source (4)	Shopping environment (physical, social and temporal), store environment, atmospherics, task definition and time constraints

The *Short-term Consequences* are characterised by the specific channel the consequence occurs, e.g., Purchase Abandonment occurring at the online channel. The string property type has therefore two possible exclusive values: "Offline Channel" and "Online Channel". *Long-term Consequences* are described by the property related to the instance of the *Post-Purchase* subclass *Post-Purchase Evaluation* (superclass: *Customer Journey Phases*) with the association "*cause*" e.g., the post-purchase evaluation caused a loss in trust. The overview of the properties and constraints for the consumer confusion domain is provided below (**Table 23**).

Table 23: *Literature-informed Consumer Confusion properties and constraints*

Class	Property	Type	Constraints	Values	Literature source (key)
Cognitive Confusion	Cause	Instance	2 (multiple)	"Informational"; "Individual and Situational"	Chauhan and Sagar (2021); Garaus and Wagner (2016); Anninou (2013); Walsh and Mitchell (2010); Mitchell *et al.* (2005)
Affective Confusion	Cause	Instance	2 (multiple)	"Informational"; "Individual and Situational"	
Conative Confusion	Cause	Instance	2 (multiple)	"Informational"; "Individual and Situational"	
Information Overload	Trigger	String	6 (multiple)	*see **Table 22***	Chauhan and Sagar (2021)
Information Similarity	Trigger	String	7 (multiple)	*see **Table 22***	
Information Ambiguity	Trigger	String	9 (multiple)	*see **Table 22***	
Individual Source	Trigger	String	10 (multiple)	*see **Table 22***	
Situational Source	Trigger	String	4 (multiple)	*see **Table 22***	
Purchase Abandonment	Channel	String	2	"Offline Channel"; "Online Channel"	Chauhan and Sagar (2021); Bertrandie and Zielke (2017)
Purchase Postponement	Channel	String	2	"Offline Channel"; "Online Channel"	
Confusion Reduction	Channel	String	2	"Offline Channel"; "Online Channel"	
Decision Avoidance	Channel	String	2	"Offline Channel"; "Online Channel"	
Reactance	Channel	String	2	"Offline Channel"; "Online Channel"	
Cognitive Dissonance	Channel	String	2	"Offline Channel"; "Online Channel"	
Confusion of other Customers	Channel	String	2	"Offline Channel"; "Online Channel"	
Helplessness	Channel	String	2	"Offline Channel"; "Online Channel"	
Negative WOM	Cause	Instance	1	"Post-Purchase Evaluation"	Chauhan and Sagar (2021); Bertrandie and Zielke (2017)
Shopping Fatigue	Cause	Instance	1	"Post-Purchase Evaluation"	
Loss in Loyalty	Cause	Instance	1	"Post-Purchase Evaluation"	
Loss in Trust	Cause	Instance	1	"Post-Purchase Evaluation"	
Negative Impact on Brand Image	Cause	Instance	1	"Post-Purchase Evaluation"	
Dissatisfaction	Cause	Instance	1	"Post-Purchase Evaluation"	
Purchase Intention	Cause	Instance	1	"Post-Purchase Evaluation"	

Omnichannel Customer Journey Properties and Constraints

Each *Customer Journey Phase* is assigned a string property capturing the possible *activity* of each step as a property value (e.g., “Need Recognition & Information Search” in the pre-purchase phase) (Bijmolt *et al.*, 2021). Hereby, the property cardinality is set as “multiple” allowing more than one value instantiated, e.g., “Need Recognition & Information Search” and “Alternatives Evaluation”. The channel switching paths for *Show*- and *Webrooming* (switching from the *Offline Channel to Online Channel* and vice versa) either on the basis of the *same* or *different* retailers can be instantiated through the instances of the off- and online assortment. However, this is only the case for the *same* retailer instance. For the *different* retailer instances, the other channel is undefined since the assortment is based on competitor assortment outside the scope of the ontology. As mentioned earlier, multiple switching behaviour (“Omni-shopping”, Section 2.6.1) is not regarded in the behaviour scenario (restricted to one value instance per property) to reduce complexity.

Table 24: *Literature-informed Omnichannel Customer Journey properties and constraints*

Class	Property	Type	Constraints	Values	Literature source (key)
Pre-Purchase	Activity	String	2 (multiple)	“Need Recognition” & Information Search”; “Alternatives Evaluation”	Bijmolt *et al.* (2021)
Purchase	Activity	String	2 (multiple)	“Choice Making”; “Actual Order Placement”	
Post-Purchase	Activity	String	3 (multiple)	“Consumption”; “Return”; “Post-Journey Evaluation”	
Offline Channel to Online Channel (same)	Offline Store Type	Instance	2	Offline Assortment Instances	Van Nguyen *et al.* (2022); Bijmolt *et al.* (2021); Frasquet and Miquel-Romero (2021); Schneider and Zielke (2021); Kang (2018); Manss *et al.* (2020); Genlser *et al.* (2017)
	Online Store Type	Instance	4		
Offline Channel to Online Channel (different)	Offline Store Type	Instance	2	Offline Assortment Instances	
Online Channel to Offline Channel (same)	Online Store Type	Instance	4	Online Assortment Instances	
	Offline Store Type	Instance	2	Offline Assortment Instances	
Online Channel to Offline Channel (different)	Online Store Type	Instance	4	Online Assortment Instances	
Offline Channel Only	Offline Store Type	Instance	2	Offline Assortment Instances	Neslin (2022); Timoumi *et al.* (2022)
Online Channel Only	Online Store Type	Instance	4	Online Assortment Instances	

The subclasses of *Non-Switching* behaviour *Offline Channel Only* and *Online Channel Only* are instantiated by the corresponding off- and online assortment. An overview of the properties and constraints is provided in **Table 24**.

Retail Performance Properties and Constraints

Properties for the subclasses *Financial-* and *Non-Financial Performance* are defined as any *metric* (string) retrieved from the KPI collection provided in **Table 49** and **Table 50** in **Appendix D-1** that are suitable to be utilised (**Table 25**).

Table 25: *Literature-informed Retail Performance properties and constraints*

Class	Property	Type	Constraints	Values	Literature source (key)
Financial Performance	Metric	String	-	*See **Table 49** and **Table 50***	Cakir *et al.* (2019)
Non-Financial Performance	Metric	String	-	*See **Table 49** and **Table 50***	

Relational Properties

The rationale for the links and associations between classes and instances stem primarily from literature and logical reasoning and captures influences such as cause-effect relationships (e.g., antecedents leading to consequences) or behavioural relation (showrooming representing a form of switching channels). Most of the hierarchical relations between classes are defined as an "is a subclass of" association by describing them through an "is a" or "has a" relation, e.g., "Assortment Coordination *is a* Strategic Assortment Decision", or "Omnichannel Assortment *has* Decision Levels". However, non-hierarchical relations are labelled individually, e.g., "Online Channel Expansion *creates* an Online Assortment". The hierarchical level of the positioning of the relations is following the guideline from Noy and McGuinness (2001) advising to keep the hierarchical level for the related classes at a specific level that sufficiently informs about the logic of the relation (assigning on not too abstract or not too detailed levels). Moreover, it should be noted that the relations between the decision levels have been omitted deliberately since the focus of the ontology lies on strategic assortment decisions. **Table 26** provides an overview of the non-hierarchical relations below. To begin with, *Omnichannel Assortment* can be described as being "experienced through" *Omnichannel Customer Journey* as this statement seems logical based on the literature (Bijmolt *et al.*, 2021; Rooderkerk and Kök, 2019; Bertrandie and Zielke, 2017). Straightforward is the relation between the classes *Assortment Integration Type* and *Omnichannel Assortment*, described as "applies on" (Bertrandie and Zielke, 2019; Bertrandie and Zielke, 2017; Emrich *et al.*, 2015), allowing statements such as “a full integration approach is applied on the omnichannel assortment”. With regard to relations in the consumer confusion domain, the *Antecedents* “cause” the different phenomena expressed as the dimensions of the *Consumer Confusion* phenomenon (e.g., Garaus and Wagner, 2016; Mitchell *et al.*, 2005). The occurrence of the different consumer confusion *Dimensions* again “lead to” various *Consequences* (e.g., Garaus and Wagner, 2016; Walsh and Mitchell, 2010; Walsh *et al.*, 2007; Mitchell *et al.,* 2005; Mitchell and Papavassiliou, 1999). Following the causal chain further, the *Consequences* “affect negatively” *Retail Performance* (e.g., Hense and Hübner, 2022; Bertrandie, 2020; Wobker *et al.*, 2015). In the Omnichannel Customer Journey Domain, the different customer journey phases are related to each other through a sequence. The *Pre-Purchase* phase is “followed by” the *Purchase* phase which in turn is “followed by” the *Post-Purchase* phase. The *Post-Purchase* phase then again “informs” the *Pre-Purchase* phase based on post-journey evaluation outcomes, closing the loop (e.g., Bijmolt *et al.*, 2021; Lemon and Verhoef, 2016; Howard and Sheth 1969). Lastly, the *Customer Journey Phases* “can show” *Channel Switching Behaviour* as a typical consumer characteristic in omnichannel retailing (e.g., Van Nguyen *et al.*, 2022; Bijmolt *et al.*, 2021; Schneider and Zielke, 2021; Hsiao *et al.*, 2012), followed by the fact that a customer “is exposed to” *Inconsistencies between Offline and Online Assortment* while showing *Channel Switching Behaviour* (Bertrandie, 2020; Bertrandie and Zielke, 2017; Zhang *et al.*, 2010; Neslin and Shankar, 2009), especially in the activities “Alternatives evaluation” and “Information Search” (Sarabhai and Singh, 2014). However, based on the proposition by e.g., Rooderkerk and Kök (2019), Berry *et al.* (2010), Zhang *et al.* (2010), and Neslin and Shankar (2009), a *Full Assortment Integration* approach is favourable to preventing consumer confusion completely, meaning, it prevents the occurrence of *Inconsistencies between Offline and Online Assortment*. This relation is captured by the description “cancels out”. The relations of the other integration types are not made explicit in the ontology since in this research it is proposed that the full integration approach is the only type that is capable of nullifying assortment inconsistencies.

Table 26: *Literature-informed non-hierarchical relations between classes*

Class	Type	Relation	Class	Type	DR	Literature source (key)
Omnichannel Assortment	Super-class	“is experienced through”	Omnichannel Customer Journey	Superclass	DR1	Bijmolt *et al.* (2021); Bertrandie (2020); Bertrandie and Zielke (2019); Rooderkerk and Kök (2019); Bertrandie and Zielke (2017); Logical Reasoning

Offline Channel Expansion	Subclass	"creates"	Offline Assortment	Subclass	DR2	Rooderkerk and Kök (2019); Logical Reasoning
Online Channel Expansion	Subclass	"creates"	Online Assortment	Subclass	DR2	
Assortment Integration Type	Subclass	"applies on"	Omnichannel Assortment	Superclass	DR2	Bertrandie and Zielke (2019); Rooderkerk and Kök (2019); Bertrandie and Zielke (2017); Emrich *et al.* (2015)
Antecedents (Consumer Confusion)	Subclass	"cause"	Consumer Confusion	Superclass	DR3	Garaus and Wagner (2016); Walsh and Mitchell (2010); Mitchell *et al.* (2005); Foxman *et al.* (1990)
Dimensions (Consumer Confusion)	Subclass	"lead to"	Con-sequences (Consumer Confusion)	Subclass	DR3	Shiu and Tzeng (2018); Bertrandie and Zielke (2017); Garaus *et al.* (2016); Walsh and Mitchell (2010); Walsh *et al.* (2007); Mitchell *et al.* (2005); Turnbull *et al.* (2000); Mitchell and Papavassiliou (1999); Foxman *et al.* (1992); Foxman *et al.* (1990); Settle and Alreck (1988)
Con-sequences (Consumer Confusion)	Subclass	"affect negatively"	Retail Performance	Superclass	DR1	Hense and Hübner (2022); Bertrandie (2020); Wobker *et al.* (2015); Logical Reasoning
Customer Journey Phases	Subclass	"can show"	Channel Switching Behaviour	Subclass	DR4	Van Nguyen *et al.* (2022); Bijmolt *et al.* (2021); Schneider and Zielke (2021); Lemon and Verhoef (2016); Hsiao *et al.* (2012)
Channel Switching Behaviour	Subclass	"is exposed to"	In-consistencies between on- and offline assortment	Instance (Information Overload, Information Ambiguity)	DR1	Bertrandie (2020); Bertrandie and Zielke (2017); Sarabhai and Singh (2014); Zhang *et al.* (2010); Neslin and Shankar (2009)
Full Assortment Integration	Subclass	"cancels out"	In-consistencies between on- and offline assortment	Instance (Information Overload, Information Ambiguity)	DR1	Rooderkerk and Kök (2019); Berry *et al.* (2010); Zhang *et al.* (2010); Neslin and Shankar (2009)
Pre-Purchase	Subclass	"followed by"	Purchase	Subclass	DR4	Bijmolt *et al.* (2021); Herhausen *et al.* (2019); Lemon and Verhoef (2016); Howard and Sheth (1969); Logical Reasoning
Purchase	Subclass	"followed by"	Post-Purchase	Subclass	DR4	
Post-Purchase	Subclass	"informs"	Pre-Purchase	Subclass	DR4	

(4) Creation of Instances

Instances of the classes have been created and defined accordingly. Exemplary instances are formulated as scenarios in natural language statements for each cluster below.

- An omnichannel retailer [decides] on a [strategic level] to [expand its assortment] in the [online channel] and [creates] an [online assortment] via the introduction of a [mobile] shopping app.
- [Information overload] is an [informational source] and an [antecedent] [causing] [cognitive] and [affective confusion].
- The [Pre-Purchase Phase] is a [Customer Journey Phase] in an [Omnichannel Customer Journey] where a customer [performs] [Showrooming] as a type of [Channel Switching Behaviour].
- [Customer Lifetime Value] is a metric for [Financial Performance] as an indicator to measure [Retail Performance].

(5) Generation of a Class Diagram

As a final step, a class diagram depicting all classes and their relations is generated and integrated into the final ontology shown in 4.3.3.

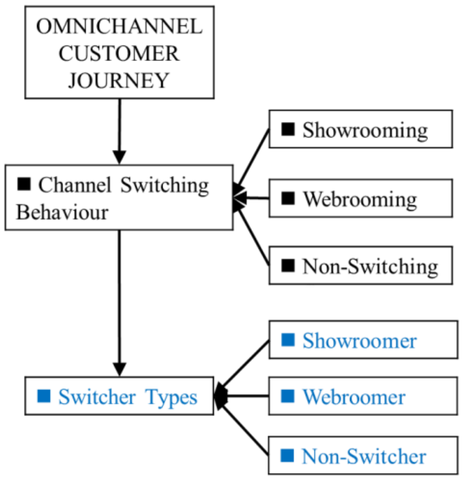
4.3.2 Practitioner-based Ontology

The practitioner-based ontology has been constructed on the basis of collaborative activity with the case study company involving FGs, expert interviews, and observational activities (FG1, FG2, E1 to E5, OB, Section 4.2.1). Concepts of the literature-based ontology served as guidance for the practitioners. However, to avoid biasing the practitioners, only the super-classes have been shown. Several new concepts, properties and associations among concepts emerged out of the discussions and have been added to the consolidated ontology. Additions to the ontology are primarily motivated out of the FG1, FG2, and E1-E5 discussions including a feedback loop from EVAL4.2. Some of the additions have been confirmed abductively by literature. There have been many potential contributions that have been omitted since being out of the scope of this study (e.g., assortment optimisation procedures and decisions, information on decision workflows, and product and SKU characteristics). The following describes the new concepts, properties, and their linkage to the ontology along the construction process.

(1) Additions to Terms and Classes

Along the discussions, for example, new terms such as "Showroomer", and "Webroomer" in the context of "(Non)-Omnichannel Shopper" emerged (DR4) (FG1; FG2; E2; E3; E5). On the basis of an abductive process, these terms have been confirmed to be existent in the literature describing an individual customer performing the specific channel switching behaviour (e.g., in Timoumi *et al.*, 2022; Eriksson and Fagerstrøm, 2019; Dahana *et al.*, 2018) and have been incorporated into the ontology as *Showroomer*, *Webroomer*, and *Non-Switcher* under the newly created *Channel Switching Behaviour* subclass labelled as *Switcher Types* (**Figure 39**).

Figure 39: *Practitioner-informed additions (highlighted in blue) to class hierarchy on "Omnichannel Customer Journey"*

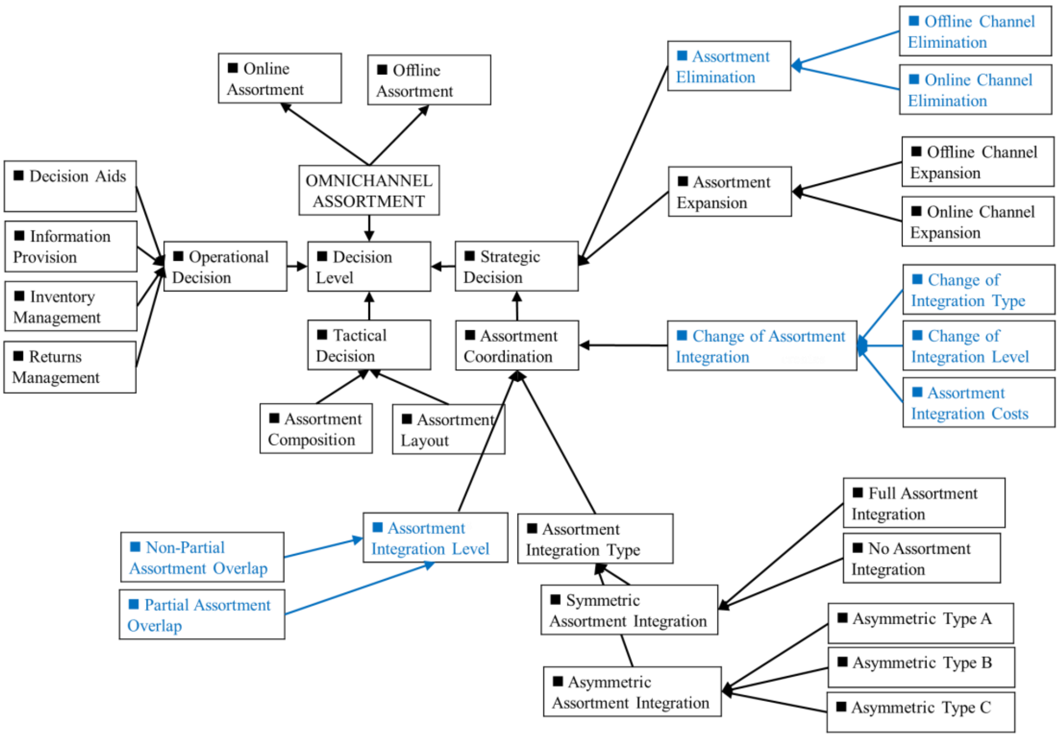


A Showroomer is a type of customer specifically entering a physical store first in the customer journey phase *Pre-Purchase* before visiting an online channel whereas a Webroomer is defined as a customer who already started the customer journey on the online channel before entering the physical store and a Non-Switcher is a customer following the traditional non-omnichannel journey without switching channels during the phases. These findings have also been incorporated into the discussion on the channel switching behaviour domain in Section 2.6.1.

Another topic emerged in the discussion of whether to define an additional superclass labelled as "Channels" since the terms "online" and "offline channel" emerged several times in the exchange (FG1). It makes sense to consider a superclass "Channels" with subclasses "Online" and "Offline" and instances such as "Web-Shop", and "Mobile-Shop", etc. in order to avoid redundancy in the ontology. However, this would occur at the expense of increased complexity in the linkages. As a result, an agreement between the FG participants on omitting the idea was made. Only for one addition though, the explicit distinction between off- and online channels is made (see below on *Channel Occurrence*). Further discussions agreed upon incorporating an additional decision within the subclass *Assortment Coordination* labelled as *Assortment Integration Level* accounting to determine a specific *degree* of overlap between channels (subclasses *Partial Assortment Overlap* and *Non-Partial Assortment Overlap*) next to deciding only on the integration type as contributed from the literature base (FG1; E1; E5). The discussions revealed that this would be necessary because the class *Assortment Integration Type* captures only what type of integration to apply (full vs. no vs. asymmetric integration), whereas *Assortment Integration Level* would represent additional information to characterise the integration. To justify the decision further, for example, an asymmetrical integration, that has a partial overlap, can be instantiated either with an overlap degree of 1% or 99% showing a huge difference in the configuration. Non-Partial overlap is defined as a binary overlap type, either no overlap or full overlap as the property value as discussed in the addition of properties section further below.

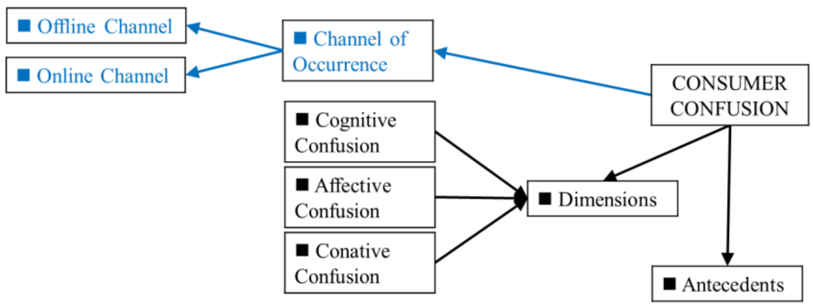
In the course of design decisions, an additional subclass labelled as *Change of Assortment Integration* was deemed necessary due to it being a valid strategic decision to trigger a change in the current assortment integration structure in the organisation. This addition is a result of the demonstration phase of the study (EVAL 4.2, Section 5.3.2) that fed back to the design and development phase (this phase). The defined subclasses are *Change of Integration Type* and *Level* which account for the two possible changes on the *Assortment Integration Type* as well as *Assortment Integration Level*. On the one hand, the assortment type should be changeable from one integration type to another, e.g., from an asymmetrical integration to a full integration approach. On the other hand, the assortment level should be adjustable either between full, no, or partial overlap (see below in the properties discussion). The subclass *Assortment Integration Costs* as a concept is introduced additionally to account for the significance of capturing the costs for integration efforts (e.g., to be considered in yearly budgeting and financial planning) (FG1; E1; E4; E5). Abduction reveals that this concept is indirectly addressed in the literature when oftentimes assumptions on the motivations of the retailers not to realise a full assortment integration are made (usually labelled as a “costly undergoing”) (Rooderkerk and Kök, 2019; Bhatnagar and Syam, 2014; Zhang *et al.*, 2010). The class was previously considered as a subclass of Assortment Coordination (FG1; E1; E4; E5) but was incorporated into the *Change of Assortment Integration* class after the evaluation based on EVAL4.2 (Section 5.3.2). Assortment integration costs can arise through the reallocation of SKUs across channels, e.g., through adding SKUs into the online- or offline assortment. Such activities can usually involve costs associated with occupying additional physical space (in-store and stockroom), training staff on the new products, updating POS cash systems, and other costs (e.g., printing new price tags) for physical stores or new product pictures, updating content management systems for web-shops but also costs associated with updating social media channels, re-optimisation and analytics efforts to optimise the new assortment structure across channels, or the impact on existing viabilities of delivery and returns policies (both channels) (FG1; E1). The additions are shown in **Figure *40***.

Figure 40: *Practitioner-informed additions (highlighted in blue) to class hierarchy on "Omnichannel Assortment"*



A further addition is introduced as the concept of *Channel of Occurrence* as a subclass of the Consumer Confusion superclass. This is to account to determine the "space" dimension of the occurrence of the consumer confusion phenomenon next to the "time" dimension that is already addressed through the *Omnichannel Customer Journey* superclass with its subclass *Customer Journey Phases* (E2; E3; OB). This addition is confirmed by observational data, revealing the occurrence of consumer confusion either on the offline channel, the online channel or even on both channels when the phenomenon is occurring in-store while performing a show- or webrooming via a mobile device (Rapp *et al.*, 2015; Santos and Gonçalves, 2019). It provides further characterisation of the phenomenon by stating which channel the effect occurs at. Thus, *Offline* and *Online Channel*, as well as *Off- and Online Channel* are added as subclasses additionally (**Figure 41**).

Figure 41: *Practitioner-informed additions (highlighted in blue) to class hierarchy on "Consumer Confusion"*



Lastly, during the ex-ante evaluation process in FG2, the strategic concept of *Assortment Elimination* was reflected. Inspired by the notion of "product elimination" from the marketing literature where deliberate elimination of specific products in the assortment is made based on strategic decisions (e.g., Homburg *et al.*, 2010; Baker and Hart, 2007; Avlonitis, 1983), the discussion led to the conclusion that retailers would not exclusively want to expand their assortment to new channels but also consider reduction of their assortment per channel. This motivated the introduction of a new sibling subclass with the description of *Assortment Elimination* denoting the option of eliminating a specific channel presence. Its subclasses correspond to the Assortment Expansion sibling subclass (*Online Channel Elimination* and *Offline Channel Elimination*) (**Figure 40**). The following **Table 27** provides the summary of the practitioner-informed additions of classes.

Table 27: *Practitioner-informed additions of classes*

Class	**DR**	**MOI**	**Description**	**Justification**
Switcher Types	DR4	MF	Class capturing the concept of individuals performing specific channel switching behaviour types.	FG1; FG2; E2; E3; E5; FG2; OB; confirmed in literature through e.g., Timoumi *et al.* (2022); Eriksson and Fagerstrøm (2019); Dahana *et al.* (2018)
Showroomer	DR4	MF	Subclass of *Switcher Types*. A *Showroomer* is a type of customer specifically entering a physical store first in the customer journey phase *Pre-Purchase* before visiting an online channel.	
Webroomer	DR4	MF	Subclass of *Switcher Types*. A *Webroomer* is defined as a customer who already started the customer journey on the online channel before entering the physical store.	
Non-Switcher	DR4	MF	Subclass of *Switcher Types*. A *Non-Switcher* is a customer following the traditional non-omnichannel journey without switching channels during the phases.	
Assortment Integration Level	DR2	DA	Class determining a specific type and degree of overlap between the assortments.	FG1; E1; E5; FG2

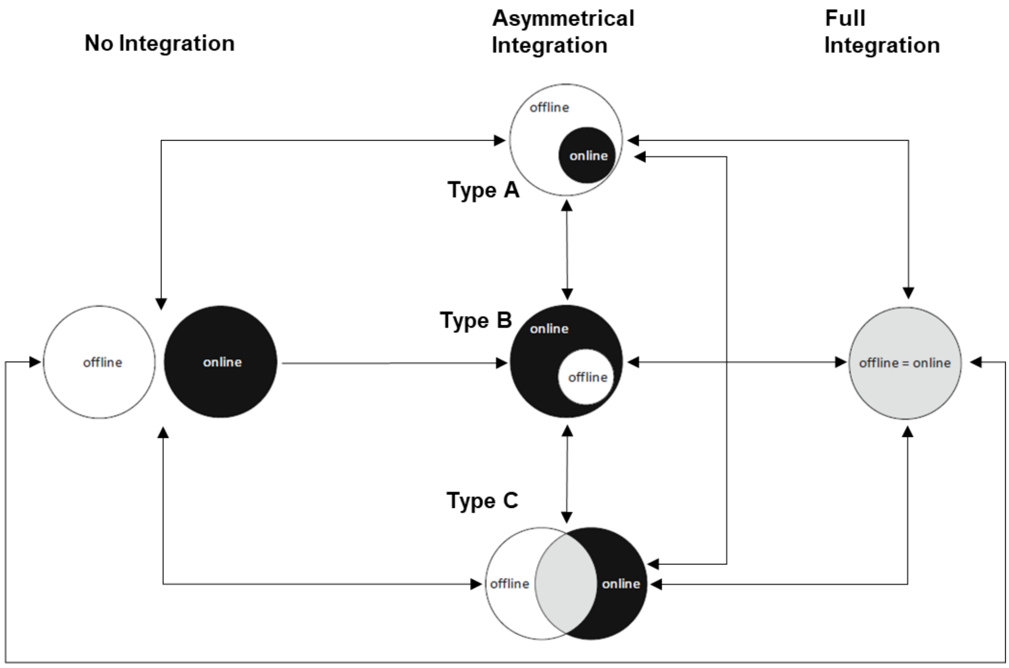
Partial Assortment Overlap	DR2	DA	Subclass of *Assortment Integration Level*. Captures any assortment overlap that is not either fully or not overlapping.	
Non-Partial Assortment Overlap	DR2	DA	Subclass of *Assortment Integration Level*. Captures any assortment overlap that is either fully or not overlapping.	
Change of Assortment Integration	DR2	DA	Class that accounts for the strategic decision in triggering a change in the current assortment integration structure.	EVAL4.2
Change of Integration Type	DR2	DA	Subclass of *Change of Assortment Integration*. Dedicated decision on changing the *Assortment Integration Type*.	
Change of Integration Level	DR2	DA	Subclass of *Change of Assortment Integration*. Dedicated decision on changing the *Assortment Integration Level*.	
Assortment Integration Costs	DR2	DA	Subclass of *Change of Assortment Integration* that captures the extent of the costs when changes on the assortment integration are made. This class is addressing the significance of capturing the costs for integration efforts.	FG1; E1; E4; E5; Rooderkerk and Kök (2019); Bhatnagar and Syam (2014); Zhang *et al.* (2010)
Assortment Elimination	DR2	DA	Class capturing the option to eliminate specific assortment channels opposite to Assortment Expansion.	FG2
Offline Channel Elimination	DR2	DA	Concept of eliminating the offline assortment.	
Online Channel Elimination	DR2	DA	Concept of eliminating the online assortment.	
Channel of Occurrence	DR3	MF	Subclass of the superclass *Consumer Confusion*. Concept accounting to the "space" dimension of the occurrence of the consumer confusion phenomenon.	E2; E3; OB
Offline Channel	DR3	MF	Consumer confusion occurring in the offline channel.	
Online Channel	DR3	MF	Consumer confusion occurring in the online channel.	
Off- and Online Channel	DR3	MF	Consumer confusion occurring in the off- and online channel at the same time.	

DR = Design Requirement; DA = Decision Area; MF = Marketing Function; CS = Corporate Strategy.

(2) Additions to Properties or Constraints

The new subclass *Assortment Integration Costs* is expressed by the properties "Absolute", capturing the absolute amount of costs, "Relative", capturing the relative amount of costs measured in percentage, and its association to a reference KPI (string, from "Sales", "Profit", or "Other"), reference Unit (string, "Company", "Business Unit", "Product Department", "Brand", "Channel", "Store", "Supplier", or "Other"), and the period (string, "Month", "Quarter", "Year" or "Other") (EI1; EI4; EI5; FG2). The property for the new class *Change of Integration Type* is defined as an instance type of property labelled "change" due to its linkage to the corresponding class *Assortment Integration Type* where the notion of change is applied either on "Symmetric Assortment Integration" or "Asymmetric Assortment Integration" (relational property). Possible changing paths have been elaborated and are presented in **Figure 42** (EVAL4.2). A retailer can change the integration from any type to another type. For instance, from an asymmetrical integration type C to full integration, then back again to asymmetrical integration type B. Thereafter to type A and so on.

Figure 42: *Changing paths for Assortment Integration Types (source: own illustration)*



Respectively, the same applies to the concept of *Change of Integration Level* with the property values "Partial Assortment Overlap" and "Non-Partial Assortment Overlap". These subclasses on the other hand, have the properties "Full Assortment Overlap"; "No Assortment Overlap" as two different (binary) expressions for a *Non-Partial Assortment Overlap*, and the "Degree of Overlap" as an expression for *Partial Assortment Overlap*. The property value has been elaborated as a value between 1 and 99%. Any other degree would correspond to no overlap (0%) or full overlap (100%) (FG1, EI3, EI4, FG2). Inspired by Campo *et al.* (2021) who offer an operationalisation of the assortment overlap that is "*the ratio of category's p online assortment size at the chain c over category p's offline assortment size at the chain c*", (p. 160), **Table 28** below provides an overview how the value ranges are operationalised via the development of mathematical expressions (based on the logic formula and Venn diagram operators, e.g., in Chen *et al.*, 2011). The assumption is that there are up to three different assortment sets at a time applied by a retailer with an off- and online channel. This perception is also confirmed by the observational data. These are defined as A_{offline} (assortment available offline), B_{online} (assortment available online), and C (assortment available off- as well as online). For a full integration approach, all three assortment sets exist – and they are all equal ($A_{offline} = B_{online} = C$). This corresponds to a 100% overlap of channels. No integration means there are only two assortment sets ($A_{offline}$, B_{online}) since C = 0 (0% overlap). Asymmetric Integration Type A, B and C are represented by all three assortment sets available at the same time where $B_{online} \subset A_{offline}$ and $C = B_{online}$ for Type A, $A_{offline} \subset B_{online}$ and $C = A_{offline}$ for Type B, and $C = A_{offline} \cap B_{online}$ for Type C. The degree of the overlap for type A is calculated by (B_{online} divided by $A_{offline}$) *100, and ($A_{offline}$ divided by B_{online}) *100 for type B respectively. However, for Type C, exclusive sets need to be determined first since none of the assortment sets capture the whole size of the assortment. These can be defined as X = assortment available exclusively offline and Y = assortment available exclusively online. With this proposition, the degree of overlap for type C integration can be calculated as C divided by (X+Y+C) *100.

Table 28: *Assortment sets and overlap degrees for Assortment Integration Level (source: own derivations)*

Instance	**Assortment Sets**	**Degree of Overlap**
No Integration (disjoint sets) 	$C = A_{offline} \cap B_{online} = \emptyset$ $(disjoint\ sets)$ $X = A_{offline}; Y = A_{online}$	0%
Full Integration 	$C = A_{offline} = B_{online}$ $X = \emptyset ; Y = \emptyset$	100%
Asymmetric Type A 	$C = B_{online} \subset A_{offline}$ $X = C - B_{onfline}; Y = \emptyset$	$\frac{B_{online}}{A_{offline}} * 100$
Asymmetric Type B 	$C = A_{offline} \subset B_{online}$ $X = \emptyset ; Y = C - A_{online}$	$\frac{A_{offline}}{B_{online}} * 100$
Asymmetric Type C 	$C = A_{offline} \cap B_{online}$ $X = A_{offline} - C; Y = B_{online} - C$	$\frac{C}{X + Y + C} * 100$

With $A_{offline}$ = set of items offered in the offline channel; B_{online} = set of items offered in the online channel; "C" = set of items offered on both offline and online channel; "X" = set of items offered exclusively on the offline channel; "Y" = set of items offered exclusively on the online channel; "Ø" = empty set / no intersection; ∩ = intersection; ⊂ = subset of.

The addition *Switcher Types* with its subclasses are assigned the following properties: *Non-Switcher* is instantiated by the instances of *Offline* and *Online Channel Only* from the class

Non-Switching. This is to denote that non-switching customers *stay* at a particular channel experiencing a particular assortment only. Analogically, the properties of *Show*- and *Webroomer* are represented by the instances *Offline/Online Channel to Online/Offline Channel* of the *same* or *different* retailer from the classes *Show*- and *Webrooming*. This is motivated by the fact that show- or webroomer are characterised by a "switches from" relation with the corresponding switching type (see further below) (FG1; FG2; E2; E3; E5; OB). The additions *Offline* and *Online Channel* (*Channel of Occurrence*) are not assigned specific properties but are linked to the *Offline* and *Online Assortment* via the hierarchical link "has" (E2; E3). Lastly, the subclasses *Online* and *Offline Channel Elimination* (*Assortment Elimination*) can be instantiated via the instances of the *On*- and *Offline Assortment* class under the relationship "eliminates" (FG2). The practitioner-informed property and constraint additions are summarized below in **Table 29**.

Table 29: *Practitioner-informed additions to properties and constraints*

Class	Property	Type	Constraints	Values	Literature source (key)
Assortment Integration Costs	Absolute	Number	Any number ≥ 0	[number]	FG1; E1; E4; E5
	Relative	Percentage	0-100	[percentage value]	
	Reference KPI	String	3	"Sales", "Profit", "Other"	
	Reference Unit	String	8	"Company"; "Business Unit"; "Product Department"; "Brand"; "Channel"; "Store"; "Supplier"; "Other"	
	Period	String	4	"Month"; "Quarter"; "Year"; "Other"	
Change of Integration Type	Change	String	2	"Symmetric Assortment Integration"; "Asymmetric Assortment Integration"	EVAL4.2
Change of Integration Level	Change	String	2	"Partial Assortment Overlap"; "Non-Partial Assortment Overlap"	
Partial Assortment Overlap	Degree of Overlap	Percentage	1-99	[percentage value]	FG1; E1; E5; FG2; OB
Non-Partial Assortment Overlap	Type	String	2	"Full Assortment Overlap"; "No Assortment Overlap"	
Offline Channel Elimination	Store Type	Instance	2 (multiple)	Offline Assortment Instances	FG2
Online Channel Elimination	Store Type	Instance	4 (multiple)	Online Assortment Instances	
Non-Switcher	Stay	Instance	2	"Offline Channel Only"; "Online Channel Only"	FG1; FG2; E2; E3; E5; OB
Showroomer	Switch	Instance	2	"Offline Channel to Online Channel (same)"	

				"Online Channel to Offline Channel (different)"
Webroomer	Switch	Instance	2	"Online Channel to Online Channel (same)" "Offline Channel to Offline Channel (different)"
Offline Channel Only	Store Type	Instance	2	Offline Assortment Instances
Online Channel Only	Store Type	Instance	4	Online Assortment Instances

Additional relational properties have been identified and assigned to the specific classes (**Table 30**).

Table 30: *Practitioner-informed additions to non-hierarchical relations between classes*

Class	Type	Relation	Class	Type	DR	Literature source (key)
Assortment Integration Level	Subclass	"applies on"	Omnichannel Assortment	Superclass	DR2	FG1; E1; E5; FG2
Non-Partial Assortment Overlap	Subclass	"applies on"	Symmetric Assortment Integration	Subclass	DR2	
Partial Assortment Overlap	Subclass	"applies on"	Asymmetric Assortment Integration	Subclass	DR2	
Change of Integration Type	Subclass	"changes"	Assortment Integration Type	Subclass	DR2	EVAL4.2
Change of Integration Level	Subclass	"changes"	Assortment Integration Level	Subclass	DR2	
Change of Assortment Integration	Subclass	"causes"	Assortment Integration Costs	Subclass	DR2	
Assortment Integration Costs	Subclass	"affect negatively"	Retail Performance	Superclass	DR1	
Retail Performance	Superclass	"enables"	Change of Assortment Integration	Subclass	DR1	
Offline Channel Elimination	Subclass	"eliminates"	Offline Channel	Subclass	DR2	FG2
Online Channel Elimination	Subclass	"eliminates"	Online Channel	Subclass	DR2	

To begin with, the new class *Assortment Integration Level* is associated with *Omnichannel Assortment* through the relation "applies on" to express the application character of the decision. Equally, the subclasses *Non-Partial/Partial Assortment Overlap* are "applied on" *Symmetric/Asymmetric Assortment Integration* (FG1; E1; E5; FG2). Moreover, the new classes *Change of Integration Type* and *Level* are linked to their respective association with *Assortment Integration Type* and *Level* decisions. The links are denoted with "changes". With this, the link of the changing activities to the *Assortment Integration Costs* is argued:

with a *Change of Assortment Integration*, integration costs occur due to reconfiguration measures of assortment across channels (EVAL4.2). This relation is denoted with the label "causes". With this, a negative effect of the integration costs on the *Retail Performance* is argued to be considered as well (EVAL4.2). However, *Retail Performance* is the key concept that relates to the *Change of Assortment Integration* capability due to essentially "enabling" the change (EVAL4.2). Lastly, *Offline/Online Channel Elimination* is associated with the *Offline/Online Assortment* with the denotation of "eliminates" (FG2).

(3) Addition to Instances

Instances of the new concepts have been elaborated and scenario examples in natural language are formulated as follows (with "[ ]" highlighting the instances):

- The [Pre-Purchase Phase] is a [Customer Journey Phase] in an [Omnichannel Customer Journey] where a customer [performs] [Showrooming] as a type of [Channel Switching Behaviour] being [exposed to] [Inconsistencies between the off- and online assortment] triggering [Information Overload] and thus [causing] [Consumer Confusion].
- An omnichannel retailer [decides] on a [strategic level] to [eliminate] its [online assortment] and [eliminates] an [online assortment] via the elimination of a [mobile] shopping app.
- A retailer decides to [Change] the [Assortment Integration Type] and switches from a [Full Assortment Integration] approach to an [Asymmetrical Assortment Integration] [Type B].

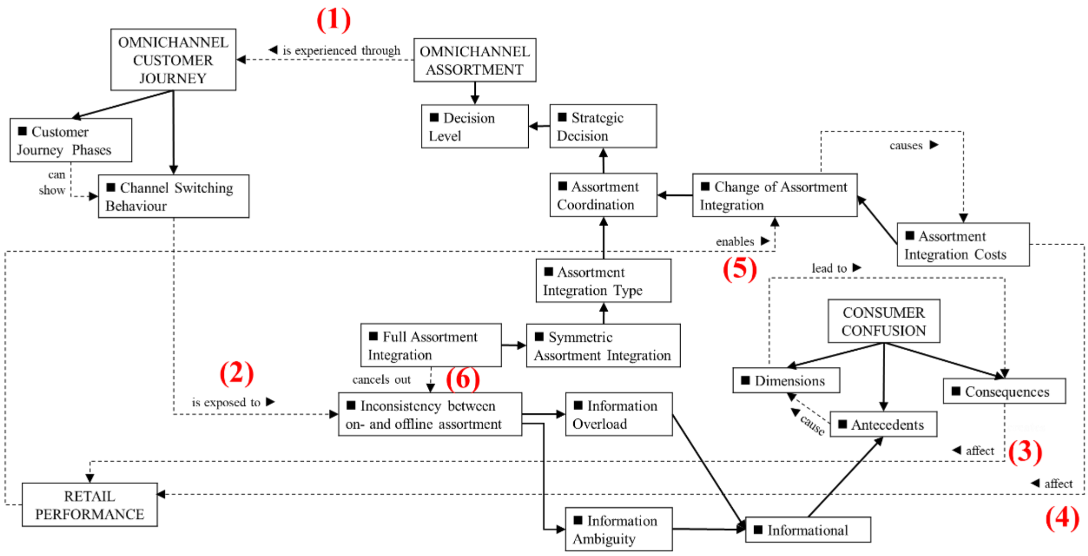
4.3.3 Consolidated Omnichannel Assortment Ontology for Consumer Confusion

The combined knowledge of the literature-based and practitioner-informed ontology has been consolidated into the "Omnichannel Assortment Ontology for Consumer Confusion" and visualised as a class diagram (**Figure 44**). The practitioner-informed additions are made explicit in the diagram through blue highlighting.

Aligning Strategic Assortment Decisions to the Consumer Confusion Concept

To meet DR1, the ontology is required to align the concepts from the knowledge domain Omnichannel Assortment to the Consumer Confusion concept. The ontology establishes this link through the integration of each domain and dedicated associations between concepts within these domains. The relevant key concepts and relations accomplishing this are carved out of the ontology and shown below in **Figure 43**.

Figure 43: *Relevant classes and relations establishing the alignment between the knowledge domains*

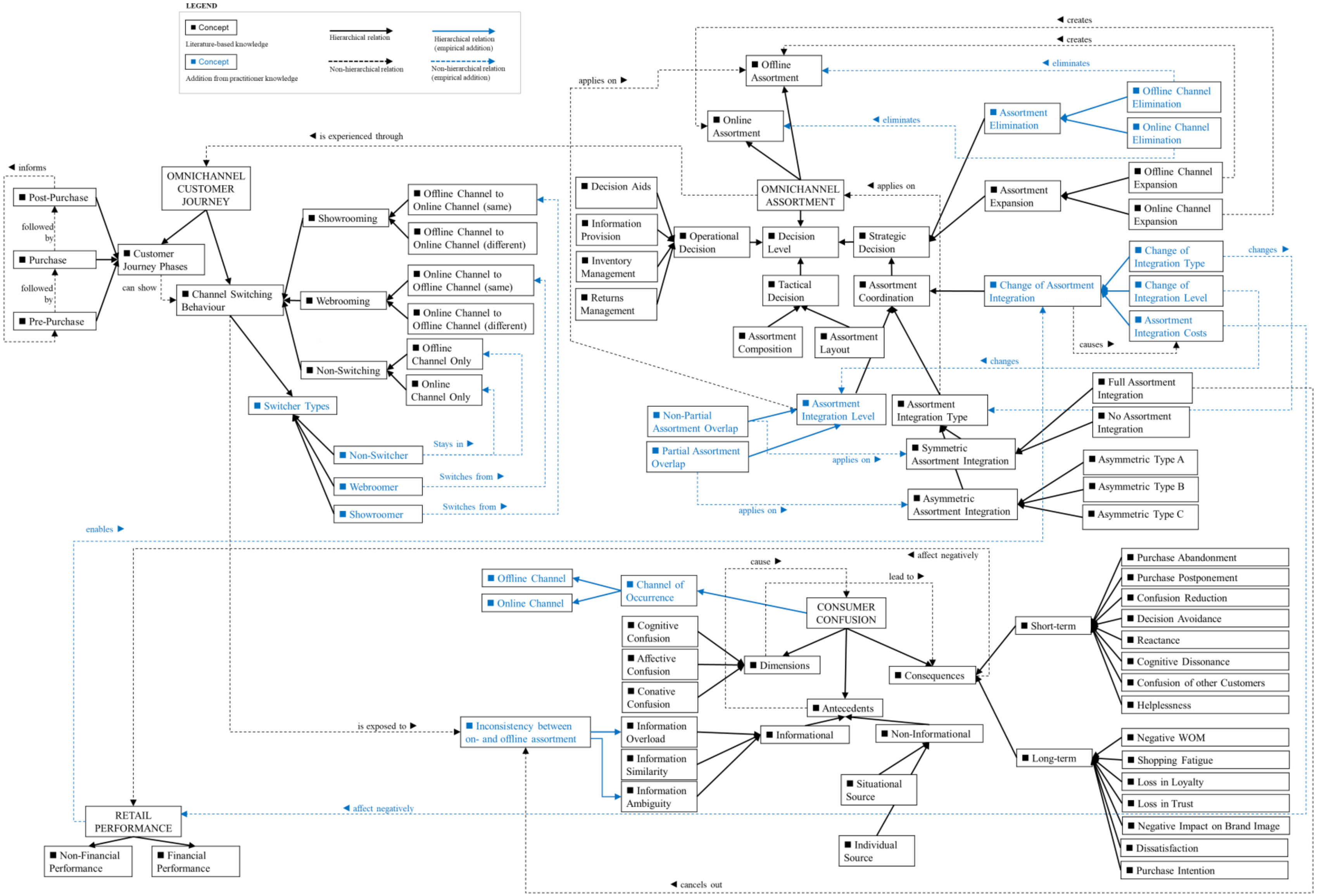


Specifically, the alignment is established through 6 linkages (highlighted in red numbers). The first link relates the *Omnichannel Assortment* domain to the *Omnichannel Customer Journey* domain (1). The second link is represented by the class *Channel Switching Behaviour* related to the *Consumer Confusion* domain via an instance of the *Information Overload* class (2). The *Consequences* class within the *Consumer Confusion* domain connects to the *Retail Performance* domain in the third link (3). The fourth link is evident in the class *Assortment Integration Costs* connecting to the *Retail Performance* domain (4). The fifth link is established by the *Retail Performance* domain connecting back to the *Change of Assortment Integration* class (5). Lastly, a link between the *Omnichannel Assortment* and *Consumer Confusion domain* is evident in the sixth link (6).

Formalisation of the ontology

The formalisation of the ontology is undergone via the utilisation of Protégé, the ontology development software introduced by Stanford University (2019) (**Appendix D-3**). Following the guideline by DeBellis (2021) which is a revised version based on Horridge *et al.* (2009), and the latest Protégé Documentation by Standford University (2023), the ontology is successfully formalised into the OWL language. Protégé incorporates several reasoner plugins to allow users the execution of reasoning tasks on the ontology. A reasoner typically analyses potential logical inconsistencies (e.g., hierarchy structure, annotations or property issues) before doing so and reports results via the Protégé log file. After the complete implementation of the ontology, the reasoner ("HermiT 1.4.3.456") reports no errors as displayed by the log file (**Appendix D-2**) and thus confirms a successful formalisation.

Figure 44: *Consolidated "Omnichannel Assortment Ontology for Consumer Confusion"*



4.4 Summary

Within this chapter, the Omnichannel Assortment Ontology for Consumer Confusion is designed and developed. The process of the construction involves the merging of a literature-informed ontology with a practitioner-informed ontology based on the collaborative activity with a case study retail SME company. Focus groups, expert interviews, and observational activities were defined as means for empirical data collection during this phase. The ontology establishes the alignment between strategic assortment decisions and the consumer confusion concept via the incorporation of a channel switching behaviour and a retail performance perspective and thus effectively addresses the Main-RQ of this research project. Throughout the construction process, several new concepts and relations emerged out of the discussion with individuals from the case company. These empirically grounded additions are new in the field of omnichannel retailing research and provide valuable contributions to the current discourse in the relevant field.

However, to prove whether the artefact is able to meet the solution objectives as defined for this research, demonstration and evaluation activities are required. The next chapter is dedicated to the next phase within the DSRM and presents the demonstration and evaluation of the Omnichannel Assortment Ontology for Consumer Confusion.

CHAPTER 5 – DEMONSTRATION

5

"Human beings, viewed as behaving systems, are quite simple. The apparent complexity of our behavior over time is largely a reflection of the complexity of the environment in which we find ourselves."

— Herbert A. Simon,
The Sciences of the Artificial

5.1 Introduction

The previous chapter outlines the construction of the consolidated Omnichannel Assortment Ontology for Consumer Confusion. However, in order to assess to what extent the artefact is able to meet the solution objectives as defined in Chapter 1, this chapter covers the demonstration of the ontology based on a real-world case study that is different from the context in which the development of the ontology is based. Demonstration as part of the DSRM aims at showing that the use of the artefact is capable of solving one or more instances of the problem (Peffers *et al.*, 2007) thus effectively serving as a validation activity of the artefact (Winter and Aier, 2015). The demonstration can be accomplished by involving a case study, experiment, simulation, or similar activities that can prove its use (Peffers *et al.*, 2007). The demonstration study of this research combines a case study approach with the use of a system dynamics-based simulation. The case company is an SME retailer facing a problem located in the assortment decision area within the MOI, requiring an alignment between strategic assortment decisions and the consumer confusion concept. Motivated by the nature of the case problem, the use of the ontology is demonstrated via the development of a SDM, that is informed by relevant classes, linkages, and class properties from the ontology. The next sections describe the demonstration approach and provide details on the case study company and the case problem first. Thereafter, the approach to how the ontology serves as a reference model to inform the SDM development is presented, followed by a detailed description of the SD development steps. Lastly, a discussion on how the ontology effectively demonstrates the alignment between strategic assortment decisions and the consumer confusion concept through the use of the SDM in a case study concludes the demonstration phase.

5.2 Case Study Company

The medium-sized retail company is based in Ireland and utilises several physical stores and a web-shop following an omnichannel approach. The company was founded in 2010 and employs over 200 people today. It positions itself within the apparel market and sells clothing, footwear, and accessories in the high-price segment with over 9,000 SKUs while seeking to establish a seamless customer experience across its channels. The company currently maintains an asymmetrical integration type B for its assortment integration with a large online assortment and selected items in the physical stores that represent a subset of the online assortment. As a result, the assortment is therefore inconsistent across the channels. The degree of overlap varies between 35 to 45% depending on the physical store since the assortment across the physical stores also varies (different store sizes and regional differences in demand). The company maintains departments for business development, marketing, finance, and retail management (physical stores).

5.2.1 Case Problem Articulation

The retailer utilises an asymmetrical integration approach where its online assortment is larger than the offline assortment (Type B) and is confronted with the experience of the consumer confusion phenomenon, particularly evident by customers switching from the online channel to the offline channel (webroomers). However, the retailer is not fully aware of the consequences of the phenomenon on its performance. It is generally observed that some customers ask in-store for particular products that are only available in the web-shop. Sales staff report similar observations, e.g., customers entering a store and looking for a particular product in the assortment but leaving with no purchase. Initial discussions revealed that the retailer is also not aware of the existing differences in assortment integration types for omnichannel retailing (Section 2.4.1) thus indicating an inherent misalignment between assortment coordination decisions and the consumer confusion concept. The aim of the retailer is:

1. to approximate to what extent the consumer confusion phenomenon induced by webrooming behaviour leads to purchase abandonments expressed in financial terms for a specific physical store within one business year (12 months) (objective 1).
2. to investigate how changes in the assortment integration level between the web-shop and the specified physical store can lead to changes in the occurrence of the consumer confusion phenomenon and thus in-store sales (objective 2).

The retailer is addressing the consumer confusion problem occurring through webrooming behaviour and is interested in assessing the impact of the effect on a specific physical store. Moreover, it is also of interest how the impact might change if changes on the assortment integration level of that store are made. The problem and objectives show a clear requirement for an alignment (DR1) between the current assortment integration type and level (DR2), the consumer confusion phenomenon (DR3), its consequences and financial implications (DR3, DR6), and webrooming as a specific type of channel switching behaviour (DR4) at the decision area within the MOI (DR5).

Justification for the Use of System Dynamics Modelling

After discussions with the CEO of the company, it was agreed to adopt a simulation approach that is capable of addressing the defined objectives instead of conducting actual changes on the current assortment integration configuration of the retailer since these changes would involve unreasonable assortment reconfiguration efforts potentially involving major disruptions of the day-to-day business as well as time-consuming field experiments. Moreover, the opportunity to use a powerful simulation approach that is proven effective and established in the management discipline strengthened the decision on the demonstration via a simulation tool. An SD approach was deemed as the most appropriate tool since (1) it is capable of considering changes over time in the simulation that are stated in the objectives formulation, (2) it allows for experimentation of different scenarios, (3) there are appropriate tools available that are capable in realising those simulations and experimentations (e.g., Vensim® PLE, Ventana Systems, 2022), (4) there is a strong fit for ontologies serving as reference models (see Section 3.5.4), and (5) it is a proven method to be used in management literature and practice to solve complex strategic decisions (Sterman, 2010). Alternative implementation approaches such as the Balanced Scorecard (Kaplan and Norton, 1996), Cognitive Mapping (Eden, 1988), Structural Equation Modelling (Westland, 2015; Duncan, 2014; Saghaei and Ghasemi, 2009), Total Interpretive Structure Modelling (Jena *et al.*, 2017), or Soft Systems Methodology (Checkland, 1999; Mirijamdotter, 1998) have been discussed but were considered inappropriate mainly due to missing dynamic features accounting to changes over time in the simulation.

5.2.2 Data Collection and Analysis

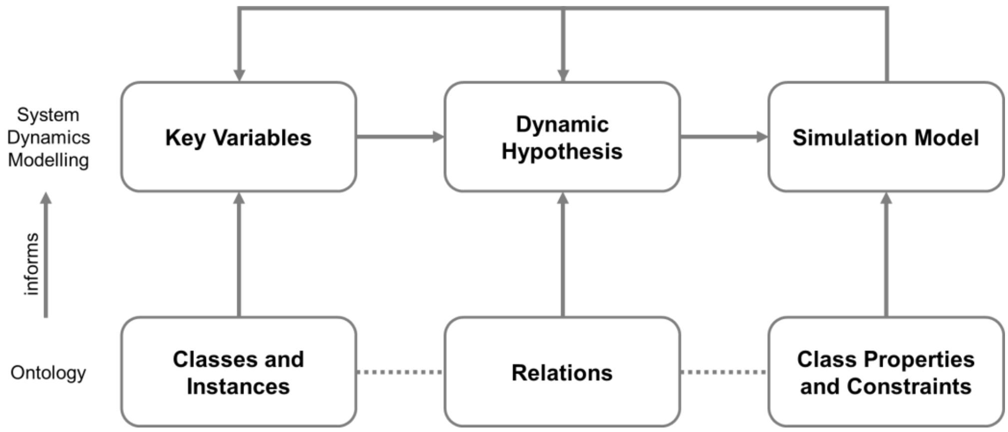
Guided by a case study protocol (**Appendix E-1**), the data collection for the demonstration case study involves semi-structured interviews (Yin, 2017) with the CEO of the case company. Interviews are an appropriate way to extract mental models of domain experts for SD modelling (e.g., Sterman, 2010; Luna-Reyes and Andersen, 2003) and are thus selected as the data collection method of choice for the case study. The case study protocol outlines eight stages in total. Beginning with Stage 1, a first contact is established where I introduce myself to the company and explain my intent (case study for artefact demonstration). This includes initial discussions on an appropriate case problem positioned at the MOI of the company. The contact was carried out via an inquiry via email and a subsequent online call using Microsoft Teams. The company contact existed based on prior engagement with the CEO and a research project outside of the scope of this thesis. After Stage 1, a judgement on the suitability of the company as a case problem is made in Stage 2. The company qualifies as a suitable demonstration case as outlined above and accepts the inquiry for case study research, thus proceeding to Stage 3 on the protocol: the arrangement of a meeting with the purpose to present the artefact, the demonstration intent and the procedure on data collection. This includes discussions on the required data and participants. After agreeing on the next steps, dates and formats have been determined. It was agreed to conduct the data collection via semi-structured interviews organised along two sessions with the CEO of the company: one for construction and one for validation of the SDM. The reflections on the data collection revealed that the CEO as a single participant is sufficient to gather the required data and thus represents the only interviewee for data collection in the case study. The CEO of the retail company has 13 years of experience in business management and retailing and is directly responsible for the finance department. However, he works with the marketing team and is the responsible person for strategic assortment decisions, especially in the allocation of products across the channels. The discussions revealed that he is competent in providing sufficient knowledge and expertise in the required field for the demonstration activity (strategic assortment decisions, consumer confusion, channel switching behaviour, and financial data). After the meeting of Stage 3, consent forms and information statements have been sent to the CEO of the company. Stage 4 involves the collaborative construction of the SDM guided by an interview protocol. The activity aims at extracting the mental models of the CEO that are used for the problem definition in the SD modelling. The Omnichannel Assortment Ontology for Consumer Confusion serves hereby as a reference model to identify associated variables, relations, and properties of variables that effectively inform the SD modelling. After the collaborative construction, a separate interview guide for EVAL4.2 is used to gather evidence from the CEO for the utility and quality of the ontology before the end of the session. In Stage 6, the SDM is transferred into the Vensim® PLE environment and fully formalised without the involvement of the CEO of the company. Afterwards, Stage 7 involves a second meeting with the CEO to validate the final model including further refinements. After acceptance of the model by the CEO, a case report including the final model has been generated and provided to the company (Stage 8).

For data analysis, Template Analysis (King, 2012; King, 1998) is utilised since the SD modelling steps provide concrete themes to structure the template. The template is organised along concepts and instances, relations, and property types. The collected data is processed after each session with NVivo. The whole process is designed under ensuring the anonymity of the company as well as the individuals involved in the data collection process. No personal data is addressed, data is treated confidential (no names are identified) and hard copies are stored in a locked cabinet at the researcher's place with encryption, accessible only by the author.

5.3 Ontology-Informed System Dynamics Modelling

The following describes how the Omnichannel Assortment Ontology for Consumer Confusion is used to inform the modelling steps for SD modelling (following Sterman, 2010, Section 3.5.4) in Stage 4 of the case protocol. For this, the components of the ontology are mapped to the modelling steps of the SD modelling, where classes and instances inform the identification of key variables, the relations and associations inform on how to shape the structure and causal logic of the model, and class properties and constraints inform the formalisation of the model into a simulation model with suitable data types and limitations (**Figure 45**).

Figure 45: *Mapping the ontology components to the SD modelling Steps (source: own mapping)*



Iterations between the SD modelling steps are intended and oftentimes necessary (Sterman, 2010). These are conducted in Stage 4 according to the case protocol.

5.3.1 Retrieving Key Variables from the Ontology

First, concepts from the problem scenario are mapped to the classes of the ontology in order to identify relevant variables that qualify for the "building blocks" of the SD model. A variable inventory is generated and subsequently, argued and selected which variables to incorporate into the model. The final list of relevant variables is summarized in **Table 31** and classified based on their explanatory feature into endogenous and exogenous variables. *Endogenous* (ENDO) explanation means that the model dynamics are produced by the variables within the model, whereas *exogenous* variables (EXO) which are outside of the model boundary can be linked to the system as influencing factors (Sterman, 2010). The latter variable type is treated as a constant in the SD modelling. The operationalisation of the problem (see above) leads to the initial identification of the following classes from the ontology: *Assortment Integration Level, Webrooming, Inconsistency between On- and*

Offline Assortment, Consumer Confusion, (Consumer Confusion) Consequences, Short-Term (Consequences), Purchase Abandonment, and *Retail Performance.*

Further discussions concluded that, in order to approximate the total impact on the financial performance of a specific store and considering the fact that among all store visitors, only webroomers would qualify as candidates of interest, structuring of store visitors is necessary. That means other visitors that are outside of interest (showroomer, non-switcher) are separated from the webroomers. However, they are still considered for the overall in-store performance (sales, profit) to enable overall store performance measurements. This allows to isolate the consumer confusion effect on the in-store performance induced by webrooming behaviour. Accordingly, the retrieved three variables from the *Omnichannel Customer Journey* domain for the SD model that serve as defining the *Store Visitor* structure are defined as:

- *Switcher Types/Store Visitors: (1) Webroomer, (2) Showroomer, (3) Non-Switcher*

The further exchange led to the agreement in expressing the financial impact via a "sales" and a "profit" metric since these measures represent the most relevant metrics at the MOI to assess the performance of a physical store of the retail company. For this, an *In-Store Conversion* indicator is utilised to bridge the gap from store visits to *Retail Performance*. It represents the number of in-store conversions that are generated by the visitors (webroomer, showroomer, and non-switcher) adjusted by an *In-Store Conversion Rate* applied to the number of visitors. Thereafter, the indicator is multiplied by the *In-Store ATV per Conversion* (average transaction value per conversion) to determine the *In-Store Total Sales* per month. To account for the impact of the consumer confusion occurrence, the number of total purchase abandonments in the store is reflected by the *In-Store Purchase Abandonment* variable. Lastly, the indicator *In-Store Average Profit Margin* applied to the *In-Store Sales* is used to determine the net *In-Store Profit* of the store reflecting the profit performance in a fiscal year. All indicators are retrieved as instances of the class *Financial Performance* from the *Retail Performance* domain and applied at a store level:

- *In-Store Purchase Abandonment*
- *In-store Conversion*
- *In-Store Conversion Rate*
- *In-Store Sales*
- *In-Store ATV per Conversion*
- *In-Store Average Profit Margin*
- *In-Store Profit*

To account for the second objective, the conceptualisation of a feedback loop was discussed and deemed necessary. It is agreed that a *Change in the Integration Level* is facilitated through explicit investments into assortment integration measures that are linked to the *Annual In-Store Profit*. For example, 5% of the monthly in-store profit is used as a budget for assortment integration measures effective in the next month. A feedback effect is then evident since the change on the integration level has a direct effect on the subsequent consumer confusion occurrence which again influences the *In-Store Conversions* and so on. The rationale behind this decision is that *In-Store Profits* can be used to cover *Assortment Integration Costs* that in turn allow the desired *Change of the Integration Level*. The following variables are added to the model accordingly:

- *Change of Assortment Integration Level*
- *Assortment Integration Costs*
- *Share of Profit for Integration Measures*

This discussion on the incorporation of deliberate action on changing the assortment across channels led to a practitioner-informed addition to the ontology development incorporated through an iteration (Section 4.3.2). Moreover, the distinction between *Assortment Integration Type* and *Assortment Integration Level* is deemed necessary since the decision on the integration type does not involve a decision on the degree of the assortment overlap.

Table 31: *Variable inventory for the construction of the SDM*

Variable	Type	Variable	Type
1. Assortment Integration Level	ENDO	10. Change of Integration Level	ENDO
2. In-Store Consumer Confusion Rate	ENDO	11. Assortment Integration Costs	ENDO
3. In-Store Purchase Abandonments	ENDO	12. Share of Profit for Integration Measures	EXO
4. In-Store Conversions	ENDO	13. Store Visitors	EXO
5. In-Store Conversion Rate	EXO	14. Omnichannel Shoppers	ENDO
6. In-Store Sales	ENDO	15. Webroomer	ENDO
7. In-Store ATV per Conversion	EXO	16. Showroomer	ENDO
8. In-Store Profit	ENDO	17. Non-Switcher	ENDO
9. In-Store Average Profit Margin	EXO		

In the second step, the relational properties from the ontology which inform the causal linkages and polarity (positive or negative) in the model are retrieved and incorporated into the CLD shown in the development of the Dynamic Hypothesis step.

5.3.2 Dynamic Hypothesis Development

Within this step, the CLD is constructed. For this, the relations between the variables are retrieved or inferred from the ontology and assigned with distinctive polarities. To begin with, the relation between the variable *Assortment Integration Level* and *Consumer Confusion Rate* is negative since a higher integration level leads to less consumer confusion ("…the lower the degree of integration, the higher the amount of confusion.", Bertrandie and Zielke, 2017, p. 439). Correspondingly, the adopted causal link between those variables in the CLD is defined as outlined in (1):

$$(1)\ Assortment\ Integration\ Level \xrightarrow{(-)} In-Store\ Consumer\ Confusion\ Rate$$

Following the causal chain further, the increase in the *In-Store Consumer Confusion Rate* leads to the increase in *In-Store Purchase Abandonments* of visiting webroomers, denoted by a positive polarity between the variables (2). Moreover, the more *Webroomers* are exposed to the phenomenon, the more cases of *In-Store Purchase Abandonments* are evident (3).

$$(2)\ In-Store\ Consumer\ Confusion\ Rate \xrightarrow{(+)} In-Store\ Purchase\ Abandon.$$

$$(3)\ Webroomers \xrightarrow{(+)} In-Store\ Purchase\ Abandonments$$

In-Store Conversions are aggregated conversions consisting of conversions from *Webroomers*, *Showroomers*, and *Non-Switchers* (4). More importantly, it is negatively impacted by the number of *In-Store Purchase Abandonments* (5). The different type of visitors constitutes the structure of the *Store Visitors* following the typology as defined in Section 2.6.1 and shown in **Figure 15**. The *In-Store Conversions* are adjusted by the *In-Store Conversion Rate* (the higher the conversion rate, the higher the number of conversions) which informs about the average ratio of the conversions out of the different visitor types (6).

$$(4)\ Webroomers + Showroomers + Non-Switchers \xrightarrow{(+)} In-Store\ Convers.$$

$$(5)\ In-Store\ Purchase\ Abandonments \xrightarrow{(-)} In-Store\ Conversions$$

$$(6)\ In-Store\ Conversions\ Rate \xrightarrow{(+)} In-Store\ Conversions$$

In line with the requirement to represent retail performance via the metrics of sales and profit, the *In-Store Conversions* are translated into an actual *In-Store Sales* figure based on a positive relationship (the more conversions are generated the more sales incur) (7). The use of the variable *In-Store ATV per Conversion* informs about the value per conversion and thus increases *In-Store Total Sales* (8).

$$(7)\ In-Store\ Conversions \xrightarrow{(+)} In-Store\ Sales$$

$$(8)\ In-Store\ ATV\ per\ Conversion \xrightarrow{(+)} In-Store\ Sales$$

In the next step, the *In-Store Sales* are then again translated into profit reflected by the *In-Store Profit* figure (positive relationship) (9) which is adjusted by the *In-Store Average Profit Margin* (positive relationship) (10).

$$(9)\ In-Store\ Sales \xrightarrow{(+)} In-Store\ Profit$$

$$(10)\ In-Store\ Average\ Profit\ Margin \xrightarrow{(+)} In-Store\ Profit$$

In view of incorporating the loop effect into the CLD as discussed above, discussions argued first to establish a positive link between the *In-Store Profit* and the *Change of Integration Level* variable. The relationship is motivated by the logic that profit can be used to allocate resources which would cover costs associated with the restructuring measures of the assortment across channels (11). This practitioner-based proposition informed the ontology design in incorporating a corresponding link between *Retail Performance* and *Change of Assortment Integration* that is labelled as "enables" (Section 4.3.2) through iterating back to the design and development phase (Chapter 4). To determine the amount from the *In-Store Profit* that would be used to spend on the *Changes in Integration Level*, the variable *Share of Profit for Integration Measures* is incorporated (the higher the share, the more resources are allocated for the measures that enable changes on the assortment integration) (12).

$$(11)\ In-Store\ Profit \xrightarrow{(+)} Change\ of\ Integration\ Level$$

$$(12)\ Share\ of\ Profit\ for\ Integration\ Meas. \xrightarrow{(+)} Change\ of\ Integration\ Level$$

To close the loop, *Changes in Integration Level* would positively link back to the *Assortment Integration Level* (13), establishing a reinforcing loop.

$$(13)\ Change\ of\ Integration\ Level \xrightarrow{(+)} Assortment\ Integration\ Level$$

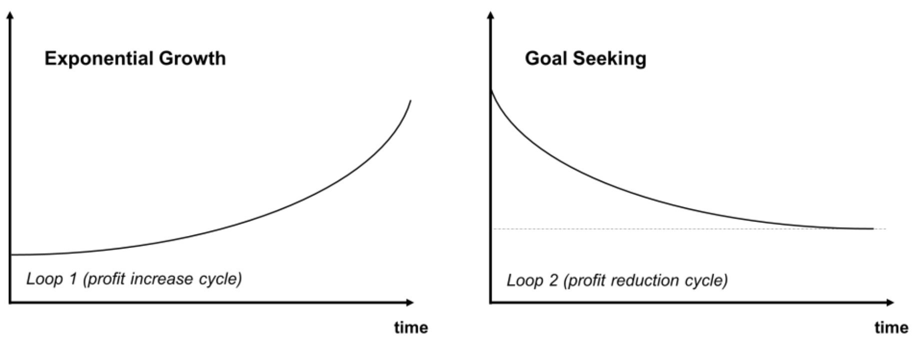
However, with *Changes in Integration Level*, *Assortment Integration Costs* (14) occur. This positive relationship is establishing a second loop in the CLD (balancing) since the *Assortment Integration Costs* negatively feed back to *In-Store Profit* (15).

$$(14)\ Change\ of\ Integration\ Level \xrightarrow{(+)} Assortment\ Integration\ Costs$$

$$(15)\ Assortment\ Integration\ Costs \xrightarrow{(-)} In-Store\ Profit$$

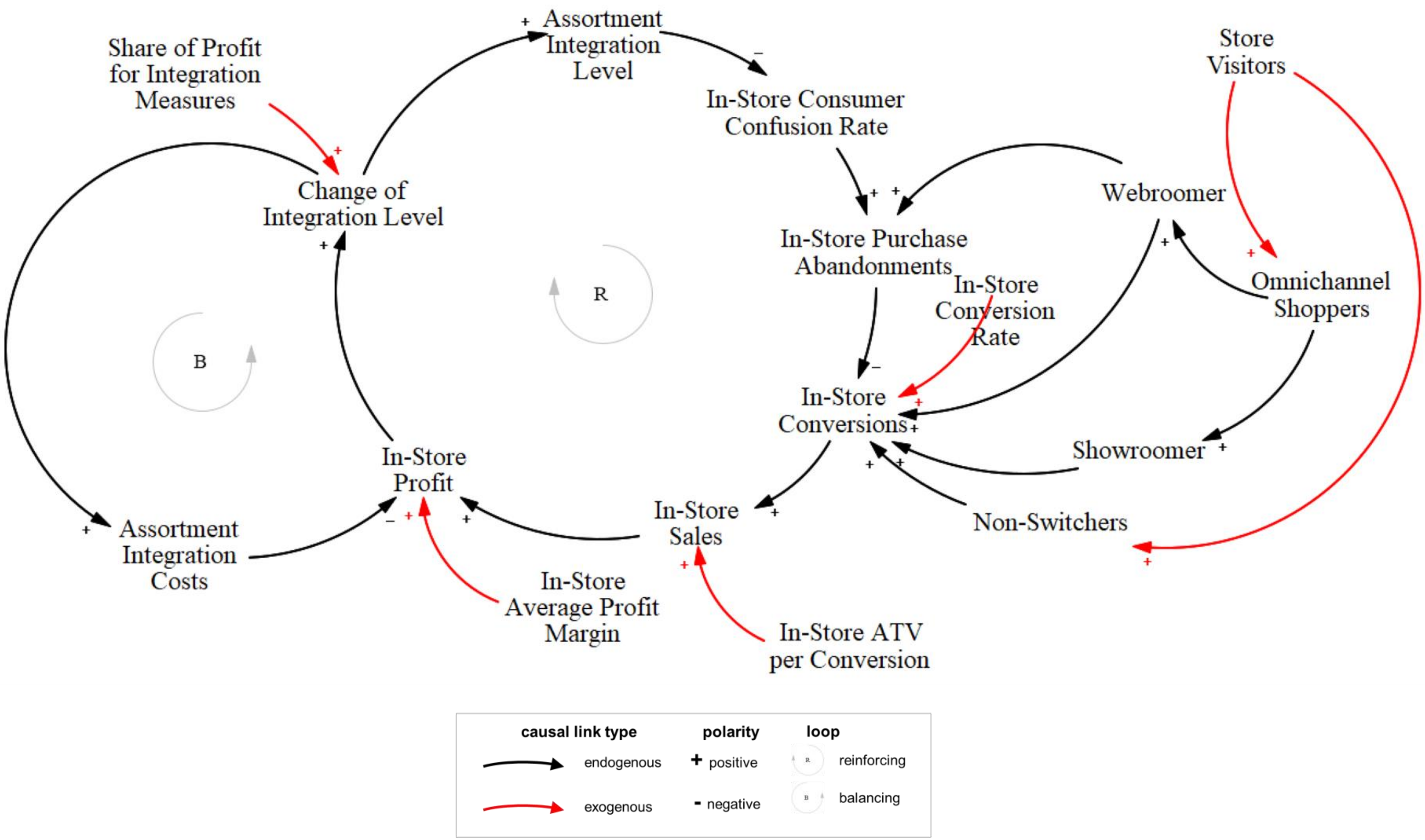
The structure displays now two significant **Loops**: A reinforcing (Loop 1) and a balancing one (Loop 2). *Loop 1* (profit increase cycle) is reinforcing in nature (increase leads to more increase, resulting in continuous growth with each cycle). A higher *Assortment Integration Level* leads to a reduction of the occurrence of the *In-Store Consumer Confusion Rate* (negative relationship) in turn leading to fewer *In-Store Purchase Abandonments* measured by *In-Store Conversions*. Thus, an increase in *In-Store Sales* per cycle is evident. The sales value translates into an *In-Store Profit* value that again allows for further increase of the *Assortment Integration Level* through *Changes in the Integration Level*, closing the loop. This dynamic behaviour represents an exponential growth pattern (Sterman, 2010) (**Figure 46**). *Loop 2* (profit reduction cycle) is balancing in nature (changes in one direction are countered with changes in the opposite direction, leading to a balanced state). *Changes in Integration Level* are achieved by a certain value of *Assortment Integration Costs*, reducing the *In-Store Profit* per cycle that again reduces the ability to conduct *Changes on the Integration Level* and so on. This dynamic behaviour represents a "goal-seeking" pattern (Sterman, 2010) (**Figure 46**). As a result, potential measures to increase the *Assortment Integration Level* are reduced with each cycle. In conjunction with the profit increase cycle, this loop eventually creates a balanced state of the CLD due to concurring increase of profit induced by a reduction of the consumer confusion rate leading to increased conversions, sales, and profit.

Figure 46: *Loop 1 and 2 behaviour patterns in the CLD (based on Sterman, 2010)*



The CLD showing the causal linkages and the feedback effects is depicted in **Figure 47**.

***Figure 47:** Causal Loop Diagram*



5.3.3 Formalisation into a Simulation Model

The formalisation of the model has been conducted by following three steps:

1. Transferring the CLD into the software Vensim® PLE
2. Incorporation of stock and flow components to account for variable levels
3. Formulation of equations

The first step aims at transferring the causal loop diagram into a software environment. For this study, the software Vensim® PLE has been selected as the most suitable application to conduct simulations. The software environment allows structural and syntactical tests on the CLD. Along with the transfer into software, adjustments to conventions and notations need to be made. These reflect integral parts of a successful formalisation.

The second step covers the incorporation of stock and flows to account for the variable levels. The CLD does not (nor is intended) to reflect stocks in the model. Therefore, in this process, the CLD is transformed into an SFD. Specifically, the two variables *Assortment Integration Level* and *In-Store Profit* are translated into the stock format. To account for the flows, new variables are created denoting the in- and outflow of the stocks. Moreover, lookup functions have been introduced. Lookup functions are arbitrary non-linear relationship functions based on external data that can be integrated into the SDM in Vensim® PLE (Ventana Systems, 2015). Vensim® PLE extracts data from a corresponding matrix that contains the x and y values of the function. Furthermore, the following additional changes in the course of the SFD construction are made. Firstly, the variable *Change of Integration Level* has been relabelled as *Investments in Assortment Integration Measures* to operationalise the change of the integration level. The variable reflects a certain investment value per cycle that informs the corresponding increase in percentage via the use of the lookup variable *Investments to Overlap* which again determines the inflow for the degree of overlap. Secondly, to operationalise the visitor structure, the additional variables *Webroomer Rate* and *Omni-Shopper Rate* are added since they are deemed necessary to determine the proper share for *Webroomers*, *Showroomers*, and *Non-Switchers*. In general, the number of customers entering a store can typically be measured by a footfall metric. A footfall metric captures the "traffic" into the store (sometimes also referred to as "people counter", or "shopper traffic") within a specific period of time (hourly, daily, weekly, monthly, etc.). In this demonstration study, footfall represents an exogenous variable with an application of an average value based on historical company data. The sum of the footfall for a specific period can be represented mathematically through a summation term:

$$\sum_{k=t}^{n} f_k = f_{t_1} + f_{t_2} + f_{t_3} + \cdots + f_{t_n}$$

With f_t = number of visitors at t point in time (e.g., months) and n = upper bound of the period (e.g., 1 year = 12 months). This study considers a time horizon of 12 cycles representing 12 months or 1 year.

The third and last step in the formalisation process involves the formulation of equations for each variable, differing in the type of variable applied, and thus represents the most delicate task in the formalisation process since the equations determine the dynamic behaviour of the model. Here, the properties and constraints from the ontology serve as a reference to inform about relevant data types. The initial timeframe for simulation is defined as a 12-month period (1-year scope with 12 cycles). **Table 32** summarizes the equations of the model. For example, the variable *Assortment Integration Level* (AIL) is defined as follows: AIL is the first essential stock variable measured in percentage. It measures and contains the current degree of assortment overlap for each month with a value range between 1 and 100%. Its change in overlap per cycle is increased through the stock-inflow-variable *Assortment Overlap Increase* (AOI). The growth can therefore be computed by the following integral function:

$$AIL(t) = \int_{t_0}^{t} [AOI]dt + AIL_{t_0}$$

With

- *AIL(t)* = the state of the current integration level,
- *AIL(t_0)* = the initial level of integration at the initial time (t),
- *AOI* = the increase of the overlap per cycle at time (t).

The extent of the increase is determined by the *Investments to Overlap* lookup function that captures the value from *Investments in Assortment integration Measures* and assigns a corresponding *AOI* that is added to the *AIL*. Since there is no empirical data on the relationship between the desired degree of overlap change and the associated necessary investments in assortment integration (general as well as store-specific), discussions with the CEO led to agree for estimating the functional relationship. The discussion covered potential associated costs such as reallocation of SKUs across the physical store and warehouses (transportation), the costs of occupying additional space in-store, updates on the POS and warehouse systems, as well as costs related to updating marketing material, etc. However, it was agreed that the relationship would not be linear but non-linear in nature (goal-seeking pattern) since the higher the desired degree, the more costs would occur exponentially due to physical space limitations required to contain more and more SKUs without equivalent sales increases staying constant. AIL in turn determines the extent of the *In-Store Consumer Confusion Rate*.

Table 32: *Summary of the equations for the simulation model*

Variable	Description and formula	Unit/measure	Code
Assortment Integration Level (stock)	The degree of the assortment overlap between the web-shop and the physical store assortment. It is determined by the initial value and the monthly change per simulation cycle. $$= \int_{t_0}^{t} [AOI]dt + AIL_{t_0}$$	%	AIL
In-Store Profit (stock)	Accumulated net store profits. On each cycle, the monthly increase and decrease in profits are integrated into the sum of the yearly net profit. $$= \int_{t_0}^{t} [PI - PD]dt + ASP_{t_0}$$	EUR per year	ASP
In-Store Consumer Confusion Rate	The rate of the occurrence of consumer confusion rate. The rate is determined by a lookup function referring to the relationship between the degree of overlap and the occurrence rate of the consumer confusion effect. $$= determined\ by\ lookup\ function$$	%	CCR
In-Store Purchase Abandonments	The sum of purchase abandonments resulting from the consumer confusion effect is measured as a reduction of the In-Store Conversions. This only applies to Webroomer shoppers. $$= CCR * WR$$	Conversions per month	PA
In-Store Conversions	The number of total conversions per cycle. The sum of conversions from Showroomers, Webroomers, and Non-Switchers. $$= NOS * CR + SR * CR * 0 + WR * CR$$	Conversions per month	CO
In-Store Sales	EUR value resulting from the total number of conversions multiplied by the In-Store average transaction value per Conversion. $$= CO * ATV$$	EUR per month	ITS
Investments in Ass. Int. Measures	The planned amount of expenditure in EUR is intended to increase assortment overlap. Determined by the Share of Profit for measures applied to the annual In-Store Profits. $$= ASP * SPM$$	EUR per month	IAI
Overlap to Confusion (lookup)	Represented by a function relating the degree of overlap (%) to the In-Store Consumer Confusion Rate (%). The function follows non-linear behaviour and is practitioner-informed. $$f(x) = goal\ seeking$$	-	O-C
Investments to Overlap (lookup)	Represented by a function relating investments for integration measures (EUR) to the degree of overlap (%). The function follows a non-linear behaviour. $$f(x) = S - Shaped\ Growth$$	-	I-O

Share of Profit for Measures (constant)	Exogeneous variable. Share from annual In-Store Profits in percentage intended to be invested monthly in integration measures. $= [constant\ value]$	%	SPM
Assortment Overlap Increase (inflow)	Stock-inflow variable. The monthly increase in assortment overlap due to investments in integration measures. Determined by the Share of Profit from the annual In-Store Profit. $= determined\ by\ graph$	% points per month	AOI
Profit Increase (inflow)	Stock-inflow variable. The monthly increase in profits from In-Store Sales. $= ITS * APM$	EUR per month	PI
Profit Decrease (outflow)	Stock-outflow variable. Monthly decrease in profits from investments in integration measures. $= IAI$	EUR per month	PD
Store Visitors (constant)	Exogeneous variable. Reflects the total number of store visitors. Constant value to be determined initially. $= [constant\ value]$	Shoppers per month	FF
Omnichannel Shoppers	Share of omnichannel shoppers from Store Visitors. Determined by the Omnichannel Shopper rate. $= FF * OSR$	Shoppers per month	OS
Non-Switchers	Share of non-omnichannel shoppers from Store Visitors. Determined by the Omnichannel Shopper rate. $= FF * (1 - OSR)$	Shoppers per month	NOS
Webroomer	Share of Webroomers from Omnichannel Shoppers. Determined by the Webroomer Rate. $= OS * WRR$	Shoppers per month	WR
Showroomer	Share of Showroomers from Omnichannel Shoppers. Determined by the Webroomer Rate. $= OS * (1 - WRR)$	Shoppers per month	SR
Omnichannel Shopper Rate (constant)	The number of Omnichannel Shoppers / Non-Switchers from Store Visitors in percentage. Constant value to be determined initially. $= [constant\ value]$	%	OSR
Webroomer Rate (constant)	The number of (Show-)Webroomers from the Omnichannel Shoppers in percentage. Constant value to be determined initially. $= [constant\ value]$	%	WRR
In-Store Conversion Rate (constant)	Average conversion rate from Store Visitors. Constant value to be determined initially. $= [constant\ value]$	%	CR
In-Store ATV per Conversion (constant)	Average transaction value per conversion applied on the In-Store Conversions. Constant value to be determined initially. $= [constant\ value]$	EUR	ATV

In-Store Average Profit Margin (constant)	The average profit margin is the percentage applied to In-Store-Sales to determine net profits. Constant value to be determined initially. $= [constant\ value]$	%	APM

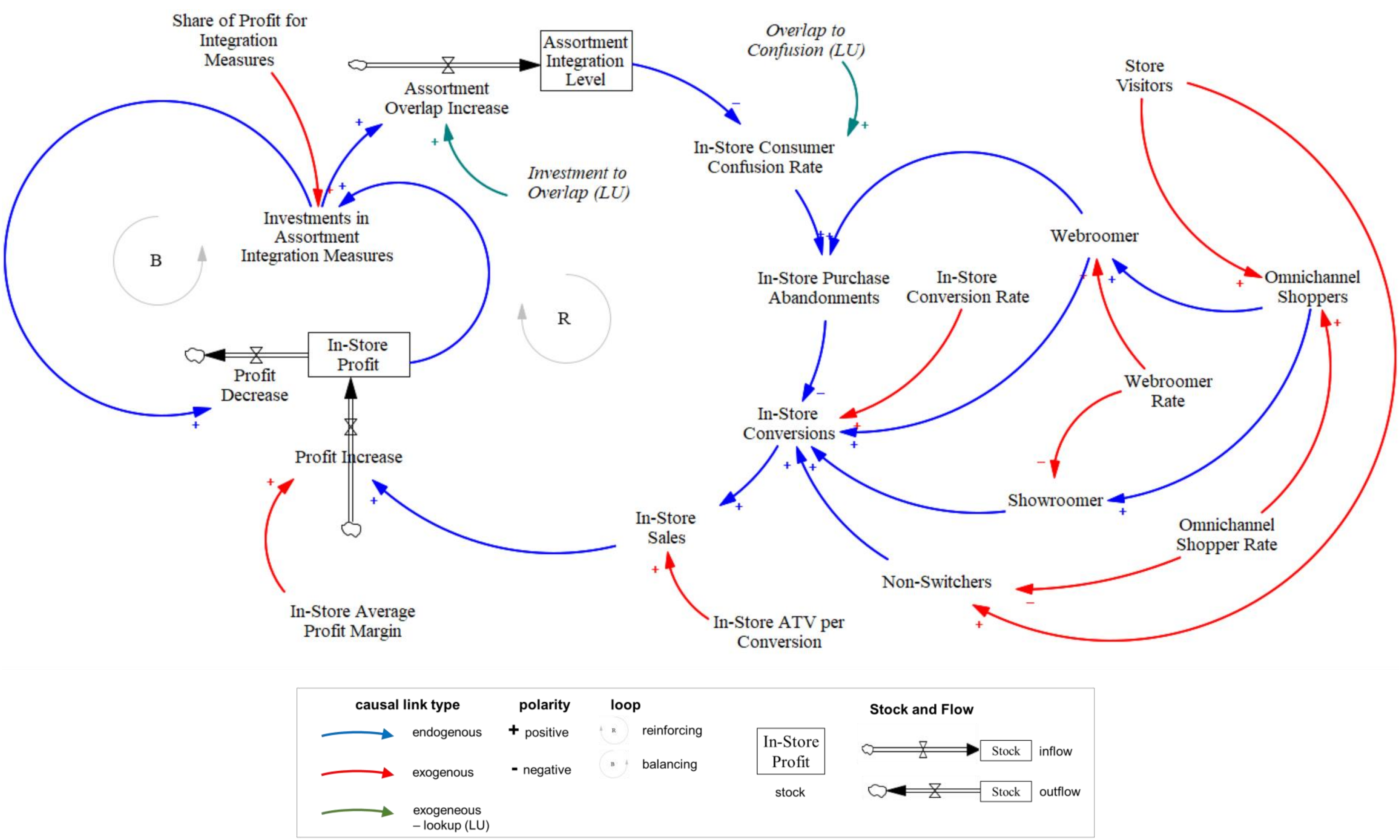
System Boundary and Assumptions

To reduce complexity and variance, the SDM comes along with five basic assumptions. These are defined as follows:

1. For simplification purposes, average values are utilised where appropriate.
2. A time horizon encompassing 12 months is applied. This corresponds to a typical fiscal year of the retail company, in line with decision-making cycles for planning, budgeting, and reporting (monthly, quarterly, or yearly). In addition, it covers also seasonal characteristics.
3. To reduce complexity in in-store visitor behaviour, showroomers leave the store and do not return. Understandably, there is a probability of showroomers deciding otherwise than planned to purchase an item in-store, but this behaviour is neglected to focus on the webroomer type of shoppers and reduce variance in the conversion metric.
4. Purchase Abandonment is understood as a 100% consequence of the in-store consumer confusion phenomenon. Alternative outcomes are outside of the scope of the case problem (e.g., postponement, confusion of other customers, etc.).
5. Since the developed SDM represents a first iteration, the SFD considers only positive changes in the assortment integration level and does not account for changes towards reduction of the degree of assortment overlap.

The constructed SFD is provided in **Figure 48**. With the successful construction of the SFD, a simulation model addressing the case objectives has been provided to the case company. As a next step, the model would need to be simulated with the use of key company data. However, for the purpose of the demonstration, the ontology successfully demonstrates its use by informing the construction of both the CLD and SFD until this point.

Figure 48: *Stock and Flow Diagram*



5.4 Discussion

The demonstration of the use of the ontology on the basis of a real-world problem successfully shows the utility of the artefact. Firstly, the components of the SDM (CLD and SFD) are effectively informed by the classes, relations and class properties & constraints of the ontology. The SDM entails variables that represent directly or indirectly instances of relevant classes of the ontology. Most of the variables are retrieved directly, whereas others are inferred indirectly (e.g., the class *Consumer Confusion* is translated as the variable *Consumer Confusion Rate*). Moreover, the relations successfully inform the causal relations required for establishing the behavioural structure of the SDM. What is more, is the fact, that class properties and constraints successfully provide the required set of information on how to formalise the CLD into an SFD by providing relevant measures and units. Secondly, the novelty of the ontology, represented by the incorporation of the channel switching behaviour domain that establishes the link between strategic assortment decisions and the consumer confusion concept, is reflected in the demonstration by accounting for a webrooming scenario within the SDM. Webroomers are identified as those types of visitors who are associated with the consumer confusion effect that affects store performance based on the assortment integration level. Lastly, the collaborative construction of the SDM with the CEO of the case company reveals the additional informational benefits the ontology can provide. For instance, the company was initially not aware of how different assortment integration types can be systemised or how they are positioned along assortment decision levels. The ontology along with its domains and hierarchical structure provides rich knowledge about relevant concepts and relations that might potentially resonate with the situational context of omnichannel retailing companies. On the other hand, case study data contributes new insights into the practice of assortment decisions. For example, the discussions revealed that the retailer deliberately utilises different assortment sets across the physical stores in order to meet different regional demands. This insight can certainly be added to the many contextual factors a retailer considers while deciding on the assortment across channels as portrayed in Section 1.2.

CHAPTER 6 – EVALUATION

6

"An artifact can be thought of as a meeting point—an "interface" in today's terms—between an "inner" environment, the substance and organization of the artifact itself, and an "outer" environment, the surroundings in which it operates. If the inner environment is appropriate to the outer environment, or vice versa, the artifact will serve its intended purpose."

— Herbert A. Simon,
The Sciences of the Artificial

6.1 Introduction

Evaluation is an essential part of a DS project since it is critical for a successful DS project to provide evidence for the fitness for purpose of the designed artefact (Sonnenberg and vom Brocke, 2012; Peffers *et al.* 2012; Hevner and Chatterjee 2010). In DS, the artefact is assessed against carefully chosen evaluation criteria to demonstrate this (vom Brocke *et al.*, 2020; Venable *et al.*, 2016). However, evaluation activities are not limited to the final phase of the DSR process but are evident through iterative processes along each phase (Sonnenberg and vom Brocke, 2012). In the following sections, an evaluation strategy for this study is proposed, developed and executed. It encompasses specific evaluation methods along the different stages of the DS process and the careful selection of evaluation criteria. This chapter concludes with the evaluation results and a discussion of the main findings.

6.2 General Evaluation Approach

Evaluation is an activity vital for producing evidence that the developed artefact is successful in achieving its purpose which it is designed for (Venable *et al.*, 2012; March and Smith, 1995). A critical decision at the beginning is therefore to determine how the main purpose of the evaluation activity for the DS project is defined. Venable *et al.* (2012) distinguish five different purposes for evaluation within a DS project (**Table 33**).

Table 33: *Different evaluation purposes in DS (source: Venable et al., 2012)*

	Purpose	Key Criteria of interest	Relevance for this research
1	Evaluate an instantiation of a designed artefact to establish its utility and efficacy (or lack thereof) for achieving its stated purpose.	Utility, efficacy	✓
2	Evaluate the formalized knowledge about a designed artefact's utility for achieving its purpose.	Utility	
3	Evaluate a designed artefact or formalized knowledge about it in comparison to other designed artefacts' ability to achieve a similar purpose.	Greater relative utility	
4	Evaluate a designed artefact or formalized knowledge about it for side effects or undesirable consequences of its use.	(long-term) side effects, undesirable consequences	
5	Evaluate a designed artefact formatively to identify weaknesses and areas of improvement for an artefact under development.	Areas for weakness / improvement	✓

The first purpose addresses the demonstration of the utility of the artefact being evaluated and investigates whether or how well the developed artefact realises its purpose. For this, design artefacts are assessed against relevant criteria of value or utility (March and Smith, 1995). The second purpose describes the assessment of the utility of design theories as formalized knowledge about design artefacts (e.g., design principles). Design artefacts or design theories evaluated in comparison to other solutions are subject to the third purpose definition. The fourth purpose is focused on the evaluation of (long-term) side effects or undesirable consequences of the use of designed artefacts or design theories. Lastly, the fifth purpose for evaluation is defined as the evaluation of the artefact while under development for improvement or weakness identification intentions, specified as formative evaluation. The purpose of the evaluation of this DS project is in line with the first and fifth definitions: the (summative) evaluation of the designed artefact (ontology) aimed at retrieving evidence for its *utility*, and the (formative) evaluation while the artefact is under development. The reason lies in the problem-oriented research intent of this DS project stating that a solution aims to fulfil a specific purpose (utility) situated within an organisational environment. This is regarded as the most significant criterion in evaluation approaches (e.g., Aier and Fischer, 2011). An additional formative approach is desired to provide evidence for improvement and the identification of weaknesses throughout the design and development phase before the construction of the artefact and thus enhance overall artefact *quality*. This is supported by Helfert *et al.* (2012) stating that for sufficient research output quality, evaluation should not be limited to final assessments after the construction of the artefact. The utility and quality represent essential and specific characteristics of DS outputs (Helfert *et al.*, 2012; Hevner and Chatterjee, 2010; Hevner *et al.*, 2008; Pries-Heje *et al.*, 2008; Iivari, 2007; Peffers *et al.*, 2007).

The content of measures for the evaluation (Symons, 1991) is oftentimes associated with quality criteria for artefact evaluation (Pries-Heje *et al.*, 2008). Generally, the notion of quality can be defined from different perspectives, e.g., performance, reliability, or perceived quality (Garvin, 1988). Relevant quality attributes in DSR are often identified as functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, or other attributes (Hevner *et al.*, 2008) and can be measured with methods reflecting differences in quantity or state of some product attribute (Venable *et al.*, 2016; Pries-Heje *et al.*, 2008). The relation between utility and quality is that quality attributes in DSR somewhat contribute to the overall utility (Helfert *et al.*, 2012) and their difference in the *dependency* to end users in the evaluation activity: quality measures are regarded as predominantly objectively measurable independent from end users (e.g., accuracy) whereas utility evaluation is dependent from the subjective needs of the end users (Helfert *et al.*, 2012; Gamble and Goble, 2011). The utility construct in DSR evaluation is therefore regarded as being socially constructed relative to the individual perceptions of end users (e.g., relevance). However, some quality criteria such as "perceived quality" also represent a measure that is dependent on end-user perception. For this research, both types of quality criteria are utilised for the evaluation prior to and after the construction of the artefact (ex-ante and ex-post evaluation, see next section). End users are generally regarded as users from the application domain (practitioners) but also from the scientific knowledge base (researchers) (Pries-Heje *et al.*, 2008).

In general, utility is defined as the artefact's main purpose (Venable *et al.*, 2016) and can be distinguished between the utility of product- or process-oriented artefacts. These two artefact types represent the principal styles an artefact can have (Cleven *et al.*, 2009; Pries-Heje *et al.*, 2008; Gregor and Jones, 2007). The utility of a product-oriented artefact (e.g., tools, diagrams, software) lies in the usage by individuals to solve a problem whereas process-oriented artefacts (e.g., a form of method or procedure) guide individuals on what to do in order to solve a problem. In view of the artefact evaluation for this DSR project, a product-oriented artefact (ontology) is subject to evaluation where a definition of the end users is required to determine the subjective needs relevant to the evaluation process of the utility criteria. In this case, the end users are defined as *domain experts in retailing* in the field of omnichannel assortment decisions. These can be retrieved from the ontology specification document outlined in Section 4.3 and divided into domain experts from the retail industry (practitioners) and from the research domain (researchers). The above-described derivation of the evaluation approach along with the main criteria and the relevant end-user definition is summarized below in **Table 34**.

Table 34: *Evaluation purpose and main criteria identification*

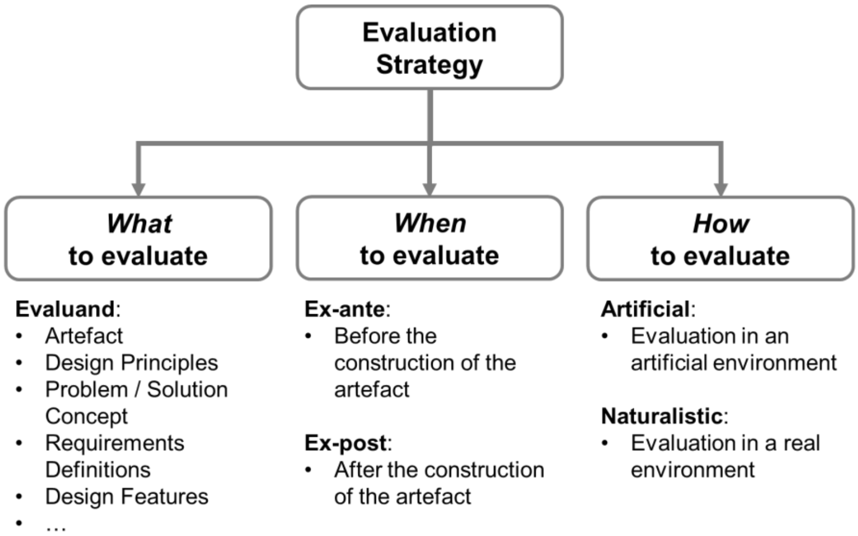
Evaluation purpose (Pries-Heje *et al.*, 2008)	**Main Evaluation Criteria** (Venable *et al.*, 2016; Helfert *et al.*, 2012; Hevner *et al.*, 2008; Pries-Heje *et al.*, 2008)	**Evaluation dependency** (Helfert *et al.*, 2012; Gamble and Goble, 2011)	**Relevant end user** (Pries-Heje *et al.*, 2008)
Evaluate a designed artefact to establish its utility for achieving its stated purpose.	Utility	dependent on end-user	domain experts from the retail industry (practitioners) and from the research domain (researchers).
Evaluate a designed artefact formatively to identify weaknesses and areas of improvement for an artefact under development.	Quality	Dependent and independent from end-user	

After defining the purpose, a strategy on how to implement the evaluation is required.

6.2.1 Evaluation Strategy

The evaluation strategy defines the concrete subjects, goals, and methods of the evaluation. Various approaches of evaluation methods in a DSR context exist (e.g., Helfert *et al.*, 2012; Sonnenberg and vom Brocke, 2012; Peffers *et al.*, 2012; Venable *et al.*, 2012; Venable, 2011; Hevner *et al.*, 2008; Pries-Heje *et al.*, 2008). Principal guidance on how to structure evaluation activities is proposed by the framework by Pries-Heje *et al.* (2008). According to the authors, evaluation can be distinguished between the dimensions of *what* to evaluate (identifying the "evaluand"), *when* to evaluate (identifying the "timing" of the evaluation), and *how* to evaluate (identifying the methods/techniques to apply for the evaluation). The evaluand is referred to the artefact itself or any other output generated throughout the DS process (e.g., design principles, design features). This also includes the problem statement conceptualisation in the early stage ideally validated from a practitioner and researcher perspective. Related to this, the timing of the evaluation is positioned relative to the constructed artefact where two points in time can be differentiated (Pries-Heje *et al.*, 2008): the evaluation activity is considered *ex-ante* in case it is conducted before the construction of the artefact and *ex-post* in case it is performed after the construction of the artefact (Sonnenberg and vom Brocke, 2012; Venable *et al.*, 2012; Pries-Heje *et al.*, 2008).

Figure 49: *Identifying components of the evaluation strategy*

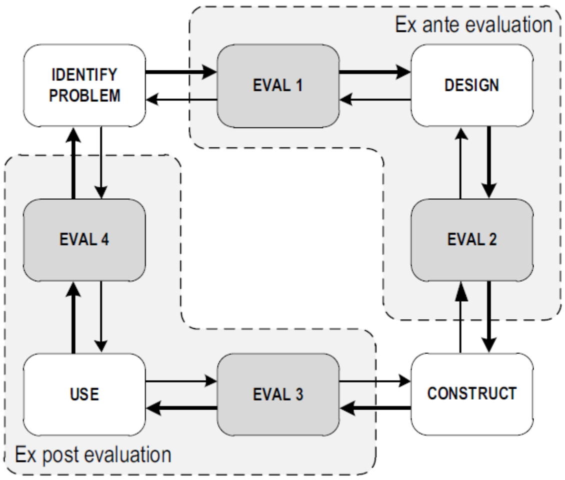


Regarding the "how" to evaluate, a distinction between *artificial* and *naturalistic* approaches can be made (Venable *et al.*, 2016; Pries-Heje *et al.*, 2008). Artificial approaches are characterised by being artificial in the setting and thus evaluating the artefact in a non-realistic way (e.g., laboratory experiments, simulations, or mathematical proofs), whereas naturalistic methods focus on the assessment of the artefact within its real application environment, underpinning an empirical characteristic for the evaluation (e.g., case studies, field experiments, or expert interviews).

For this research, the three dimensions discussed above are considered for the conceptualising of the evaluation strategy (**Figure 49**).

Sonnenberg and vom Brocke (2012) provide a comprehensive evaluation approach for DS projects that is capable of incorporating all three dimensions. The framework encompasses four evaluation activities organised along the DS cycles with ex-ante and ex-post differentiation for the timing. The evaluands are implicitly referred to as outputs emerging at the phases "problem identification", "design", "construction", and "use" (**Figure 50**).

Figure 50: *Evaluation activities within a DSR process (source: Sonnenberg and vom Brocke, 2012)*

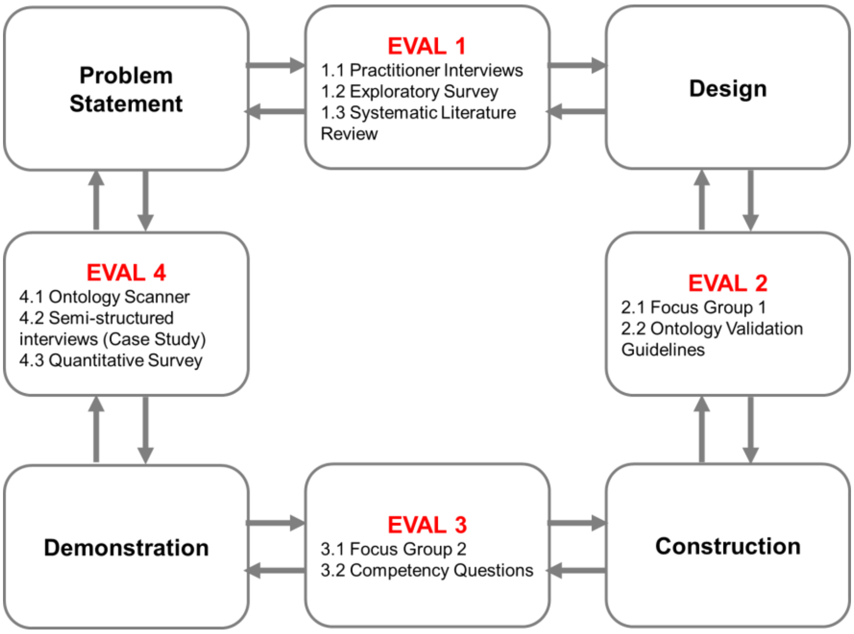


The authors suggest various methods for each distinct evaluation activity and emphasise the iterative feature of the process and the feedback loops between each design and evaluation activity (Sonnenberg and vom Brocke, 2012). Moreover, for each evaluation cycle, a set of evaluation criteria is proposed. EVAL1 represents the evaluation of the problem identification and aims at providing a meaningful research objective and thus justification for the DSR project. EVAL2 is characterised by showing that the design and design components are essential and purposeful in solution development and thus critical in addressing the problem. EVAL3 activities involve the initial demonstration of the constructed artefact on how well it meets the goodness criteria. Here, the evaluation can be conducted at the intersection between artificial and naturalistic conditions, e.g., interaction with organisational elements (Sonnenberg and vom Brocke, 2012). EVAL4 activities focus on the application of the artefact within a real-world environment to show its usefulness and applicability for the practice. Therefore, only naturalistic evaluation is considered at this stage.

Conceptualising the Evaluation Strategy for this Research

In order to adopt the above-proposed framework and develop an appropriate evaluation strategy, an analysis of the applicability of the "what", "when", and "how" for this research is necessary. To begin with, the initial phase of this research produces a problem and a relevance statement (Sections 1.2 and 1.5), and the formulation of the research aim and objectives (Section 1.3). These outputs ("whats") correspond to the problem identification phase of the framework ("when") and are therefore subject to EVAL1 activities ("how") (ex-ante). In the subsequent design phase, two distinct outputs have been generated, the literature- and practitioner-informed ontology along with its concepts and relations (Sub-RQ1). These two artefacts are subject to EVAL2 activities (ex-ante). Thereafter, the consolidated ontology is constructed (Sub-RQ2) representing the artefact aimed at addressing the problem space of this research and thus subject for EVAL3 activities (ex-post). With the demonstration of the artefact within a real-world scenario (retailer case study), which aims at assessing to what extent it meets the solution criteria (defined in Section 1.3), EVAL4 activities become relevant at this stage (ex-post). Evaluation results at any stage of the cycle can stimulate iterations feeding back to the relevant design activities and fostering further improvements of the artefact.

Figure 51: *Evaluation activities for this research*



In the next step, relevant evaluation methods that fit each evaluation step from EVAL1 to EVAL4 are required to be identified and applied. Along with this, evaluation criteria are defined and selected accordingly. While selecting the criteria, it is also important to consider a balance between the interest of practitioners (e.g., ensuring “utility”) and researchers (e.g., verifying “validity”) when it comes to choosing the appropriate evaluation criteria (Sonnenberg and vom Brocke, 2012; Aier and Fischer, 2011). This is in line with the principle aim of DS projects. The adopted evaluation process for this research is shown in **Figure 51**.

Evaluation Criteria and Methods in EVAL1

In EVAL 1, the evaluation of the identified problem is the focus of the evaluation activities. DSR literature emphasises the importance of ensuring that the problem is of relevance for the practice but also novel from a theory perspective at the same time (research gap). According to Sonnenberg and vom Brocke (2012), the identified problem can be evaluated by means of assertion, literature reviews, reviews of practitioner initiatives, expert interviews, focus groups, or surveys. In view of this research, the aim of the evaluation is to retrieve justification for the problem statement, defined as the lack of guidance for retailers on how to align strategic assortment decisions to the consumer confusion concept and its consequences in an omnichannel context (need in practice). However, there is also an essential need to confirm that there is a lack of solutions or the fact that existing solutions are insufficient in addressing the problem from a theory point of view (research gap). Therefore, two critical criteria need to be considered for EVAL1: relevancy and novelty. The criteria *relevancy* justifies the problem statement and provides meaning for the DSR project, whereas *novelty* ensures that the identified problem represents a valid research gap in theory. In view of the alternative methods that can provide evidence for the relevancy of the identified problem, expert interviews with practitioners (EVAL1.1) and an explorative survey (EVAL1.2) have been applied.

The use of the explorative survey aims at gaining exploratory insights into assortment configuration and consumer confusion experience of selected European retailers (convenience sampling, non-probability approach, Saunders *et al.*, 2016). The survey design is informed by Krosnick (2018), Braun *et al.*, (2021) and Wright (2005) on the design of online surveys for qualitative research aims. The semi-quantitative survey encompasses three sections (company details, assortment integration between channels, and assortment inconsistencies leading to consumer confusion), a total of 18 MCQs with branching features and a comment section for qualitative feedback (pilot-tested). The target group are individuals from top / middle management from European retail organisations. Contact details are retrieved using an existing database of contacts. The contact method of choice is digital via emails and for the implementation of the questionnaire, Microsoft

Forms is used. This is reasoned on practical reasons and the advantages of digital data collection. Moreover, all retrieved data has been handled anonymously and no personal data has been collected or stored.

To validate novelty, a systematic literature review (Brocke *et al.*, 2009; Webster and Watson, 2002) confirming valid research gaps related to the problem statement has been conducted as already presented in Chapter 2 (EVAL1.3).

Evaluation Criteria and Methods in EVAL2

In EVAL2, the subjects for evaluation are the literature- and practitioner-informed ontologies which form the components to be merged for the consolidated ontology (Section 4.3). These artefacts are to be assessed against quality measures in the course of the development phase as discussed above (second purpose of the evaluation). The next step, therefore, involves the identification of an appropriate set of quality measures for the evaluation of the ontologies.

For this, specific guidelines and evaluation criteria for ontologies can be consulted. For ontology evaluation, several works exist contributing with methods, systematisation, and criteria (e.g., Raad and Cruz, 2015; Poveda-Villalón *et al.*, 2014; Vrandečić, 2009; Brank *et al.*, 2005; Gómez-Pérez, 2004). The most common and established criteria to evaluate ontologies are defined as follows (Raad and Cruz, 2015; Vrandečić, 2009; Obrst *et al.*, 2007; Brank *et al.*, 2005; Gruber, 1995):

- **Accuracy**: Criteria measuring to what extent the axioms (statements that are asserted to be true in the domain being described) of the ontology comply with the domain knowledge of the domain stakeholders. High accuracy can be achieved through correct definitions and descriptions of classes, properties, and instances.
- **Adaptability**: Criteria measuring to what extent the ontology can anticipate its use, e.g., in new environments, by new tools, etc. The ontology should offer the possibility of extending or specialising its features in an intuitive way.
- **Clarity**: Criteria measuring how effectively the ontology is able to communicate the intended meaning of the defined terms. For this, definitions should be objective and independent of the context (ontologies should use definitions instead of descriptions for classes).

- **Completeness**: Criteria measuring if the domain of interest is appropriately covered (concepts, instances, etc.). All questions on the ontology should be able to be answered.
- **Computational efficiency**: Criteria measuring the ability of the used tools to work with the ontology, especially, the speed that is required to fulfil the tasks (e.g., query answering, classification, consistency checks).
- **Conciseness**: Criteria stating if the ontology includes irrelevant elements related to the domain to be covered or redundant representations of the semantics.
- **Consistency**: Criteria measuring that the ontology does not include or allow for any contradictions (logical consistency, consistency of formal and informal descriptions).
- **Organisational fitness**: Criteria measuring how easy an ontology can be developed within an organisation. Organisations are characterised by different tools, libraries and data sources that constrain the ontology.

The criteria provide a comprehensive set in evaluating various qualities of an ontology. Most of them resonate with the proposed criteria for EVAL2 activities as stated by Sonnenberg and vom Brocke (2012), e.g., understandability, simplicity, completeness, or level of detail. Out of the criteria, for EVAL2, the criteria *accuracy* and *clarity* are considered. *Conciseness* and *consistency* as well as the criteria *completeness* are applied for the EVAL3 phase. This is due to the fact that the consolidated ontology is generated in the construction phase after EVAL2 activities. Only then it is possible to view the constructed artefact as a whole in order to assess its conciseness, consistency, and completeness. In contrast, accuracy and clarity address elements of the ontology (classes, properties, and instances) that can ideally be evaluated before the consolidation of the ontology. The criteria "adaptability", "computational efficiency", and "organisational fitness" have been omitted from the criteria selection process due to their measurability and application by computational means only.

As evaluation methods, Sonnenberg and vom Brocke (2012) suggest that "assertion", "mathematical proof", "logical reasoning", "ex-ante demonstration", "simulation", "benchmarking", "expert interviews", or "focus groups" are suitable for EVAL2 activities. Also, Noy and McGuinness (2001) emphasise the suitability of consulting experts to evaluate ontologies. For the EVAL2 phase of this research, the collaborative engagement with the case study partner (FG1, expert interviews) serves as the basis for the evaluation activities since the measurability of the quality measures is dependent on the end user perception (see discussion above). In the course of the knowledge sourcing conducted as part of the sourcing processes (Section 4.3.1 and 4.3.2), the literature- and practitioner-informed ontologies have been assessed against the selected criteria in dedicated discussions (EVAL2.1, see Questioning Route for FG1). In addition to the criteria above, Noy and McGuiness (2001) provide a comprehensive guide on ontology validation with specific principles and guidelines addressing pitfalls and challenges in the course of ontology development. The key guidelines have been extracted and consolidated into a set of evaluation criteria for the artefacts in EVAL2. These serve as objective quality measures independent of the end user and are complementary to accuracy and clarity (EVAL2.2). Overall, 18 criteria have been assessed against the literature- and practitioner-informed ontology (**Appendix F-3**). Any inconsistencies or flaws have been addressed with an intervention feeding back to the design phase. This approach is also utilised by the Ontology validation tool "OOPS!" which embodies the validation guidelines in its validation routines (Poveda-Villalón *et al.*, 2014). The tool serves as the method of choice for the validation of the syntactical quality of the ontology in EVAL4.

Evaluation Criteria and Methods in EVAL3

For EVAL3, the evaluation of the consolidated ontology is at the centre of this activity. As mentioned above, the criteria *completeness*, *conciseness* and *consistency* can be applied to the final artefact. Sonnenberg and vom Brocke (2012) state that among different experimenting and prototyping approaches, benchmarking, surveying, expert interviews or focus groups can be applied as evaluation methods. For the same reason as stated above for EVAL2.1, a dedicated FG is utilised for the evaluation of the ontology (FG2). The FG aims at focusing on improving the final artefact along all three criteria that are measured subjectively relative to the perception of the FG participants (EVAL3.1). The FG participants are asked whether (1) the domain of interest is appropriately covered (completeness), (2) the ontology includes irrelevant elements related to the domain to be covered or redundant representations of the semantics (conciseness), and (3) the ontology does not include or allow for any contradictions (consistency). As a complementary evaluation, *Competency Questions* (CQs) are applied as objective validation (Ren *et al.*, 2014; Grüninger and Fox, 1995) within FG2. CQs are defined as questions that the ontology should be able to answer (Grüninger and Fox, 1995). According to Ren *et al.* (2014), the answerability of CQs is a critical requirement of ontologies. On the one hand, CQs are applied in order to scope ontology development but also to evaluate the constructed ontology.[8] Accordingly, the demonstration with CQs as part of FG2 acts as a valid evaluation activity within the ex-ante evaluation of this research. The aim is to demonstrate the successful retrieval of information of interest out of the ontology. Information of interest is hereby defined as questions specifically addressing the DRs expressed as design specifications entailed within the ontology in the form of entities and their relations. Selected queries on the ontology will be applied in the course of FG2. This evaluation is captured as the *competency* criteria for the remainder of the thesis.

Evaluation Criteria and Methods in EVAL4

EVAL4, characterised by the application of the ontology in a real-world environment, is subject to be assessed against utility and quality. Sonnenberg and vom Brocke (2012) suggest case studies, field experiments, surveys, expert interviews, or focus groups as appropriate methods for the evaluation of artefacts within a real-world environment. Within EVAL4 of this activity, three different evaluation methods are applied to assess the utility and quality of the ontology (ontology validation scanner, semi-structured interviews with experts, and a quantitative online survey collecting evidence from European retailers). The following briefly outlines the rationale for the selection of these methods and the set of evaluation criteria.

Appropriate evaluation criteria and methods are determined through approaches accounting for user perceptions of conceptual models. Lindland *et al.* (1994) introduced a systematic framework to assess the quality of conceptual models grounded in linguistics and semiotics. The empirically validated framework is based on the assumption that modelling corresponds to making statements in a specific language. These statements in the model are assessed against "language", "domain", and "user interpretation" where the degree of correspondence determines its quality dimensions: *Syntactic quality* (correspondence of the model to language, e.g., grammar), *semantic quality* (correspondence of the model to the domain of interest reflecting the reality), and *pragmatic quality* (correspondence of the model to user interpretation) (Maes and Poels, 2007; Lindland *et al.*, 1994).

Syntactical Quality of the Ontology. Syntactical Quality (SNQ) is understood as to which extent the model corresponds to the underlying language rules (e.g., grammar) and can be measured objectively due to its controllable nature (Krogstie *et al.*, 2006). The evaluation

[8] CQs are especially useful for authoring or using ontologies that are not intended to utilise "Description Logics" as a form of a more technical and formalised approach (Ren *et al.*, 2014). This is in line with the intention of this research to guide retail practitioners who are not necessarily familiar with Description Logics or the computation of ontologies.

outcome is characterised by the statements of the model either being correct or not according to the syntax of the modelling language (Krogstie *et al.*, 1995). The online ontology validation tool "OOPS!" (https://oops.linkeddata.es/index.jsp) is suitable to evaluate the syntactical correctness of ontologies based on the RDF language for ontologies and a range of dimensions (structural, functional, and usability perspectives) (Poveda-Villalón *et al.*, 2014). On the basis of the formalised ontology in Protégé, the OWL code is assessed against a set of 41 criteria via OOPS! to validate the syntactical correctness of the ontology (EVAL4.1).

Semantic Quality of the Ontology. The measurement of Semantic Quality which is defined as the correspondence between the domain (reality) and the externalised model (individual's perception), is less controllable since it depends highly on the individual's perception of reality and thus poses a great challenge because of too many factors to consider (Maes and Poels, 2007). To overcome this, Krogstie *et al.* (2006) provide an extension of Lindland's framework with the addition of *Perceived Semantic Quality* (PSQ) as a surrogate of semantic quality defining the correspondence between "user interpretation" (the information that users think the model contains) and "domain knowledge" (the information that users think the model should contain), thus providing a less difficult construct to measure. The idea is therefore not to capture the actual semantic quality but the perceived semantic quality of the model. This approach is adopted for the evaluation of the semantic quality of the ontology. The assessment itself is undergone through the utilisation of an established measurement scale with four distinct indicators based on experiments proving the validity and reliability of the scale (Rittgen 2010; Maes *et al.*, 2007). The indicators with the adapted statements to be measured are provided below (**Table 35**).

Table 35: *Perceived Semantic Quality Measurement (adopted from Rittgen, 2010)*

Indicator	Definition	Statement
Correctness	All statements in the representation are correct.	The reference model represents the domains correctly.
Relevance	All statements in the representation are relevant to the problem.	All the elements in the reference model are relevant for the representation of the domains.
Completeness	The representation contains all statements about the domain that are correct and relevant.	The reference model gives a complete representation of the domains.
Authenticity	The representation gives a true account of the domain.	The reference model is a realistic representation of the domains.

The measurement is undertaken on the basis of a 7-point Likert scale ranging from "strongly disagree" to "strongly agree" (Rittgen, 2010). In terms of wording, instead of using the term "ontology", "reference model" is used to ensure construct validity since practitioners are more familiar with the latter expression.

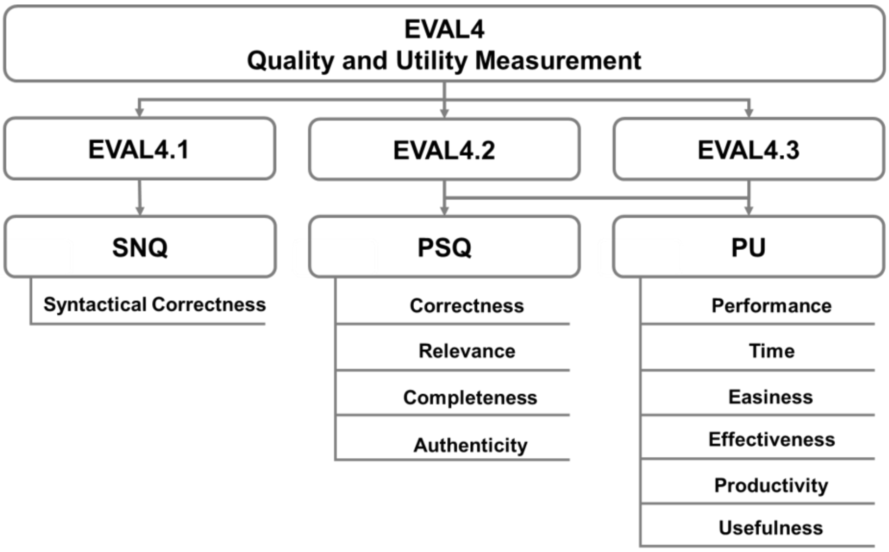
Pragmatic Quality of the Ontology. Pragmatic Quality is referred to the user's interpretation of the model and how well it is "understood" (Rittgen, 2010; Maes and Poels, 2007; Mendling *et al.*, 2007). An approach to assess the understandability of a model is to ask the user a set of questions and check to what extent the model is understood (Rittgen, 2010; Maes and Poels, 2007). Rittgen (2010) recommends the use of *Perceived Usefulness* (PU) based on the Technology Acceptance Model (TAM) (Davis, 1989) due to its successful application in modelling studies (e.g., Liang and Hung, 1997) and its proven validation within a business context (Rittgen, 2010). PU is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance.*" (Davis, 1989, p. 320) and can be measured with a scale consisting of six indicators. Also in this case, the measurement is undertaken on the basis of a 7-point Likert scale ranging from "strongly disagree" to "strongly agree" (Rittgen, 2010). Also here, instead of using the term "ontology", "reference model" is used to ensure construct validity. The indicators and measurement statements are provided below in (**Table 36**).

Table 36: *Perceived Usefulness Measurement (adopted from Rittgen, 2010, and Davis, 1989)*

Indicator	Definition	Statement
Performance	How far the user believes that using the model improves job performance.	Using the reference model would improve my job performance.
Time	How far the user believes that using the model enables accomplishing tasks more quickly.	Using the reference model would enable me to accomplish tasks more quickly.
Easiness	How far the user believes that using the model makes the job easier to do.	Using the reference model would make it easier to do my job.
Effectiveness	How far the user believes that using the model enhances the effectiveness on the job.	Using the reference model would enhance my effectiveness on the job.
Productivity	How far the user believes that using the model increases productivity.	Using the reference model would increase my productivity.
Usefulness	How far the user finds the model as being useful in the job.	I would find the reference model useful in my job.

In summary, EVAL4 involves the utilisation of three criteria that are objective (SNQ) and subjective in nature (PSQ and PU) (**Figure 52**).

Figure 52: *Overview of applied criteria and indicators for EVAL4*



In line with previous studies (e.g., Rittgen, 2010; Maes *et al.* 2005) and the provision of validated and reliable measurement scales, for both PSQ and PU, a quantitative survey as means for the evaluation is carried out. The items in the questionnaire are measured via a 7-point Likert scale with "strongly disagree" (1), "disagree" (2), "somewhat disagree" (3), "neither agree or disagree" (4), "somewhat agree" (5), "agree" (6), and "strongly agree" (7).

The quantitative survey encompasses five short sections (introduction, video presentation, PSQ measurement, PU measurement, and contact details) with a total of 5 profile questions and 10 items and statements to be measured (**Appendix F-6**). The introductory part asks for company details used to profile individual respondents (country of operation, company size, type of offering, type of retailer, responsibility, or familiarity with strategic assortment decisions) that are not mandatory to answer except for the retailer type (pure online retailer, pure offline retailer, omnichannel retailer) and whether the respondent is involved or familiar with strategic assortment decisions within his/her organisation. The two questions serve as validation for the preselected contacts that are based on the selection of omnichannel retailers only and targeting potential domain experts within strategic assortment decisions. Respondents not meeting these two criteria are classified as invalid responses. Company size classification defines four different classes determined by employee size and annual revenue in € as defined by the established SME classes by the EU Commission (2020). Companies above the threshold with more than 250 employees or an annual revenue over 50 million € are identified as being "large / multinational". The next section provides a video presentation of the ontology based on a recording via Microsoft PowerPoint where the motivation, the purpose and the structure of the ontology are presented within 8 min (including speech). This is to create a more sensory experience in order to convey the rather complex structure and features of the ontology in the best possible way. An online link to the ontology is accessible at all times throughout the survey for inspection purposes (https://postimg.cc/zLbS1jhC). The video itself is provided via YouTube (https://www.youtube.com/watch?v=4AZqoIN7UYk). The section is followed by the section for the Quality and Usefulness assessment with the specified 10 items. The last section expresses an appreciation formulation and contact details. The survey is pilot tested with peers resulting in few improvements (e.g., provision of a link to the ontology at all times in the survey process, reduction of the length of the introductory video presentation). With the introductory video part, the completion of the survey is estimated to be done within 12 minutes. The target group are identified based on purposive sampling and are individuals from top / middle management from European retail organisations that are potentially involved or familiar with strategic assortment decisions in their organisations in the context of omnichannel retailing (e.g., CEOs, strategy or business development directors, head of transformation or innovation, digital officers, retail or product managers, strategic marketing managers). Contact details are retrieved using an existing database of contacts. The contact method of choice is digital via emails and for the implementation of the questionnaire, Microsoft Forms is utilised. This is based on practical reasons (for example, the survey is changed to a responsive design layout when accessed via a mobile device) and the advantages of digital data collection.

In addition to the survey, the criteria and measurement statements are used in the course of semi-structured interviews in the demonstration phase (Chapter 5).

Both methods are represented by EVAL4.2 and EVAL4.3. EVAL4.2 is an evaluation based on the application / demonstration of the ontology whereas EVAL4.3 is aiming at capturing the perception of the ontology utility and quality based on the ontology presented as an image and explained via a video. The above-developed statements are incorporated into the interview protocol in EVAL4.2 (**Appendix E-2**). Both the survey and the semi-structured expert interview approaches are in line with Sonneberg and vom Brocke's (2012) suggestion on appropriate evaluation methods. The summary of the evaluation steps, utilised techniques and methods, criteria and aimed results are provided below in **Table 37**.

Table 37: *Overview of evaluation steps, techniques & methods, and criteria used for the evaluation strategy*

Step ("when")	**Evaluand ("what")**	**Techniques and Methods ("how")**	**Criteria**
EVAL1	▪ Problem Statement ▪ Relevance Statement ▪ Research Aim and Research Objectives	▪ **EVAL1.1** Practitioner interviews (Yin, 2017) ▪ **EVAL1.2** Exploratory online survey (Krosnick, 2018; Braun *et al.*, 2021; Wright, 2005) ▪ **EVAL1.3** Systematic Literature Review (Webster and Watson, 2002; Brocke *et al.*, 2009)	▪ Relevance ▪ Novelty
EVAL2	▪ Literature-Informed Ontology ▪ Practitioner-Informed Ontology	▪ **EVAL2.1** Focus Group 1 (Tremblay *et al.*, 2010) and Expert Interviews (Yin, 2017). ▪ **EVAL2.2** Ontology Validation Guidelines (Noy and McGuiness, 2001)	Subjective: ▪ Accuracy ▪ Clarity Objective: ▪ Ontology Validation Guidelines
EVAL3	▪ Consolidated Ontology	▪ **EVAL3.1** Focus Group 2 (Tremblay *et al.*, 2010) ▪ **EVAL3.2** Competency Questions (Ren *et al.*, 2014; Grüninger and Fox, 1995)	Subjective: ▪ Conciseness ▪ Consistency ▪ Completeness Objective: ▪ Competency
EVAL4	▪ Consolidated Ontology	▪ **EVAL4.1** Syntactical Validation via the Ontology Pitfall Scanner "OOPS!" (Poveda-Villalón *et al.*, 2014) ▪ **EVAL4.2** Semi-structured Expert Interviews based on a Single Case Study (Yin, 2017) ▪ **EVAL4.3** Quantitative Survey	Objective: ▪ Syntactic Quality (SNQ) Subjective: ▪ Perceived Semantic Quality (PSQ) ▪ Perceived Usefulness (PU)

6.2.2 Ex-Ante Evaluation Results

The ex-ante evaluation activities (EVAL1 and EVAL2) have been conducted as follows and yielded the following results.

EVAL 1.1: Practitioner Interviews

In total, three face-to-face interviews have been conducted with middle- to top retail managers of an Irish and German retailer between 2019 and 2020 (Yin, 2017). The selection process was based on purposive sampling (Saunders *et al.*, 2016) and an existing database of European retailers. The interviews with the Irish retailer have been carried out via Teams, the online conference tool from Microsoft. The interview with the German retailer was performed via phone. Each individual interview lasted between 30 to 40 minutes and has been recorded via an audio recorder. The questions were open-ended and addressed "challenges of assortment alignment along channels". The aim was to retrieve relevant knowledge and experience from retailers and determine to what extent the research problem is resonating with practitioners. Details about the practitioner interviews along with selected characteristics of the retailers are shown below in **Table 38**.

Table 38: *EVAL1.1 Overview of practitioner interviews*

Participant	Mgt. Level	Background	Business / Market	Size	Revenue	Assortment integration type	Interview duration
Retailer #1 (Ireland)	Top	Retail Management	High-quality gifting (B2C)	SME	50 M €	Asymmetric	30 min.
Retailer #1 (Ireland)	Top	Retail Strategy / E-commerce					30 min.
Retailer #2 (Germany)	Mid-dle	Retail Management	Renovation discount (B2C)	SME	500 M €	Asymmetric	40 min.

Among the interview statements, empirical evidence for the problem statement has been identified, confirming the relevance of the research objective. Selected quotes are discussed in Chapter 1. Additional quotes are provided in **Appendix F-1**.

EVAL 1.2: Exploratory Online Survey

As shown in Section 1.5, the results of EVAL 1.2 reveal a range of different findings and underline the relevance of this research project. Firstly, the responses support the occurrence of the consumer confusion phenomenon as well as its perception as a problem for the retailer. Secondly, the retailers acknowledge the problem of being challenging to capture and the lack of any solution concepts to countermeasure the phenomenon.

EVAL 1.3: Systematic Literature Review

The systematic literature review in EVAL1.3 addresses the novelty evaluation criteria for the problem statement and was conducted following the iterative review cycle as proposed by Brocke *et al.* (2009) and a concept-centric analytical approach (Webster and Watson, 2002). The results are presented in Section 2.7 as part of the literature synthesis with the identification of clear research gaps, justifying the theoretical novelty of the problem definition for this research.

The proven relevancy and novelty of the problem of this research successfully establish the justification of the problem statement formulated in Section 1.2.

EVAL 2.1: FG1 (Accuracy and Clarity of the Ontologies)

In the course of the information gathering and modelling approach (Ostrowski *et al.*, 2014) as discussed and executed in Section 4.3, the first FG in the sourcing process entails a set of questions in the FG Questioning Route addressing the evaluation of the concepts and relations of the practitioner-informed ontology. The participants were asked whether the ontologies are accurate (the extent the statements in the ontologies comply with the domain knowledge of the experts) and clear (how effective are the ontologies in the communication of the intended meaning of the defined terms). All participants assured that the ontologies did not lack any accuracy and clarity issues.

EVAL 2.2: Ontology Validation Guidelines

Noy and McGuinness (2001) provide a range of guidelines to validate ontologies in the course of construction. The guidelines address various typical pitfalls related to hierarchical logic (e.g., transitivity, inheritance), syntactical conventions (e.g., naming, consistency), the introduction of classes vs. instances (e.g., when to introduce a concept as a subclass vs. property) and general rules of thumb (e.g., number of total subclasses in an ontology, the generality of subclasses per level). Overall, 18 different guidelines have been considered for the evaluation that has been assessed against the artefact within the consolidation activity. In the first iteration, some criteria were not fulfilled. Within a maximum of two iterations, all criteria have been fulfilled eventually. **Appendix F-3** provides an overview of each guideline, its description, and the evaluation result along with possible interventions based on a second iteration. For example, the principle to ensure that all sibling classes in the hierarchy must be at the same level of generality (criteria 9) was violated in the case of assigning the subclasses for *Assortment Integration Types* while following Rooderkerk and Kök's (2019) taxonomy. The subclasses *Full Integration*, *No Integration*, and *Asymmetric Integration Type* were initially on the same hierarchical level although not representing the same generality since the class *Asymmetric Integration Type* is further divided into the subclasses *Typ A*, *Type B*, and *Type C* that correspond to the other types in terms of generality. To solve the problem, a "dummy" subclass *Symmetric Integration* as a parent class for *Full* and *No Integration* has been added to match the class Assortment Integration Type and to ensure hierarchical consistency (see also the discussion in Section 4.3.1).

6.2.3 Ex-Post Evaluation Results

The ex-post evaluation comprises all evaluation activities that are undergone after the artefact is constructed (Venable *et al.*, 2016; Sonnenberg and vom Brocke, 2012; Venable *et al.*, 2012; Pries-Heje *et al.*, 2008).

EVAL 3.1: FG2 (Completeness, Conciseness and Consistency of the Ontology)

Following the dedicated evaluation questioning route for FG2 (**Appendix F-4**), the following results could be retrieved. In terms of completeness, the FG participants agreed upon introducing the subclass *Switcher Types* and *Assortment Elimination*. The rationale for the decisions is discussed in Section 4.3.2. In view of the conciseness and consistency of the ontology, no changes were deemed to be necessary on the consolidated ontology.

EVAL 3.2: Ontology Competency Questions

Following Ren *et al.* (2014), CQs are questions in the form of natural language and can be expressed by 12 archetypes of CQ patterns (**Table 39**).

Table 39: *Competency Questions Archetypes (source: Ren et al., 2014)*

#	Competency Question Archetype
1	Which [CE1] [OPE] [CE2]? (asking relational property)
2	How much does [CE] [DP]? (asking data property relation)
3	What type of [CE] is [I]?
4	Is the [CE1] [CE2]?
5	What [CE] has the [NM] [DP]?
6	What is the [NM] [CE1] to [OPE] [CE2]? (asking for both data and relational property)
7	Where do I [OPE] [CE]?
8	Which are [CE]?
9	When did/was [CE] [PE]?
10	What [CE1] do I need to [OPE] [CE2]?
11	Which [CE1] [OPE] [QM] [CE2]?
12	Do [CE1] have [QM] values of [DP]?

With CE = class expression; OPE = object property expression; DP = datatype property; I = individual (instance); NM = numeric modifier; PE = property expression; QM = quantity modifier

In order to formulate adequate CQs that address the information to be retrieved, the DRs of the ontology are mapped to CQ archetypes. **Appendix F-5** provides a set of exemplary CQs and answers that could be successfully retrieved by the ontology without errors. The exemplary CQs have been selected by the participants within FG2.

EVAL 4.1: Syntactical Quality

For SNQ, the *OntOlogy Pitfall Scanner!* (“OOPS!”) (Poveda-Villalón *et al.*, 2014) is used. The scanner provides a range of 41 so-called “pitfalls” that cover checks for structural, functional, and usability criteria for ontology validation including comprehensive syntactical dimensions. The pitfall catalogue is available at: https://oops.linkeddata.es/catalogue.jsp. For the evaluation of SNQ, all pitfalls have been checked to be applied while scanning (**Figure 53**).

The OWL code of the ontology has been extracted from Protégé and pasted into the scanner. After running the scan (“Scanner by RDF”), the initial results reported one issue regarding the missing information on the licence of the ontology. Although classified as a "minor" issue by the scanner, information on the license (declaration of a creative commons licence CC BY 3.0 via https://creativecommons.org/licenses/by/3.0/) has been added to the ontology header on Protégé and the scan with the updated OWL code has been rerun. The ontology scanner reported no errors eventually (**Figure 54**).

Figure 53: *EVAL4.1 Application of all Ontology Pitfall Scanner pitfall criteria for SNQ evaluation*

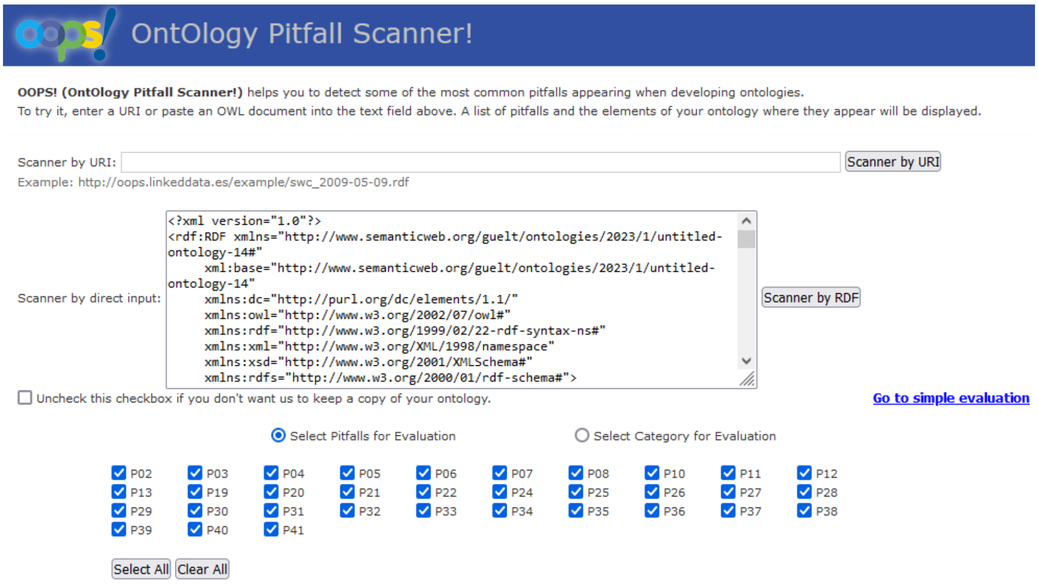
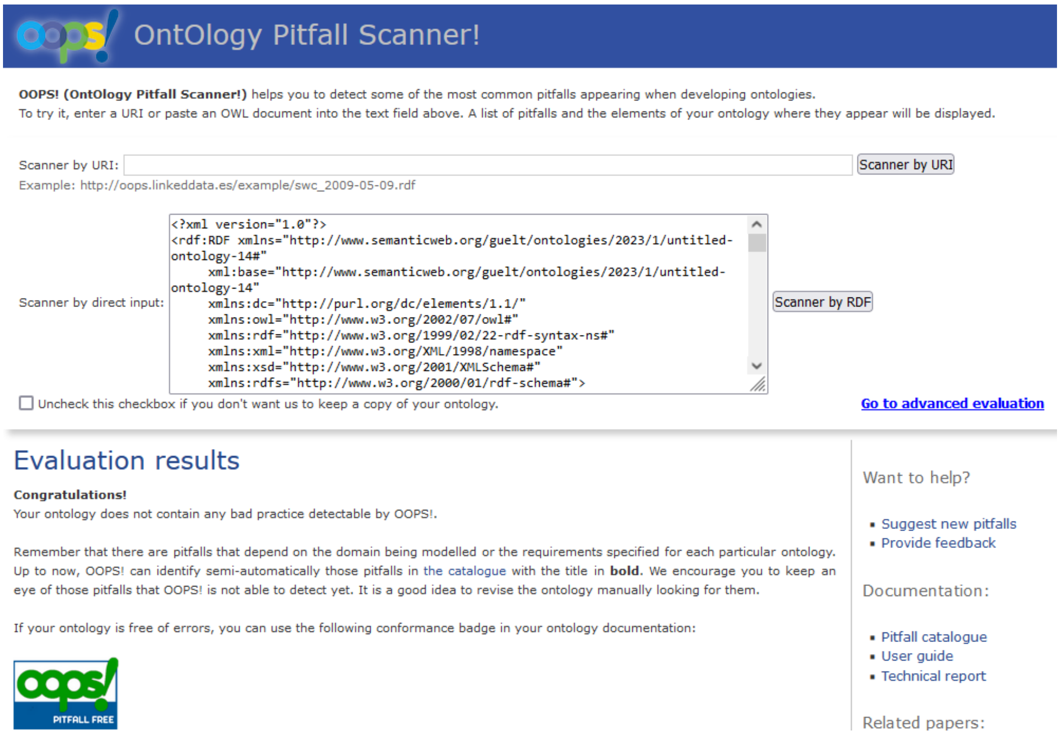


Figure 54: *EVAL4.1 Results for SNQ (source: Ontology Pitfall Scanner output)*



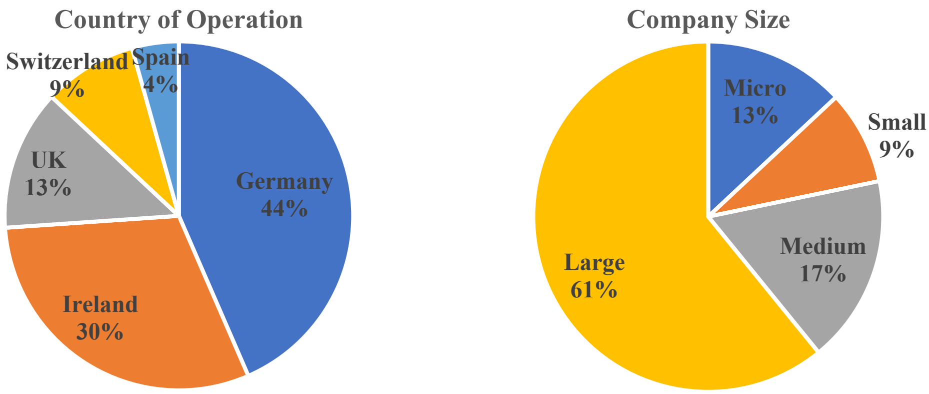
EVAL 4.2: Semi-Structured Interviews

The main feedback received in the course of the evaluation interview in the demonstration phase is the proposal of a new class in the ontology. The subclass labelled as *Change of Assortment Integration* was deemed necessary due to it being a valid strategic decision to trigger a change in the current assortment integration structure in the organisation. This was motivated by the fact that in the course of the demonstration phase, the case study problem articulation required the consideration of a deliberate activity denoting "change" on the assortment integration of the retailer. Accordingly, the new subclasses *Change of Integration Type* and *Level* have been added as the subject of change in the assortment integration decisions. As discussed in Section 4.3.2, the additions are incorporated into the consolidated ontology based on the result of this evaluation activity.

EVAL 4.3: Quantitative Survey Results

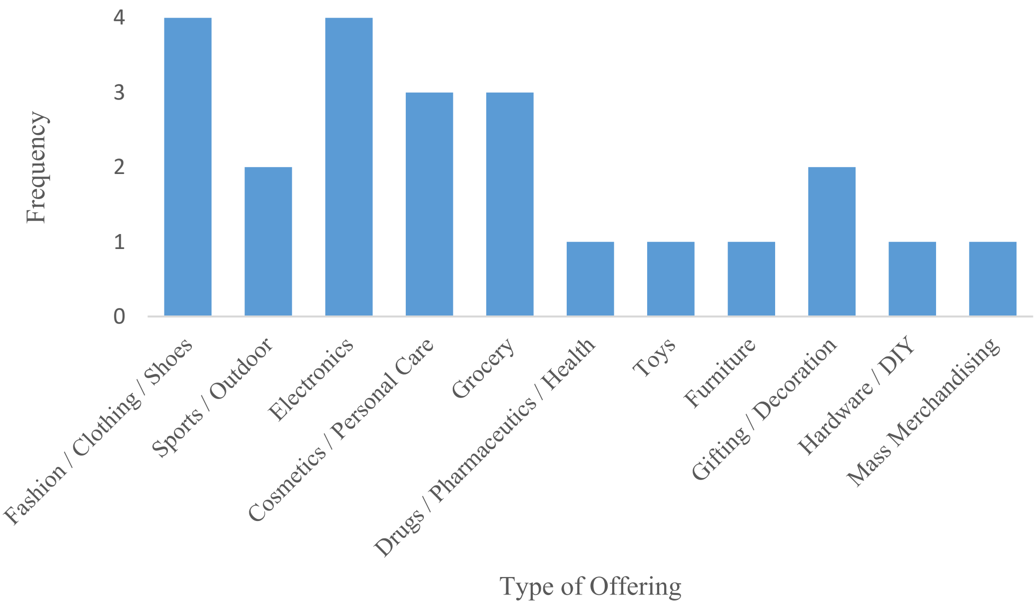
The online survey was open for around three months between November 2022 and January 2023. Out of the contacted individuals, 27 responses have been recorded. After removing 4 invalid responses (2 pure online player cases, 1 pure offline player case, and 1 pure online player case not involved or familiar with strategic assortment decisions within the organisation), a total of 23 completed questionnaires have been accepted and were subject to be analysed. The average completion time per response is 11:17 minutes, marginally longer than pilot-study responses. Most of the retailers operate in Germany (44%), Ireland (30%), and the UK (13%), and are of large company size (61%) (**Figure 55**).

Figure 55: *EVAL 4.3 Country of operation and company size of respondents (n = 23)*



There is a strong variety in the type of offering as shown in **Figure 56**. Retailers who are represented the most among the respondents are operating in the fashion / clothing / shoes as well as in the electronics markets, followed by cosmetics / personal care and grocery retailers.

***Figure 56:** EVAL 4.3 Types of offerings stated (n = 23)*

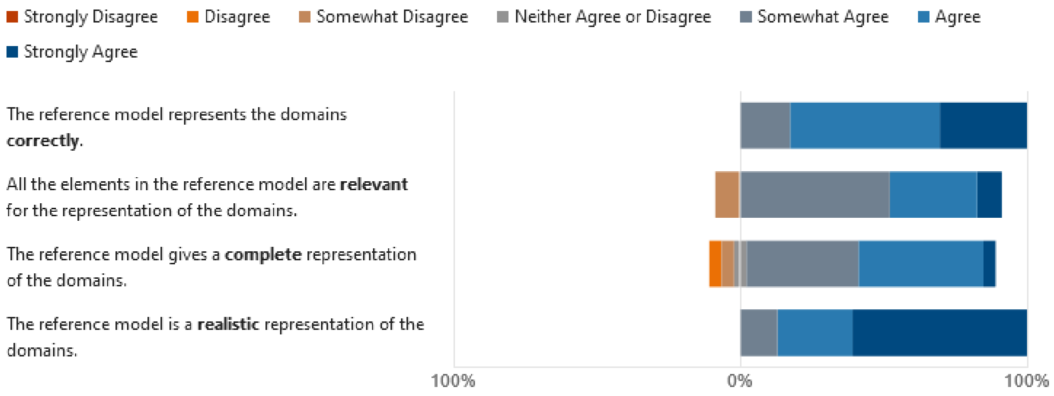


PSQ Findings. In terms of the perception of semantic quality, the percentage of the frequencies shows strong acceptance scores overall (**Figure 57**). However, slight deviations among the indicator results are observable. Unlike relatively strong agreement on the correctness (30.4% strong agreement, 52.2% agreement (mode value), 17.4% somewhat agreement) and especially on the authenticity (60.9% strong agreement (mode value), 26.1% agreement, 13% somewhat agreement) of the ontology, perception on the relevancy (8.7% strongly agreement, 30.4% agreement, 52.5% somewhat agreement (mode value), 8.7% somewhat disagreement) and completeness (4.3% strong agreement, 43.5% agreement (mode value), 39.1% somewhat agreement, 4.3% neither agree- or disagreement; 4.3% somewhat disagreement, 4.3% disagreement) of the ontology are characterised by relatively lower confidence in agreement. The overview of the frequencies and their distribution are provided in **Appendix F-7.**

PSQ Discussion. Strong agreement on the correctness and authenticity indicators among the respondents shows that the ontology is perceived as being capable of providing a correct representation of the domains as well as ensuring a realistic representation of the proposed concepts and relations. However, a relatively lower agreement is evident for the completeness and relevancy indicators. This may be accounted to the fact that the design of the ontology is based on a single source of evidence strategy for empirical data (Section

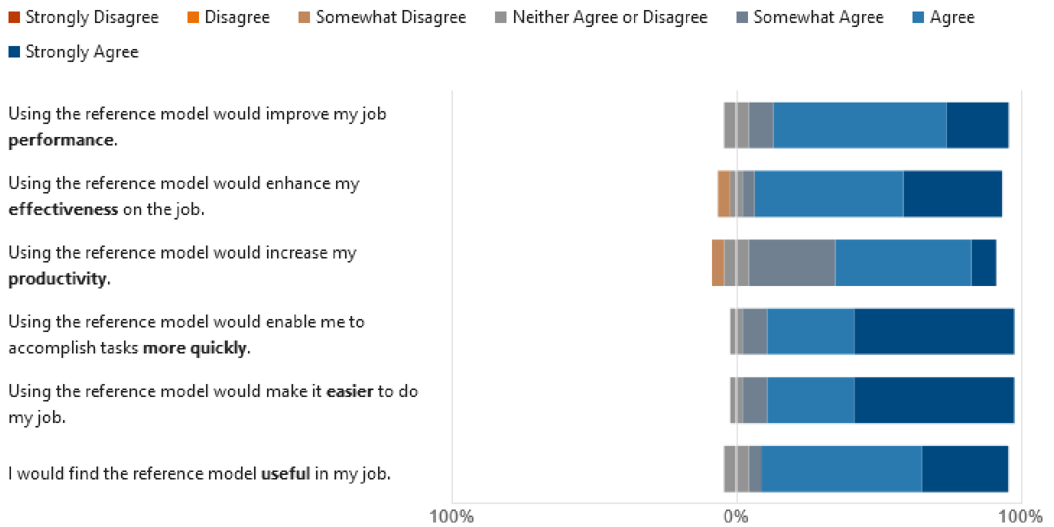
3.5.7), characterised by a high contextual influence. Thus, a complete representation of the relevant domains can indeed be questioned. Similarly, the relevancy of the representation may be affected for the same reason.

***Figure 57:** EVAL 4.3 Results for PSQ (n = 23)*



PU Findings. With regards to PU, a clear majority of the respondents express acceptance of the usefulness of the ontology overall (**Figure 58**).

***Figure 58:** EVAL4.2 Results for PU (n = 23)*



There is high agreement on the perceived potential time savings and easiness when using the ontology (both indicators with 56.5% strong agreement (mode value), 30.4% agreement, 8.7% somewhat agreement, and 4.3% neutral each). Similarly, the potential enhancement of the effectiveness on the job is perceived as being high overall (34.8% strong agreement, 52.2% agreement (mode value), 4.3% somewhat agreement/ neutral/ somewhat disagreement each). Moreover, the ontology is also found to be potentially useful in the job overall based on strong agreement scores (30.4% strong agreement, 56.5% agreement (mode value), 4.3% somewhat agreement, 8.7% neutral). Improvement of the performance on the job is also accepted based on the agreement scores (21.7% strong agreement, 60.9% agreement (mode value), 8.7% somewhat agreement and neutral each). Lastly, slightly lower agreement scores are evident by the perception of the potential productivity increase on the job (8.7% strong agreement, 47.8% agreement (mode value), 30.4% somewhat agreement, 8.7% neutral, 4.3% somewhat disagreement).

PU Discussion. There is a clear and relatively strong agreement on the potential time savings and easiness of the job. The respondents may perceive the use of the ontology as being very helpful in terms of the provision of quick references (concepts and relations) that are potentially making overall job tasks easier. A potential enhancement of the effectiveness on the job would potentially come along with these improvements. However, potential increases in productivity are perceived less strongly. Overall, the assessment of the PU of the ontology shows clearly a strong acceptance.

6.3 Discussion

The evaluation activities within EVAL1 successfully confirm the novelty and relevance of the research project. Based on the interviews with retail practitioners (EVAL1.1), an explorative online survey (EVAL1.2), and the rigorous execution of the SLR as presented in Chapter 2, a justified problem statement, justified relevance statement, and a justified research gap ground the research aim of this thesis. In EVAL2, the discussions with the FG1 participants (EVAL2.1) ensure that the ontology design specifications (represented by the literature- and practitioner-informed ontology) are accurate and clear. Moreover, the successful compliance with the set of ontology validation guidelines proves the soundness of the ontology (EVAL2.2). The EVAL3 activities including FG2 (EVAL3.1) and Competency Questions check (EVAL3.2) provide successful evidence for the completeness, conciseness, consistency, and competency of the consolidated ontology. Lastly, in the course of the EVAL4 activities, the syntactical correctness of the ontology (EVAL4.1) could be proved, as well as evidence for the semantic and pragmatic quality based on the questionnaire conducted with retail practitioners could be retrieved (EVAL4.2 and EVAL4.3). To conclude, the evaluation of the Omnichannel Assortment Ontology for Consumer Confusion can be regarded as successful in view of its quality and utility within the scope of the evaluation strategy of this research. The results are summarised below in **Table 40**.

Table 40: *Summary of evaluation results*

Step	Outcome	Results Statement
EVAL1	▪ Retail practitioners confirm the occurrence and relevance of the research problem. ▪ The SLR highlights a clear research gap.	▪ ✓ Justified problem statement ▪ ✓ Justified relevance statement ▪ ✓ Justified research gap
EVAL2	▪ FG1 participants assure that there is no lack of accuracy or clarity in the ontologies. ▪ Complied fully with the ontology validation guidelines.	▪ ✓ Validated Ontology Design Specifications
EVAL3	▪ FG2 participants enrich successfully the ontology with new empirically grounded classes to ensure completeness and assure that it meets conciseness and consistency criteria. ▪ FG2 participants prove successfully the competency of the ontology.	▪ ✓ Validated Consolidated Ontology
EVAL4	▪ Successful evaluation of the syntactical correctness of the ontology in being correct on the basis of no errors as revealed by the OOPS! Scanner. ▪ Strong agreement on the PSQ and PU of the ontology based on the quantitative survey and interview in the demonstration phase.	▪ ✓ Validated utility and quality of the ontology in a real environment

6.4 Summary

This chapter is dedicated to the evaluation of the Omnichannel Assortment Ontology for Consumer Confusion. For this, an evaluation strategy is developed and executed successfully. The evaluation activities encompass various methods and involve a range of evaluation criteria that successfully led to a set of improvements that have been adopted in the course of an iterative process leading back to the design and development phase. The results solidify the strong validity of the developed artefact and prove its quality and utility in conjunction with the demonstration as presented in Chapter 5.

The following chapter represents the concluding section of this thesis and recapitulates the research journey from the motivation to the results. It presents the range of novel contributions this thesis produces and concludes with a future outlook on potential new research avenues.

CHAPTER 7 – CONCLUSION

7

"Knowledge has to be improved, challenged, and increased constantly, or it vanishes."

— Peter Drucker

7.1 Introduction

This research was motivated by the consumer confusion phenomenon in omnichannel retailing which describes consumers experiencing confusion when confronted with assortment inconsistencies across channels of a retailer, leading to various negative short- and long-term consequences. Retailers neglect the significance of the phenomenon while making decisions on the assortment across channels since the phenomenon is not sufficiently explored or captured in an omnichannel context. This research argues that there is a *missing alignment* between strategic assortment decisions and the consumer confusion concept in omnichannel retailing at the MOI of retailers so that retailers are likely to fail in addressing and preventing the phenomenon. On the basis of the Design Science Research Methodology, this research designed, developed, and evaluated the *Omnichannel Assortment Ontology for Consumer Confusion* to address this gap and to provide retail practitioners support in the alignment of strategic assortment decisions with the consumer confusion concept. During the course of the research, several original contributions emerged as well as implications for academia and practice in the omnichannel retailing discipline were identified. The purpose of this final chapter is to summarize the main contributions and provide concluding remarks for the thesis. The next sections revisit the research questions of the study first, highlight the artefact as the main contribution, summarize the main theoretical and practical contributions of the research thereafter and discuss its limitations as well as the potential avenues for future work in the concluding sections.

7.2 Reviewing the Research Questions and Objectives

This research was guided by the research questions and objectives as outlined in Sections 1.3 and 1.4. The overall goal was to design and develop a model that is capable of aligning and integrating relevant knowledge on strategic assortment decisions, consumer confusion, and its link to short- and long-term consequences from a channel switching perspective at the MOI in an omnichannel retailing context. The research aim was operationalised into a Main-RQ with three Sub-RQs that all address three distinct ROs with three steps throughout the research process.

The first step involved the identification of the major concepts that constitute strategic assortment decisions, the consumer confusion concept, its short- and long-term consequences, and channel switching behaviour in omnichannel retailing (Sub-RQ1). This objective was argued on the basis to capture all *relevant* concepts and relations that are required for the alignment as proposed in the research aim. To answer Sub-RQ1, the information gathering activity was conducted (Section 3.5.3, 4.3.1 and 4.3.2). The results encompass a range of literature- but also practitioner-informed concepts and relations which also involve novel empirical findings that extend the current state-of-the-art in omnichannel assortment, consumer confusion, and channel switching behaviour literature in omnichannel retailing. The contributions are outlined in the following Section 7.3.

Building on the results of Sub-RQ1, the second step investigated how an *integrated view* of these concepts and relations could be designed and formalised so that an alignment between strategic assortment decisions and the consumer confusion concept, its short and long-term consequences can be *represented* from a channel switching perspective. To answer this question, it was argued to follow a knowledge representation approach (Section 3.5.3) since it provides an appropriate approach to capture and represent the meaning of concepts, properties, and relationships of specific knowledge domains. Specifically, an *ontology* was deemed as the most suitable tool to integrate and ultimately represent the alignment between said main concepts. For this, an *ontology engineering* approach was utilised, resulting in two distinct ontologies that have been consolidated into the *Omnichannel Assortment Ontology for Consumer Confusion*. In the course of the construction process of the ontology, novel insights on alignment emerged. One major finding is the proposition that the alignment requires the incorporation of a channel switching behaviour perspective to link both the strategic assortment decisions and consumer confusion domain. Without concepts and relations based on the channel switching behaviour domain, the consumer behaviour characterised by channel switching could not be represented. In fact, it is the major condition that leads to consumer confusion occurrence in the first place. Another interesting finding led to the conclusion that, unlike the short-term consequences of the consumer confusion phenomenon (that typically occur immediately at the POS), the long-term consequences are argued to be directly linked to the post-purchase phase of the customer journey process after the experience of consumer confusion.

Finally, the third step was directed towards answering the question if the proposed artefact is able to inform domain experts about the alignment as proposed in the research aim, thus ultimately demonstrating the utility of the artefact. For this, the ontology was demonstrated on the one hand, and its utility and quality were evaluated on the other hand. For the demonstration, the ontology was instantiated as an SD model based on a real-world case and problem scenario of a retailer that required the alignment between strategic assortment decisions and the consumer confusion concept. The demonstration showed a successful application of the ontology to inform the SDM ultimately representing the alignment in a specific instantiation. The SD modelling was effectively informed by the ontology where variables, behaviour, and measures of the SDM are directly retrieved from the classes, relations, and properties of the ontology. Moreover, various evaluation activities have been carried out to generate evidence for the quality and utility of the artefact. This encompassed a focus group, ontology validation guidelines, a check on the syntactical correctness of the model, expert interviews, as well as a quantitative survey of retail practitioners who assessed the quality and utility of the ontology based on an online questionnaire. The results clearly provide evidence for the feasibility of the artefact in addressing the problem of this research.

7.3 The Omnichannel Assortment Ontology for Consumer Confusion

The successful design, development, and evaluation of the Omnichannel Assortment Ontology for Consumer Confusion represent the main contribution of this thesis. The main feature of the ontology, namely to provide a knowledge representation of the alignment between the domains "strategic assortment decisions", and "consumer confusion", its link to short- and long-term consequences, and "channel switching behaviour" at the Marketing-Operations-Interface in an omnichannel retailing context, has been successfully created. Based on the key solution characteristics defined in the research aim and retrieved from the solution proposal of the work (**Table 1**), corresponding design requirements have been defined that have been successfully addressed in the final artefact. To begin with, the ontology is capable of not only providing the said main feature (DR1), but also exhibiting state-of-the-art knowledge of the domains of omnichannel assortment, consumer confusion in retailing, and channel switching behaviour (DR2, DR3, and DR4). These domains are additionally enriched with novel contributions from practice and literature as presented further below. What is more is that the ontology successfully provides a fit for the theoretical framework of this work, the MOI. All elements of the ontology can be positioned within the MOI framework, showcasing a strong fitness to the problem space that motivated this research from a theoretical point of view. The fitness between the ontology and the MOI is particularly evident through the established linkage between the concepts of consumer confusion consequences and the retail performance domain that have been incorporated into the knowledge representation. Furthermore, the ontology is successfully formalised into the OWL language and transferred into Protégé, effectively enabling means for sharing knowledge among scholars and practitioners. This is particularly beneficial for DS communities who want to build on or refine the artefact further. The intended end users of the ontology are argued as being domain experts in the field of omnichannel assortment decisions who either represent the retail industry (practitioners in retailing who are responsible for strategic assortment decision-making at the Marketing-Operations-Interface requiring informational guidance on the alignment between assortment decisions and the consumer confusion phenomenon) or the retailing research domain (domain experts from the retailing research domain who are conducting research in the area of omnichannel assortment and/or consumer confusion in omnichannel retailing). The successful demonstration of the artefact on the basis of a case study shows evidence for its utility within a specific instance of the research problem of this study. Moreover, responses from retail practitioners on the quality and utility of the artefact assure strong acceptance and provide further evidence for its practical use within the problem space.

7.4 Summary of Contributions

This research produced several contributions from different perspectives. The following presents and classifies the contributions into theoretical and managerial contributions. In general, theoretical contributions are understood as those contributions that extend and build on current existing theories (Whetten, 1989) and are mainly directed towards academic audiences. In DS, theoretical contributions can be captured or classified in different ways, e.g., as a design theory, design knowledge, design entity, etc. Managerial contributions are summarized as those contributions that can be identified as practical implications and provide utility for industry audiences. In this case, the retail industry that practices omnichannel retailing and is confronted with consumer confusion phenomena while making strategic assortment decisions is the relevant audience for the practical contributions. The generation of both types is emphasised in DSR which aims at producing specific contributions for practice, evident by a solution to the problem, but also for the knowledge base, representing design knowledge (March and Smith, 1995; Hevner *et al.*, 2008).

7.4.1 Theoretical Contributions

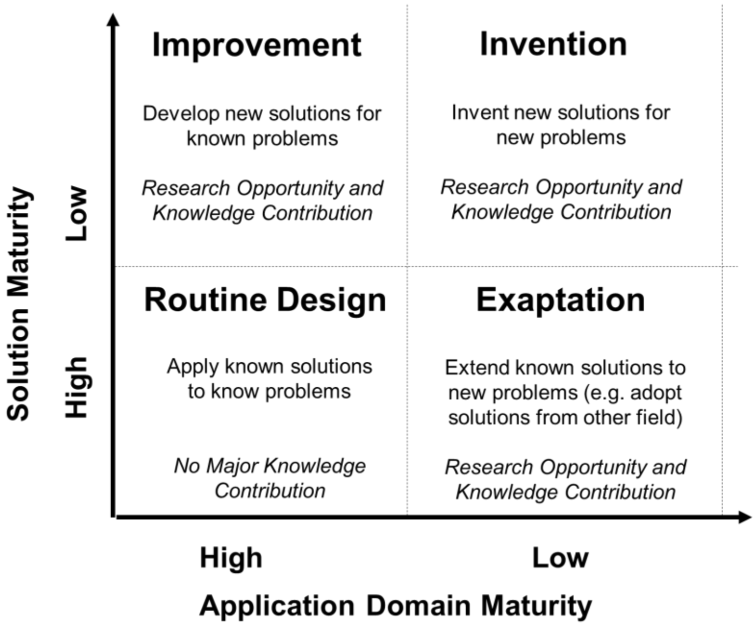
Theoretical contributions of this study that advance current existing research in the domain of omnichannel retailing are multifaceted. The contributions encompass a novel artefact representing the main contribution of this thesis, as well as the introduction of novel concepts and understanding in the domains of omnichannel assortment, consumer confusion, and channel switching behaviour in omnichannel retailing. Moreover, the results from the SLR (Chapter 2) led to the identification of research gaps in the said research domains contributing to the research communities with potential new avenues for future research. Also, theoretical contributions from a methodology point of view emerged as well. The following paragraphs summarize the contributions in detail.

The Omnichannel Assortment Ontology for Consumer Confusion as Design Knowledge

To begin with, the Omnichannel Assortment Ontology for Consumer Confusion constitutes a novel artefact to address the need for informing omnichannel retailers on the alignment between strategic assortment decisions and the consumer confusion phenomenon from a channel switching perspective. Prior research does not account for a channel switching behaviour perspective when looking at the tension between assortment decisions and the consumer confusion concept, nor it provides prescriptive knowledge in the form of theories that can inform the development of an artefact. The ontology embodies design knowledge characterised by the linkage of existing justificatory knowledge (literature- and practitioner-informed) with design decisions reflected by the final ontology design. It is argued that the artefact represents an "Exaptation" as understood in the DSR Knowledge Contribution Framework by Gregor and Hevner (2013). The DSR Knowledge framework captures four distinct types of knowledge contributions that can result from DSR and is aimed at guiding DS researchers in positioning their contribution appropriately. The framework is organised along two dimensions "Solution Maturity" and "Application Domain Maturity". The Solution Maturity within a DSR project can be characterised as high when solutions are known or low when there is a need for a new solution for the DSR project. In comparison, Application Domain Maturity is high when the problem is known and low in case the problem is characterised as new. Correspondingly, four quadrants with four cases can be distinguished in a 2x2 matrix for the knowledge contributions of DSR projects (**Figure 59**): An Improvement that develops new solutions for known problems, an Exaptation that extends known solutions to new problems, a Routine Design that applies known solutions to known problems, and an Invention that invents new solutions for new problems. An improvement, exaptation, and Invention represent research opportunities and valid knowledge contributions whereas Routine Design would not likely produce major knowledge contributions.

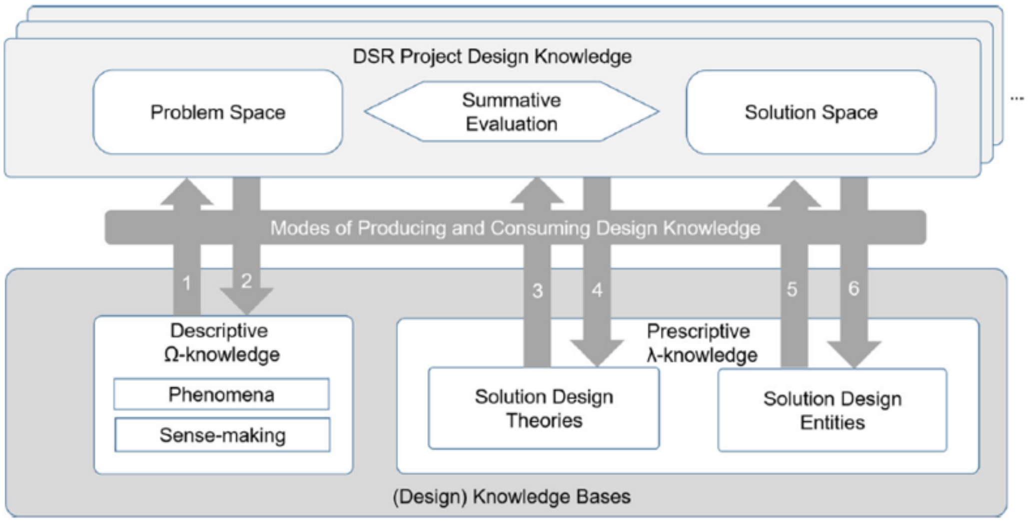
Reflecting on the output of this research, the artefact represents an Exaptation activity because of the following reasons. On the one hand, the observed phenomenon in the problem space can be considered a new challenge for retailers. The concept of consumer confusion is not a new research topic and is well-researched within a single-channel context but shows a strong lack of contributions in the context of omnichannel retailing (Section 2.7). Driven by digital transformation, the introduction of digital technologies, and new consumer behaviour patterns, retailers are exposed to new challenges resulting from disruptions. With the adoption of omnichannel retailing, customer channel switching behaviour brings a new dimension to the consumer confusion effect. Customers are not only exposed to potential confusion due to assortment size or variety (single channel) but are now confronted with potential negative perceptions while comparing assortment across channels (omnichannel). Therefore, a low Application Domain Maturity is evident. On the other hand, the concept of ontology and its application to represent knowledge for sharing and common understanding purposes can be considered as highly matured. Ontologies are applied in various disciplines and contexts and are proven solutions for diverse problems. Therefore, the Solution Maturity of the solution of this research can be regarded as high. Concludingly, the Omnichannel Assortment Ontology for Consumer Confusion can be positioned as a knowledge contribution out of an Exaptation activity.

Figure 59: *DSR Knowledge Contribution Framework (source: Gregor and Hevner, 2013)*



However, the nature of the knowledge contribution of this research can be further classified into a specific design knowledge type following Drechsler and Hevner (2018). Based on the knowledge that is produced in DSR projects, the authors distinguish between science-oriented contributions that grow the propositional knowledge base typically characterised in being descriptive and explanatory in nature, described as "Ω-knowledge" and design-oriented contributions that grow the prescriptive knowledge base, described as "λ-knowledge" (**Figure 60**). Within the prescriptive λ-knowledge, contributions can further be divided into Solution Design Theories and Solution Design Entities. The former type captures all kinds of design theories such as design principles or technological rules whereas the latter type embodies design knowledge in a tangible form to be applied in the solution space of the DS project such as solution artefacts (e.g., systems, products, processes, instantiations).

Figure 60: *Design Knowledge typology for DSR projects (source: Drechsler and Hevner, 2018)*



The relationship between the knowledge utilised within DSR projects and the (design) knowledge bases is characterised by modes of producing and consuming design knowledge. For example, DSR projects produce design theories that enrich the design knowledge base (λ-knowledge) but also consume design theories provided from the base to codify them in solution artefacts and thus again produce solution design entities.

This research has produced and consumed different types of (design) knowledge. For instance, descriptive (e.g., the taxonomy of assortment decision levels, Section 2.4.1) or explanatory knowledge (e.g., consumer confusion theories, Section 2.5.1) from the Ω-knowledge base are consumed to inform design decisions for ontology development. Inversely, the final artefact, the Omnichannel Assortment Ontology for Consumer Confusion, was produced, contributing to the λ-knowledge base with a novel solution design entity embodying novel design knowledge.

Novel Contributions to the Relevant Research Domains

Secondly, this study generated additional contributions relevant to the research domains that are addressed within the research scope. This research represents the first study that positions the tension between strategic assortment decisions and consumer confusion in omnichannel retailing within a MOI perspective. In the course of the design and development of the ontology, novel concepts emerged based on input from practitioners as well as through collaborative design decisions on the artefact that are justified by existing knowledge. The following highlights the main novel concepts and relations for each domain that contribute to the current discourse of the MOI within omnichannel retailing.

Contributions to the Omnichannel Assortment Research Domain. Discussions with the practitioners during the design and development phase resulted in introducing the new strategic assortment decision *Assortment Elimination* that is currently not evident in current omnichannel assortment literature from a MOI perspective. This decision follows the notion of “product elimination” from the marketing literature (e.g., Homburg *et al.*, 2010; Baker and Hart, 2007; Avlonitis, 1983) and argues that retailers would not exclusively want to expand their assortment to new channels (Rooderkerk and Kök, 2019) but also consider reduction of their assortment through channel elimination. This led to the incorporation of the concept as a new sibling subclass next to Assortment Expansion denoting the option of eliminating a specific channel presence. Moreover, the introduction of the concept *Change of Assortment Integration* represents another novel addition to the strategic assortment decision activities at the MOI. The concept captures the need to trigger a change in the current assortment integration structure of the organisation. The concept encompasses change on the level as well as the type of assortment integration. Prior literature does not consider a deliberate distinction between level and type but refers to integration level and type in an interchangeable manner. This reflects another novel addition to the omnichannel assortment domain. Following the context of change in assortment integration, the notion of *Assortment Integration Costs* emerged and is explicitly introduced within this research. Prior research acknowledges costs that are associated with assortment integration but does not provide explicit studies until today.

Contributions to the Consumer Confusion in Omnichannel Retailing Research Domain. Within the domain of consumer confusion in omnichannel retailing, the research introduces an addition to the discourse by proposing the *Channel of Occurrence* concept. During collaborative design activities, a need to account for the specific channel where consumer confusion occurs is argued to be introduced since this is not explicitly stated in the existing literature. With this research, it is proposed that consumer confusion can occur either on the online, the offline, or on both on- and offline channels. Another contribution to the consumer confusion research body is the argument that consumer confusion is not only triggered by information overload but can also be triggered by information ambiguity resulting from inconsistent assortment information across channels.

Contributions to the Channel Switching Behaviour Research Domain. This research makes a deliberate decision on distinguishing channel switching types by characterising individuals with channel switching behaviour, e.g., *Showrooming* vs. *Showroomer*, in order to allow decision-makers to describe channel switching from a customer profile point of view. Furthermore, discussions argue to link the long-term consequences of the consumer confusion phenomenon directly with the Post-Purchase phase within the customer journey phases subclass. This decision is argued based on the fact that, unlike short-term consequences of the consumer confusion phenomenon that take effect at the POS, long-term consequences inform pre-purchase decisions in the customer journey. For example, after experiencing confusion because of assortment inconsistencies across channels, customers can alter purchase intentions thus influencing the intention to purchase at a specific retailer, leading to lost sales from a long-term perspective (Section 4.3.2). Lastly, this research proposes a new typology on how to classify channel switching behaviour based on switching intensity (**Figure 15**) that goes beyond a distinction by channel and customer journey only. This allows classifying customers based on their switching frequency behaviour between "at no time" (non-switchers), "once" (corresponding to show- and webrooming behaviour) and "twice and more" (omni-shoppers).

Contributions from the SLR results

Thirdly, the SLR conducted in Chapter 2 contributes with several research gaps that can inform current researchers in the relevant research domains.

Methodological Contributions

From a methodological point of view, this research demonstrates the successful application of a pragmatist approach in reaching research objectives, evident by the application of a diverse set of research methods independent from epistemological principles. Moreover, in the course of the demonstration phase, a method on how to map ontology elements to SD modelling steps is introduced (Section 5.3).

7.4.2 Managerial Contributions

Particularly important in DS, this research also introduced several managerial contributions. Relevant audiences benefiting from the contributions are identified as domain experts within the omnichannel assortment domain that are confronted with the consumer confusion phenomenon. In contrast to contributions evident as design knowledge as outlined above, the generated artefact in this research contributes also with a concrete utility for practitioners.

The Omnichannel Assortment Ontology for Consumer Confusion as a Solution Artefact

The ontology serves as a reference tool capable of informing decision makers for strategic assortment decisions in omnichannel retailing about the linkage of strategic assortment decisions with the consumer confusion concept from a channel switching perspective. Practitioners are able to consider the relevant concepts and relations while making decisions at the MOI. This allows omnichannel retailers to identify and mitigate potential adverse consumer reactions induced by consumer confusion, thus eventually preventing financial impacts on retail performance. Moreover, the ontology has been successfully formalised via Protégé and is freely accessible for further use. More importantly, this research contributes to increasing the awareness of the consumer confusion phenomenon in the context of omnichannel retailing since the majority of prior research focuses on the phenomenon from a single perspective only. It is important to acknowledge that with the dawn of digital technologies and the emergence of new retailing strategies along with changing consumer behaviour, well-studied challenges evolve into new challenges that need attention.

In terms of further managerial contributions, this study proposes a set of formulas on how to determine the degree of overlap dependent on the integration type (**Table 28**). The formulas can help to identify the certain degree of overlap which could be relevant for changes in the assortment integration intentions. These could involve changes in the integration type as well. This research contributes with an outline of possible changing paths between assortment integration types (**Figure 42**). Practitioners can associate their current assortment type on the overview and identify future possible integration types along the spectrum between no, asymmetrical, and full integration.

Lastly, the demonstration phase produces a potentially reusable SDM for similar cases and practitioners that intend to analyse consumer confusion effects on retail performance based on webrooming behaviour.

7.5 Limitations of the Study

This thesis is characterised by the following limitations distinguished between research limitations in the course of the design and development phase and limitations within the demonstration and evaluation phase of the study. To begin with, in the design and development phase, a *single case study* is adopted for sourcing practitioner knowledge to inform the construction of the ontology. This is motivated by the advantages a single case study approach can offer through richer and thus superior data compared to multiple cases (Yin, 2017; Siggelkow, 2007; Dyer Jr. and Wilkins, 1991; Eisenhard, 1991). However, this brings also disadvantages compared to a multiple case study approach. For instance, the single case study approach does not offer direct replication possibilities through another case study, limiting analytical benefits (Yin, 2017). Moreover, the single case can be regarded as too specific in nature, opening further questions on the generalisability of the findings. Another limitation is expressed by the fact that the artefact is subject to *domain evolution*, meaning its components and application area can evolve over time thus making the relevance of its application more and more challenging (Noy and McGuinness, 2001). This is in line with the argument that problem spaces as understood in DS are also subject to constant change (vom Brocke *et al.*, 2020).

Lastly, this research focuses on the alignment between strategic assortment decisions and the consumer confusion concept from a channel switching perspective that does not consider *other factors at the MOI* such as the utilisation of the Long tail effect, different product characteristics (e.g., the need for touch), or consumer characteristics (Section 1.2). The rationale for the exclusion of other factors is to reduce complexity in the investigation and concentrate the focus on the consumer confusion concept. However, many discussions with the practitioners throughout the design and development phase as well as in the demonstration case study touched upon these factors. The author of this thesis understands that these factors qualify as valid subjects for further investigations suitable to extend the contributions of this study.

With regard to limitations in the demonstration and evaluation phase, similar to the design and development phase, a single case study is adopted to demonstrate the utility of the ontology, entailing the same limitations in terms of generalisability. Unlike the design and development phase, the purpose of the demonstration is to provide evidence for the application and utility of the artefact in a different instance of the problem. The demonstration can still be improved by considering different retail contexts though. However, it is important to note that this research does not want to achieve generalisability but provide evidence for the utility of the artefact as understood in the DSRM. For the same reason, the results from the retail practitioner survey aiming at assessing the quality and utility of the ontology (EVAL4.3) are not meant to be representative either. However, the sample and response size can still be deemed improvable. The results indicate a potential avenue for improvement that is in line with the reflection on the limitations: in contrast to the other dimensions, the results of the indicators on the completeness and relevance of the ontology underline the weakness in providing *generalisability*. This is explained through the assumption that the ontology is not perceived as complete or relevant since it potentially lacks concepts resonating with different contexts other than from the design and development or the demonstration case study.

7.6 Recommendations for Future Work

Following up on the discussion on the limitations of this study, recommendations for future work are identified and summarised as follows. First, it is beneficial to enrich the findings with knowledge from additional cases. The experience and expertise of relevant practitioners from different retail contexts would improve the completeness and relevance of the ontology substantially. Future studies might build on the Omnichannel Assortment Ontology for Consumer Confusion by conducting multiple case studies to expand the ontology. Since the basis (design, domains, components) of the ontology is established, future researchers could focus on the generation of additional findings from different retail contexts (e.g., consumer confusion in the context of grocery omnichannel retailing).

Second, the ontology can be expanded by findings from studies dedicating their focus on the tactical as well as operational aspects of assortment decisions within the MOI. For example, it would be interesting to investigate whether assortment inconsistencies induced by strategic assortment decisions (e.g., no or asymmetrical integration) can be offset by operational assortment decisions such as through information provision (for example, products that are listed on the web-shop only, are marked with the information that they are only available in the web-shop).

Third, the limitation in terms of neglecting other factors at the MOI relevant for strategic assortment decisions as discussed above, opens up new opportunities to investigate new factors in conjunction with the consumer confusion phenomenon. For example, the question of how a retailer can be informed best on the tension between following a Long Tail approach (asymmetrical integration type B) and the reduction of the consumer confusion effect (full integration) could assist retailers in improving their strategic decision choices at the MOI. Similarly, it would be interesting to know to what extent product characteristics play a role in the experience of consumer confusion since studies show that certain products (e.g., luxury) motivate consumers stronger to switch channels (Shankar and Jain, 2023; Arora *et al.*, 2017). Related to this, it would be reasonable to also involve performance-related approaches such as ABC or XYZ Analysis of products while making assortment decisions across channels under the perspective of consumer confusion. Moreover, following the situational sources theory that can trigger consumer confusion in a single-channel context (e.g., Garaus and Wagner, 2016), it would be interesting to learn how situational sources as defined within an omnichannel context are responsible for the experience of consumer confusion (e.g., the situational contexts of visiting a web-shop first and a physical store afterwards within one shopping journey). In contrast, individual factors such as decision-making styles or purchase involvement (Coothoopermal and Chittoo, 2017; Foxman *et al.*, 1990) could also inform domain experts in making strategic assortment decisions at the MOI.

Fourth, as argued in Section 4.3.1, consumer confusion can not only be triggered by information overload resulting from the perception of assortment inconsistencies across channels but also by information ambiguity between the on- and offline channels. For example, a retailer might claim on the web-shop to “visit our stores to try out the product” but would fail to have that product in the offline assortment, displaying a false claim leading to confusion for shoppers (e.g., Scardamaglia and Daly, 2016).

Lastly, the differentiation between short- and long-term consequences of the consumer confusion phenomenon linked to different phases of the customer journey indicates the complexity of the consequences out of assortment inconsistencies. Short-term consequences such as purchase abandonment or helplessness can occur immediately after the experience of confusion at the POS whereas long-term consequences such as loss in loyalty or trust typically occur at a later stage in the post-purchase phase of the shopping journey (Section 2.5.1), demonstrating time-delayed impact on retail performance. Studies such as from Van Baal (2014) offer approaches on how to account for delayed impact on profit (e.g., the impact of customer loyalty loss on profit, Van Baal, 2014) and would be suitable to be represented within the ontology.

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APPENDICES

Appendix A: Literature Review Appendices

Appendix A-1: Scoping Review

The PhD project is grounded in an initial scoping review (SR) which identified the area and domain of the research project. It is a valid and useful technique to utilize at the beginning of a research project (Armstrong *et al.*, 2011) based on a rather broad research question compared to a specific research question in a systematic literature review (SLR) (Arksey and O'Malley, 2005). The logic behind the specific RQ is to identify the critical success factors (CSF) in omnichannel management which are key to fulfilling set business goals. CSFs are *"…those characteristics, conditions, or variables that when properly sustained, maintained, or managed can have a significant impact on the success of a firm competing in a particular industry."* (Leidecker and Bruno, 1984, p. 24). This rationale is derived from the well-accepted and established definition of omnichannel management as representing *"the synergetic management of the numerous available channels and customer touchpoints, in such a way that the customer experience across channels and the performance over channels is optimized."* (Verhoef *et al.*, 2015, p. 176); emphasizing the "way" (= how to do it, which critical factors to consider while doing it) of achieving the optimal realization of "customer experience" and "performance" (representing business goals). The aim was therefore to identify and analyse existing challenges in those CSFs as these would reflect the relevant and critical problem areas of interest for the research. The analysis encompassed 22 articles between 2011 and 2018 addressing challenges and critical success factors which were screened in-depth (**Table 41**). During the synthesis of the SR, it became evident that, particularly, three topics were of substantial interest in the whole omnichannel research field: customer experience, channel integration and omnichannel performance. To relate the significance of customer experience to channel integration, the specific area of assortment integration in omnichannel operations was chosen as this focus represents a relevant and interesting problem field within the two most significant elements in the current omnichannel research: how is customer experience achieved through the integration of assortment in omnichannel operations?

Table 41: *Identified and screened articles in the scoping review of this research*

#	Year	Author(s)	Title	Outlet
1	2018	Bolton *et al.*	Customer experience challenges: bringing together digital, physical and social realms	Journal of Service Management
2	2018	Chen *et al.*	Omnichannel business research: Opportunities and challenges	Decision Support Systems
3	2018	De *et al.*	Avoid These Five Digital Retailing Mistakes	MIT Sloan Management Review
4	2018	Galipoglu *et al.*	Omni-channel retailing research – state of the art and intellectual foundation	International Journal of Physical Distribution & Logistics Management
5	2018	Grewal *et al.*	The Evolution and Future of Retailing and Retailing Education	Journal of Marketing Education
6	2018	Von Briel	The future of omnichannel retail: A four-stage Delphi study	Technological Forecasting & Social Change
7	2018	Piotrowicz and Cuthbertson (eds.)	Exploring Omnichannel Retailing – Common Expectations and Diverse Realities	Springer (book)
8	2018	Ye *et al.*	Drivers and barriers of omnichannel retailing in China – A case study of the fashion and apparel industry	International Journal of Retail & Distribution Management
9	2017	Bradlow *et al.*	The Role of Big Data and Predictive Analytics in Retailing	Journal of Retailing
10	2017	Grewal *et al.*	Future of Retailing	Journal of Retailing
11	2017	Hosseini *et al.*	Omni-Channel Retail Capabilities: An Information Systems Perspective	ICIS 2017 (conference proceedings)
12	2017	Kumar *et al.*	Future of Retailer Profitability: An Organizing Framework	Journal of Retailing
13	2017	Saghiri *et al.*	Toward a three-dimensional framework for omni-channel	Journal of Business Research
14	2016	Lemon and Verhoef	Understanding Customer Experience Throughout the Customer Journey	Journal of Marketing
15	2016	Mirsch *et al.*	Channel Integration Towards Omnichannel Management: A Literature Review	PACIS 2016 (conference proceedings)
16	2015	Hansen and Sia	Hummel's Digital Transformation Toward Omnichannel Retailing: Key Lessons Learned	MIS Quarterly Executive
17	2015	Verhoef *et al.*	From Multi-Channel Retailing to Omni-Channel Retailing – Introduction to the Special Issue on Multi-Channel Retailing	Journal of Retailing
18	2014	Bell *et al.*	How to Win in an Omnichannel World	MIT Sloan Management Review
19	2014	Cao	Business Model Transformation in Moving to a Cross-Channel Retail Strategy: A Case Study	International Journal of Electronic Commerce
20	2014	Piotrowicz and Cuthbertson	Introduction to the Special Issue Information Technology in Retail: Toward Omnichannel Retailing	International Journal of Electronic Commerce
21	2013	Brynjolfsson *et al.*	Competing in the Age of Omnichannel Retailing	MIT Sloan Management Review
22	2011	Rigby	The Future of Shopping	Harvard Business Review

Appendix A-2: Taxonomy of Literature Reviews

Table 42: *Taxonomy of literature reviews by Cooper (1988) (adapted from Brocke et al., 2009)*

Characteristic	Categories			
1 Focus	Research Outcomes	Research Methods	Theories	Applications
2 Goal	Integration	Criticism	Central Issues	
3 Organisation	Historical	Conceptual	Methodological	
4 Perspective	Neutral Representation		Espousal of Position	
5 Audience	Specialised Scholars	General Scholars	Practitioners / Politicians	General Public
6 Coverage	Exhaustive	Exhaustive and Selective	Representative	Central / Pivotal

Appendix A-3: Descriptive Statistics Systematic Literature Review Chapter 2

Table 43: *Distribution of publications by outlet (top 14 outlets)*

Publication	No. of Articles
Journal of Retailing and Consumer Services	17
International Journal of Retail & Distribution Management	13
Journal of Retailing	10
Journal of Business Research	7
European Journal of Operational Research	6
The International Review of Retail, Distribution and Consumer Research	6
Journal of Interactive Marketing	5
Journal of Internet Commerce	5
Journal of fashion marketing and management: an international journal	4
Marketing Intelligence & Planning	4
Book Chapter	4
Journal of Consumer Behaviour	3
Management Science	3
Asia Pacific Journal of Marketing and Logistics	3

Figure 61: *Distribution by research domain (domain, number of articles, in %; n = 169)*

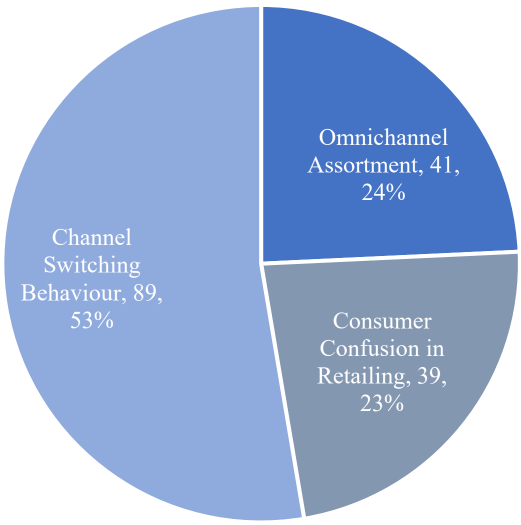


Figure 62: *Distribution of Publications by year (all domains)*

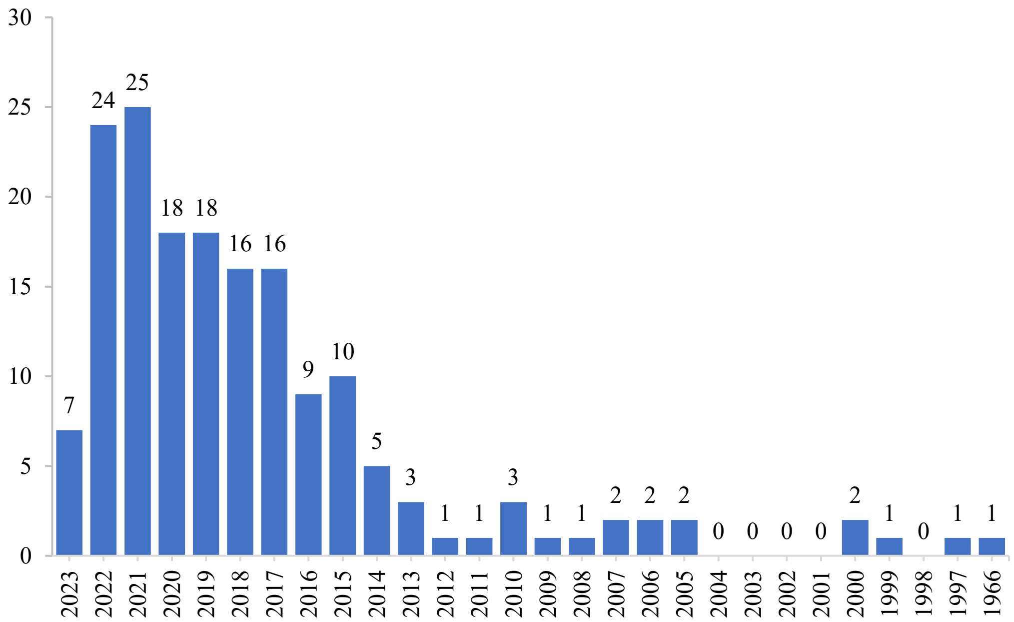
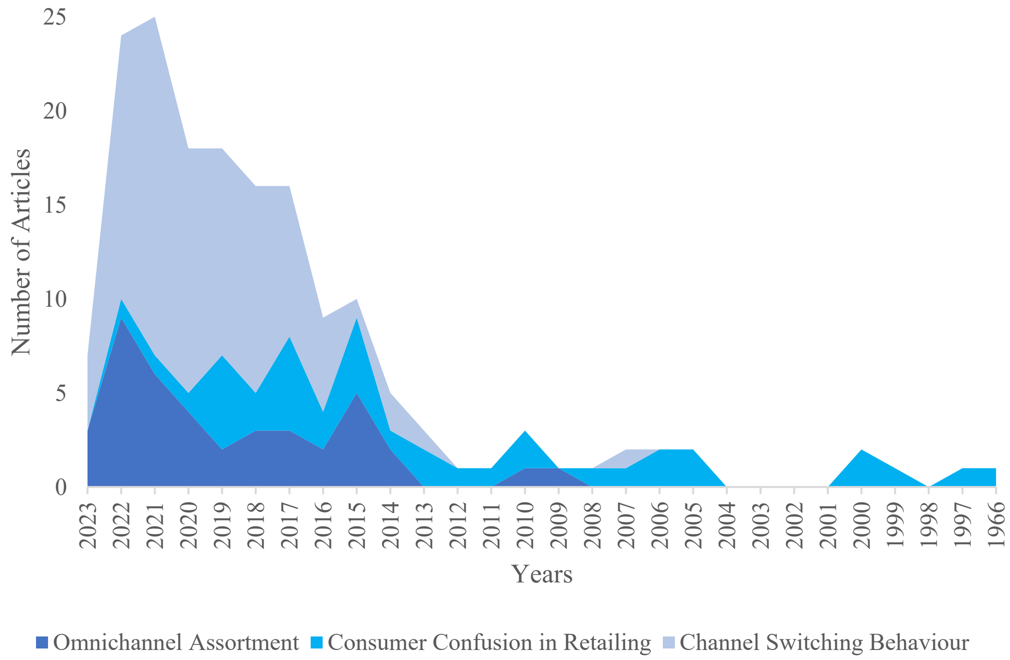


Figure 63: *Distribution of publications by year and by domain*



Appendix B: DSR Guidelines

The suitability of the applied DSR process for this study is justified by meeting the DSR guideline requirements as proposed by Hevner *et al.* (2008).

Table 44: *Meeting the DSR Guideline Requirements in this research*

	Guideline	Description	Addressed in this research	Meeting the Guideline Requirement
1	Design as an Artifact	DS research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.	This research produces an artefact (ontology) in the form of a model (Section 3.5.2 and 3.5.3; Chapter 5).	✓
2	Problem Relevance	The objective of DS research is to develop technology-based solutions to important and relevant business problems.	The objective of this research is to develop a technology-based solution to an important and relevant (retail) business problem (Section 1.3 and 3.5.2).	✓
3	Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.	The utility, quality, and efficacy of the artefact produced by this research are demonstrated rigorously via well-executed evaluation methods (Chapter 5 and 6).	✓
4	Research Contributions	Effective DS research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.	This research provides clear and verifiable contributions through the development of specific design knowledge (Chapter 7).	✓
5	Research Rigor	DS-research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.	This research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact (Section 3.5.3; Chapter 5 and 6).	✓
6	Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.	This research utilizes a collaborative approach with retail practitioners and a case study (Chapter 4) to reach the desired ends (Section 3.5.2) while satisfying the conditions determined by the case context (Section 4.2) and the theoretical framework for this study (MOI) (Section 3.2).	✓
7	Communication of Research	DS research must be presented effectively both to technology-oriented as well as management-oriented audiences.	This research is presented effectively both to technology-oriented as well as management-oriented audiences such as IS and (retail) management communities (Section 3.5.6).	✓

Appendix C: Design and Development Case Study Appendices

Appendix C-1: Case Study Protocol

Table 45: *Case study protocol in the Design and Development Phase*

	Stage	Activity
1	First Contact	Establishing the first contact with the case company. Contacting a representative and communicating research background and intent.
2	Evidence for Suitability	Gathering of evidence for suitability judgement. This involves information from the initial contact as well as publicly available information (company website, company store).
3	Suitability Judgement	Judgement on the suitability of the company as a case.
4	Meeting on Data Collection Procedure	Presentation of the data collection strategy and sequence. Agreement on the relevant participants (based on purposive sampling). Contacting participants and agreement on the dates for the FGs and expert interviews. Distribution of consent forms and plain information statements.
5	Focus Group 1 & Analysis	Conduction of the first FG (online format) and analysis of the outcome. Application of the FG1 questioning route.
6	Expert Interviews & Analysis	Conduction of the expert interviews (online format) and analysis of the outcomes. Application of the interview guide.
7	Observation	Carrying out observational activities to gather additional evidence for ontology development (show- and webrooming simulation).
8	Focus Group 2 & Analysis	Presentation of the consolidated ontology. Conduction of the second FG (online format) and analysis of the outcome. Application of the FG2 questioning route.
9	Reporting	Generation of a case report and communication to the company representative as validity measures.

Appendix C-2: Questioning Route FG1

Focus group guide including the questioning route for FG1 and EVAL2.1.

Table 46: *FG1 Questioning route*

#	Activity	Description / Content
1	Preparatory activities (pre-FG)	Before the day of the FG session: ▪ Consent forms and information sheets are sent to all participants prior to the FG session ▪ Reminder (email) to all the participants On the day of the FG session before the call: ▪ Session set-up (MS Teams ready, audio and video set-up ready, internet connection ready, transcript recording feature of MS Teams ready, substitute recording device ready) ▪ Presentation slides ready (open and ready to share via MS Teams) ▪ Paper-based documents ready (this questioning route, notepad for self-memos) Materials: ▪ Presentation slides ▪ Code Template
2	Introduction	▪ Welcome and "thank you for participation" script ▪ Introduction of purpose and scope of the FG script ▪ An indication that the session will be recorded via the transcript generator feature of MS Teams script ▪ Participant introduction roundtable ▪ Q/A on the topic, FG format, case study results reporting, data handling, etc. ▪ Initiation of the start of the FG
3	Topic presentation and questioning route	▪ Presentation on key terms and definitions to ensure construct validity in the course of the discussions (does every participant have the same understanding of each relevant term addressed within the FG session?) ▪ Opening question (Q1): "Strategic Assortment Decisions and Consumer Confusion in Omnichannel Retailing. What is the experience and knowledge from your point of view?" Follow-up question (Q1.1): "How do you decide on strategic assortment decisions for your channels?" Specific Questions (Set 1): ▪ Q2: "What concepts and relations constitute strategic assortment decisions from your point of view?" ▪ Q3: "What concepts and relations constitute consumer confusion in retailing from your point of view?" ▪ Q4: "What concepts and relations constitute channel switching behaviour from your point of view?" ▪ Q5: "What concepts and relations constitute retail performance from your point of view?" ▪ Q6: "How do the four different domains relate to each other?" Follow-up question (Q6.1): "How can all four domains be linked to each other?" General follow-up questions (Set 2): ▪ FQ1: "Do you agree with the current set of concepts and relations?" ▪ FQ2: "Do you wish to add anything else?"
	EVAL2.1 Questions	Questions for EVAL2.1 after the exchange where no new insights are discussed any longer and before the closing of the session. The participants were asked whether ▪ the ontologies are *accurate* (the extent the statements in the ontologies comply with the domain knowledge of the experts) and ▪ *clear* (how effective are the ontologies in the communication of the intended meaning of the defined terms?).
4	Closing	▪ "Thank you for participation" script ▪ Reminder on the second FG meeting scheduled
5	Post-FG activities	▪ Transcript processing for NVivo ▪ Template analysis ▪ Self-memo analysis ▪ Update of case database via NVivo ▪ Processing of insights and conclusions

Appendix C-3: Expert Interview Guide

Table 47: *Expert interview guide (semi-structured)*

Theme	Main Questions
1	"What are the concepts in your field of expertise that relate to [domain]?"
2	"What are the relations between the concepts in your field of expertise that relate to [domain]?"
3	"What are the typical properties and constraints of the concepts in your field of expertise that relate to [domain]?"
4	"What are examples of the concepts in your field of expertise that relate to [domain]?"

Appendix C-4: Code Template

Table 48: *Final code template for template analysis in the Design and Development Phase*

	FG# / EI#	**Knowledge Domain (high order codes)**		
		Omnichannel Assortment	*Consumer Confusion*	*Channel Switching Behaviour*
Ontology Aspect (lower order codes)	*Concepts*			
	Relations			
	Properties			
	Constraints			
	Instances			
	Linkages between domains			

Appendix D: Ontology Appendices

Appendix D-1: Retail Performance

An SLR following Webster and Watson (2002) was utilised in order to identify common financial and non-financial metrics used in retailing and structure along with their application on a strategic vs. operational level. The review was conducted in four steps. First, relevant journals on the basis of Scopus have been identified, the abstract and citation database of Elsevier. The source material is retrieved from high-quality journals covering a wide field of disciplines. Those journals within the 5% citescore percentile of the database have been filtered to ensure high-level quality, measured by citation quality. The journal selection process identified 80 journals out of the relevant research areas. After the application of the keyword string to every journal, a total output of 971 articles was generated. Limiting to publications from the 2008 year on and after the screening of title and abstracts, 638 articles were discarded (~66%). Only 333 papers remained to be screened in depth. After reviewing the papers, data out of the final 225 articles were extracted (108 articles were discarded after reading). The review was conducted between October 2018 and January 2019. More details are provided in the related publication of the literature review (Cakir *et al.*, 2019).

Strategic Metrics

Table 49: *Strategic Financial and Non-Financial Metrics in Retailing (source: Cakir et al., 2019)*

	Financial Metrics	Non-Financial Metrics
Strategic	• Sales / Revenue (total / annual / average / target / per channel / per store / per square foot / per salesperson / per customer / growth / return on / elasticities) • Profit (gross / margin / target / growth / per store / per salesperson / per product / per channel / per partnership) • Return on Sales (ROS), Return on Investment (ROI), Return on Equity (ROE), Return on Assets (ROA) • Return on Advertising / Marketing Spending / Ad Spending • Cost of Goods Sold (COGS), Cost of Investments, Cost Efficiency • (Relative) Market Share, Market Share Growth • Tobin's Q, Shareholder Value (e.g., Market to Book Ratio, Stock Returns) • Cash Flow (net / volatility) • Order Size, Firm Size / Employee Size • Working Capital Turnover • Customer Lifetime Value (CLV) • Share of Wallet • Stores (amount / growth / closing ratio)	• Consumer Trust, Loyalty (Consumer / Employee), Customer Engagement, Customer Experience, Online Experience, Satisfaction (Customer / Employee) • Behaviour (Customer / Employee), Customer Orientation • Service and E-Service Quality, Service Image • Brand Image, Brand Awareness, Brand Equity, Brand Profitability, Corporate Reputation • Price Premium • Customer Channel Awareness • Competitiveness • Employee Racial Diversity, Employee Identification, Social Responsibility, Leadership • Word of Mouth (WOM) and Electronic Word of Mouth (eWOM)

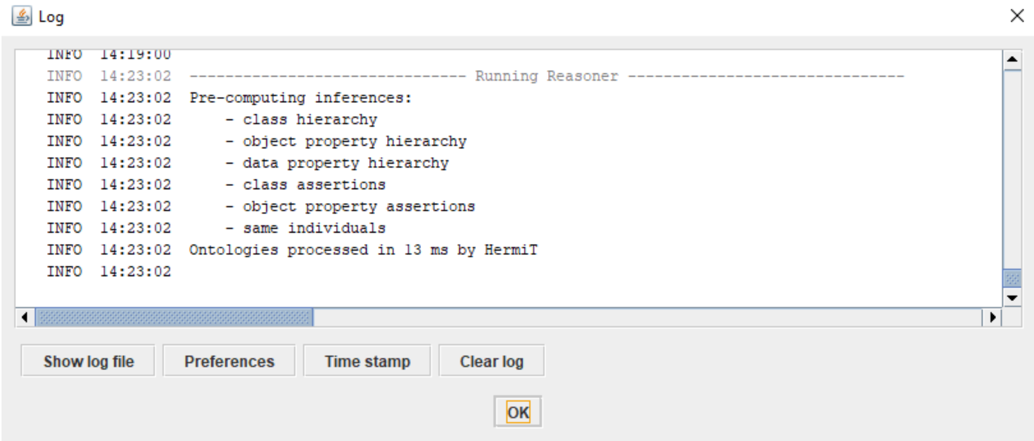
Operational Metrics

Table 50: *Operational Financial and Non-Financial Metrics in Retailing (source: Cakir et al., 2019)*

	Financial Metrics	Non-Financial Metrics
Operational	• Order Cycle Time • (Product) Return Rate • Productivity (per store / per salesperson) • Category Share, Category Sales, Share of Shelf • Shelf Space Capacity, Cross Space Elasticity • Store Traffic • Purchase Frequency per Customer • Click Through Rate, Impression Rates, Web Visits, Email Response Rates, SEA Price / Click • Customer Complaints • Customer Spending (Shopping Basket Size), Coupon Redemption Rate, Customer Trip Revenue, Customer Recency Rate, Customer Cross Buying Rate • Inventory Costs, Inventory Inaccuracy, Inventory Variance Ratio, Inventory Average • Promotion Costs • Stock Capacity, Logistics Costs (transportation / warehousing / procurement) • Demand Forecast, Demand Variance, Forecasting Period, Lead Time Average • Order Variance Ratio • Salesperson Salary, Share of Wages, Employee Absenteeism, Labour Hours	• (Re)purchase Intentions • In-Store Experience • Store Image, Perceived Showrooming, Perceived Product Value • Customer Referral Behaviour • Consumer Goodwill, Convenience • Ease of Use (Web) • Purchase Uncertainty, Purchase Likelihood, Product Return Likelihood • Order Fulfillment Quality • Service Behaviour • Organizational Climate, Employee Retention, Employee Motivation, Employee Compliance Behaviour, Salesperson Emotional Intelligence

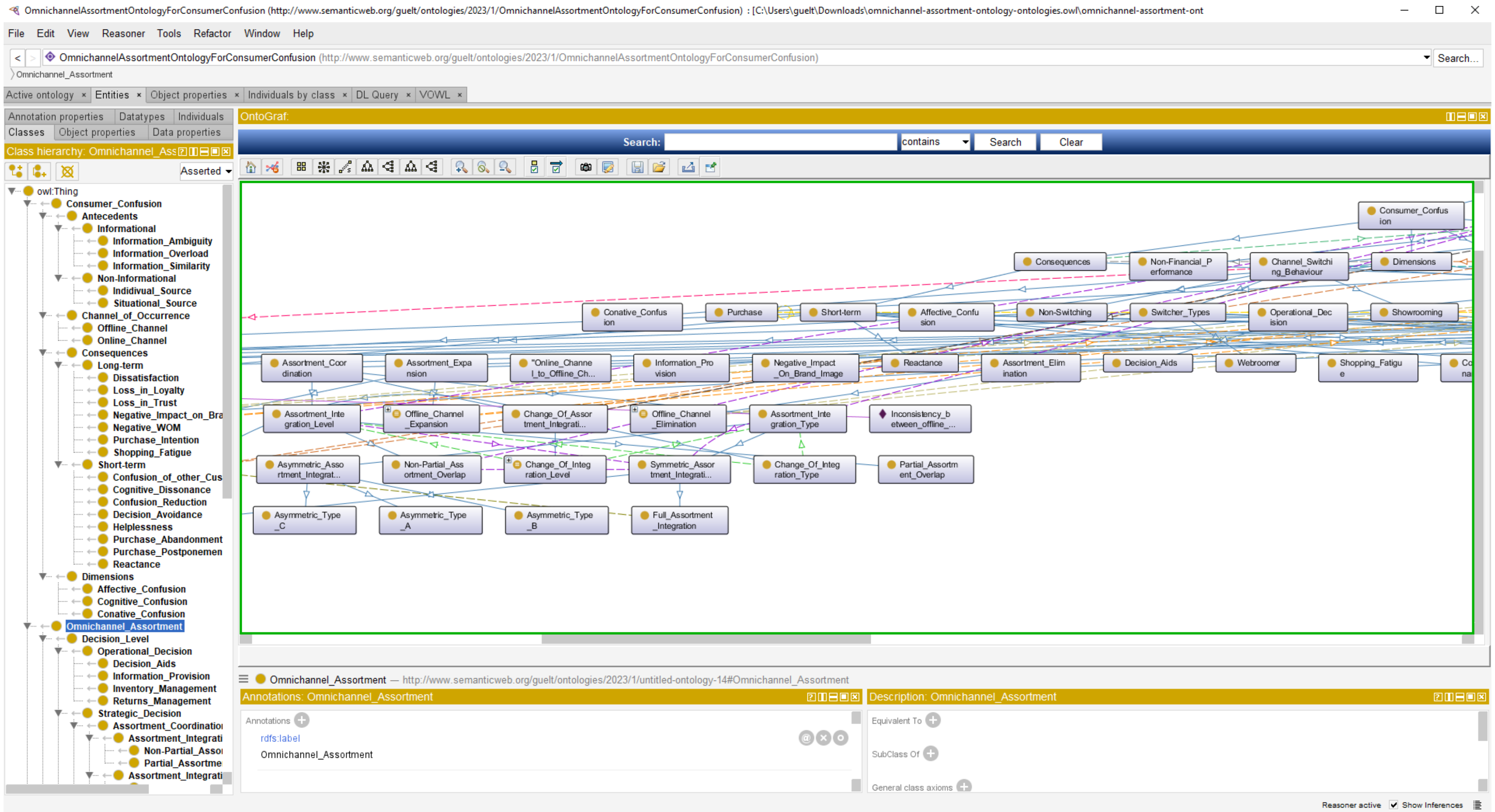
Appendix D-2: Protégé Reasoner Report

Figure 64: *Protégé reasoner check for ontology inconsistencies (reasoner: HermiT 1.4.3.456)*



Appendix D-3: Formalised Ontology

Figure 65: *Formalisation of the Omnichannel Assortment Ontology for Consumer Confusion via Protégé V.5.5.0*



Appendix E: Demonstration Phase Appendices

Appendix E-1: Case Study Protocol

Table 51: *Case study protocol in the Demonstration Phase*

	Stage	Activity
1	First Contact	Establishing the first contact with the case company. Contacting a representative and communication of artefact utility and demonstration intent. First discussions to elaborate on the fit between case problem and solution artefact.
3	Suitability Judgement	Judgement on the suitability of the company problem as an instance for demonstration of the artefact utility.
4	Meeting on Artefact Demonstration Procedure	Presentation of the artefact. Elaboration and agreement on the case problem, objectives, and demonstration procedure. Discussion on required data. Discussion on required participants. Agreement on dates and format. Distribution of the consent form and plain information statement.
5	Semi-structured Interview (data collection) and System Dynamics Modelling	Conduction of the data collection activity based on a semi-structured interview (online format). Application of an interview guide. Data analysis and collaborative SDM development. Active use of the Omnichannel Assortment Ontology for Consumer Confusion. This stage also includes an interview for EVAL4.2.
6	Formalisation via Vensim® PLE	Transferring the qualitative SDM into Vensim PLE for formalisation purposes.
7	Semi-structured Interview #2 (validation)	Presentation of the final SDM. Discussions on refinement and acceptance of the final version.
8	Reporting	Generation of a case report and communication with the company representative.

Appendix E-2: EVAL4.2 Expert Interview Guide

Table 52: *EVAL4.2 Expert interview guide (semi-structured)*

Theme	Main Questions
Quality	▪ Do you agree that the reference model represents the domains correctly? ▪ Do you agree that all the elements in the reference model are relevant for the representation of the domains? ▪ Do you agree that the reference model gives a complete representation of the domains? ▪ Do you agree that the reference model is a realistic representation of the domains?
Usefulness	▪ Did the use of the reference model improve your job performance? ▪ Did the use of the reference model enhance your effectiveness on the job? ▪ Did the use of the reference model increase your productivity? ▪ Did the use of the reference model enable you to accomplish tasks more quickly? ▪ Did the use of the reference model make it easier to do your job? ▪ Did you find the reference model useful in your job?

Appendix F: Evaluation Phase Appendices

Appendix F-1: EVAL 1.1 Practitioner Interview Excerpts

Among the interview statements, empirical evidence for the problem statement as described in Section 1.2 has been identified, confirming the relevance of the research objective. Selected excerpts are provided below (**Table 53**, **Table 54**).

Table 53: *Retailer #1: Assortment integration challenges*

#	Quote	Problem theme
R1.1	"We lost customers when customers couldn't find the products in the store they see online. Our customer journey is not aligned yet in that perspective."	Non-alignment causes consumer confusion.
R1.2	"There are no walls or barriers in our web-shop, so we put more [relevant] products in there which we couldn't do for our stores as there is limited space."	Factors influencing assortment decisions across channels.
R1.3	"Our assortment is mixed not only between web-shop and store, but from store to store. This is because of different sizes. So, we have different ranges, depending on the customer in that area. We provide different assortment according to what the customer asks for in different areas. But online, they are mostly value-driven."	
R1.4	"Maintaining the web-shop is very costly, not to underestimate. It is different but not necessarily cheaper. But scaling is different. To scale in-store you need to have more salespeople."	
R1.5	"We try to reduce the complexity, so we align the ranges along both channels, but add exclusive online and a sales area which works pretty well."	
R1.6	"Everything we need to be very mindful, don't offer too much, they might be overwhelmed. Two nice pages is easier to shop – like two tables in the store."	Balancing information overload.
R1.7	"Our wellness-department, the sales were not great in our web-shop because of the lack of sales associates providing information. However, we use social media, influencers and testimonials who describe and show these products to mitigate this."	Online lacks feel-for-touch experience and service quality.
R1.8	"Clothing is hard to sell online, we don't have a lot of it online, but recently we provided more pictures and influencers wearing them to show how they look, and that boosted the sales."	

Table 54: *Retailer #2: Assortment integration challenges*

#	Quote	Problem theme
R2.1	"We experience that customers spend some time at the decorations shelf and arrange for example a collection of decoration items together on one plate and take that all together to the checkout – this is not possible in our web-shop."	Online lacks feel for touch experience and service quality.
R2.2	"Our web-shop is still playing a small role in our overall revenue. It only provides 10% of our overall assortment."	Factors influencing assortment decisions across channels.
R2.3	"We don't see it reasonable to place products with low margin online – online, our bestsellers are listed."	
R2.4	"We experience that our web-shop customers differ to our general target group. Usually, they are much younger for example, mostly students."	
R2.5	"Students come often to our stores and ask for service. They ask specifically for items they saw online."	

Appendix F-2: EVAL 1.2 Exploratory Survey Questionnaire

Questionnaire Title and Section 1

Maynooth University National University of Ireland Maynooth

Exploring Retail Assortment Strategy and Consumer Confusion

The purpose of this study is to explore the relation between strategic assortment decisions and the consumer confusion phenomenon in omnichannel retailing.

Only basic information about your channel(s) and assortment strategy is required. The short survey takes about 4-6 minutes and no personal information is necessary or collected.

Thank you for your time and support.

* Required

Company Details

1

Country of Operation
*

Please select the country of your business operation.

Select your answer

2

Company Size
*

Please select the corresponding company size.

- Micro (1-9 employees / annual revenue < 2 million €)
- Small (10-50 employees / annual revenue 2-10 million €)
- Medium (50-250 employees / annual revenue 10-50 million €)
- Large / Multinational (> 250 employees / annual revenue > 50 million €)

3

Type of Offering
*

Please state the dominant type of your offerings.

- ○ Fashion / Clothing / Shoes
- ○ Sports / Outdoor
- ○ Jewellery / Watches / other Accessories
- ○ Household
- ○ Electronics
- ○ Media / Gaming
- ○ Cosmetics / Personal care
- ○ Grocery
- ○ Food / Beverages
- ○ Drugs / Pharmaceutics / Health
- ○ Toys
- ○ Furniture
- ○ Gifting / Decoration
- ○ Hardware / DIY
- ○ Mass Merchandising / Mixed assortment
- ○ Other

4

We are a ...
*

- ○ Pure online player (e-commerce only)
- ○ Pure offline player (physical stores only)
- ○ On- and Offline player (e-commerce and physical store(s))

Next

Section 2

Channel Expansion Development Throughout the Years

This section covers the expansion or removal of channels during your company's lifetime and how the assortment similarities have changed during and after.

5

When did your business start?
*

Please select the year range your company started its business.

Select your answer

6

How did your business start? *

- As a pure e-commerce retailer.
- As a pure physical store retailer.
- As an e-commerce as well as physical store retailer.
- Other

Back | Next

Section 3

Assortment Inconsistencies Leading to Customer Confusion

This is the last section and covers the so-called Customer Confusion Effect. Customers can experience confusion when confronted with different assortments along channels of the same retailer since they may expect the exact same products on each channel. Not finding the desired item on each channel could result in customer dissatisfaction in the customer journey and eventually to lost sales potentials for the retailer.

14

To your knowledge, how often do customers experience confusion because of assortment inconsistencies across your channels?
*

- ○ Very often.
- ○ Often.
- ○ Sometimes.
- ○ Rarely.
- ○ Never / Our assortment is identical on all channels
- ○ We do not know.
- ○ Not applicable / We are a single channel player

Back Submit

Section 4

15

Optional: Comments / feedback

Please feel free to comment below on anything related to the survey or provide additional feedback on the topics covered. Please consider contacting me if you want to be provided with the survey results or if you are interested in the topic or want to reach out to the IVI Digital Retail Cluster (https://ivi.ie/project_category/digital-retail).

Thank you for taking the time to complete this survey.

Gültekin Cakir
Innovation Value Institute
Maynooth University
Maynooth, Ireland
gueltekin.cakir@mu.ie

Enter your answer

Back   Submit

Appendix F-3: EVAL 2.2 Ontology Validation Guidelines

Table 55: *EVAL2.2 Ontology Validation Guidelines*

#	Criteria	Description	Evaluation (1st iteration)	Intervention	Evaluation (2nd iteration)
1	Transitivity	If B is a subclass of A and C is a subclass of B, then C is a subclass of A.	✓	-	-
2	Inheritance	All subclasses of a class inherit the property of that class.	✓	-	-
3	Class as Instance	Avoid overly general classes when assigning classes as instances of other classes.	✓	-	-
4	Class and Subclass as Instance	Avoid assigning a class and its subclass as instances of other classes at the same time. Remove the subclass.	✓	-	-
5	Hierarchy	A subclass of a class represents a concept that is a "kind of" concept that the superclass represents.	✓	-	-
6	Singular/ Plural	Use either singular or plural in naming classes.	✓	-	-
7	Synonyms	Synonyms of concepts do not represent different classes. Therefore, avoid creating classes based on synonyms.	✓	-	-
8	Class Cycles	Avoid cycles such as class A has a subclass B and at the same time, B is a superclass of A.	✓	-	-
9	Siblings	All siblings in the hierarchy must be at the same level of generality.	✗	Realignment of subclass along the hierarchy. Introduction of dummy subclasses such as "Symmetric Integration".	✓
10	One subclass only	Avoid cases where a class has only one direct subclass.	✗	Cases with one direct subclass only have been removed.	✓
11	Subclass limit	Avoid cases where a class has more than 12 subclasses.	✓	-	-
12	Class vs. property	If the concepts with different property values become restrictions for different slots in other classes, then a new class for the distinction should be created. Otherwise, the distinction is represented in a property value.	✓	-	-
13	Inverse Properties	Storing the information "in both directions" is redundant.	✓	-	-
14	Capitalization	It is common to capitalize class names and use lowercase for property names	✗	Complied to the convention.	✓

15	Consistency in naming	Ensure consistency when naming in singular or plural.	✘	All classes are described in a singular format.	✓
16	Prefix and suffix conventions	Prefix and suffix conventions in the names to distinguish between classes and slots, e.g., “has” (classes) or “of” (properties).	✓	-	-
17	Abbreviations	Avoid the use of abbreviations.	✘	Abbreviations have been removed from the ontology.	✓
18	Name inheritance	Names of direct subclasses of a class should either include or not include the name of the superclass.	✘	Name inheritance is followed accurately.	✓

✓ = criteria fulfilled; ✘ = criteria not fulfilled

Appendix F-4: EVAL 3.1 Questioning Route FG2

Focus group guide including the questioning route for FG2.

Table 56: *EVAL3.1: FG2 Questioning route*

#	Activity	Description / Content
1	Preparatory activities (pre-FG)	Before the day of the FG session: ▪ Sending the consolidated ontology (image) ▪ Reminder (email) to all the participants On the day of the FG session before the call: ▪ Session set-up (MS Teams ready, audio and video set-up ready, internet connection ready, transcript recording feature of MS Teams ready, substitute recording device ready) ▪ Presentation slides ready (open and ready to share via MS Teams) ▪ Paper-based documents ready (this questioning route, notepad for self-memos) Materials: ▪ Presentation slides on the consolidated ontology ▪ Competency Question template ▪ Code Template
2	Introduction	▪ Welcome and “thank you for participating again” script ▪ Introduction of purpose and scope of the second FG script ▪ An indication that the session will be recorded via the transcript generator feature of MS Teams script ▪ Initiation of the start of the FG
3	Artefact presentation and questioning route	▪ Presentation of the consolidated ontology along with descriptions ▪ Opening question (Q1): “What do you think of the consolidated ontology?” Specific Questions (Set 1): ▪ Q1 (completeness): “Are the domains of interest appropriately covered?” ▪ Q2 (conciseness): “Does the ontology include irrelevant elements related to the domains to be covered or redundant representation of the semantics?” ▪ Q3 (consistency): “Does the ontology include or allow for any contradictions?” Competency Questions check: ▪ Instruction: “I want you to formulate an arbitrary query on the ontology based on your field of expertise please.” ▪ Presentation of the competency questions by each participant ▪ Discussion
4	Closing	▪ “Thank you for participation” script ▪ Information on the provision of the case study report
5	Post-FG activities	▪ Transcript processing for NVivo ▪ Template analysis ▪ Self-memo analysis ▪ Update of case database via NVivo ▪ Processing of evaluation insights and conclusions

Appendix F-5: EVAL 3.2 Competency Questions

Table 57: *EAL3.2: Exemplary competency questions and answers*

#	Competency Questions	Answer statements
1	CQs addressing concepts and relations of the Omnichannel Assortment Domain: 1. Is [Assortment Integration Level] a [Tactical Decision] for [Omnichannel Assortment]? 2. What [Strategic Decision] do I have to make in order to create an Offline Assortment? 3. Which are Asymmetric Assortment Integration Types?	1. No. Assortment Integration → is a Strategic Decision for Omnichannel Assortment. 2. The Strategic Decision on Offline Channel Expansion needs to be made in order to → create an Offline Assortment. 3. Asymmetric Assortment Integration Types → are (1) Type A, (2) Type B, and (3) Type C.
2	CQs addressing concepts and relations of the Consumer Confusion Domain: 4. Is Cognitive Confusion a Consumer Confusion Component? 5. What type of antecedent is the Inconsistency between on- and offline assortment? 6. What leads to Consumer Confusion Consequences?	4. Cognitive Confusion → is a Consumer Confusion Component. 5. Inconsistency between on- and offline assortment → is an informational antecedent (Information Overload). 6. Cognitive, Affective, and Conative Confusion → lead to Consumer Confusion Consequences.
3	CQs addressing concepts and relations of the Consumer Confusion Consequences Domain: 7. Which are the Short-term Consequences of Consumer Confusion? 8. Is Cognitive Dissonance a Long-term Consequence of Consumer Confusion? 9. Which type of Consumer Confusion Consequences affect Omnichannel Performance?	7. Purchase Abandonment, Purchase Postponement, Confusion Reduction, Decision Avoidance, Reactance, Cognitive Dissonance, Confusion of other Customers, and Helplessness → are Short-term Consequences of Consumer Confusion. 8. No. Cognitive Dissonance → is a Short-term Consequence of Consumer Confusion. 9. Short- and Long-term Consequences of Consumer Confusion → affect Omnichannel Performance.
4	CQs addressing concepts and relations of the Channel Switching Behaviour Domain: 10. What are the Phases of the Customer Journey? 11. What do the Customer Journey Phases show? 12. What Switcher Type is switching from an online channel to an offline channel?	10. Customer Journey Phases → are Pre-Purchase, Purchase, and Post-Purchase. 11. The Customer Journey Phases → can show Channel Switching Behaviour. 12. Webroomer → is the Switcher Type → switching From Online Channel to Offline Channel.
5	CQs addressing concepts and relations representing the Alignment between Assortment Integration and Consumer Confusion: 13. Which Assortment Integration Type causes Information Overload confusion through Inconsistencies between on- and offline assortment? 14. Does Showrooming and a Full Integration approach cause Consumer Confusion? 15. What [Strategic Decision] on [Omnichannel Assortment] can help to avoid the occurrence of [Consumer Confusion] in order to prevent an impact on [Omnichannel Performance]?	13. The Assortment Integration Types [No Assortment Integration] and [Asymmetric Assortment Integration] → cause [Information Overload Confusion] → through [Inconsistencies between On- and Offline Assortment]. 14. No. Full Integration does not → lead to Inconsistencies between On- and Offline Assortment – regardless of Channel Switching Behaviour. 15. The [Strategic Decision] on [Assortment Coordination] can help to → avoid the occurrence of [Consumer Confusion].

Appendix F-6: EVAL 4.3 Quantitative Survey Questionnaire

EVAL 4.3 Quantitative Survey Questionnaire

Questionnaire Title and Section 1

Maynooth University
National University of Ireland Maynooth

Strategic Assortment Decisions and Consumer Confusion in Omnichannel Retailing

The purpose of this study is to present a Reference Model for Strategic Assortment Decisions and Consumer Confusion in Omnichannel retailing.

The survey consists of 7 questions and only basic information about your company is required. The short survey takes about 4-6 minutes along 5 pages and no personal information is necessary or collected.

Thank you for your time and support.

* Required

Company Details

1

Country of Operation

Please select the country of your business operation.

Select your answer

2

Company Size

Please select the corresponding company size.

- ◯ Micro (1-9 employees / annual revenue < 2 million €)
- ◯ Small (10-50 employees / annual revenue 2-10 million €)
- ◯ Medium (50-250 employees / annual revenue 10-50 million €)
- ◯ Large / Multinational (> 250 employees / annual revenue > 50 million €)

3

Type of Offering

Please state the dominant type of your offerings.

- ◯ Fashion / Clothing / Shoes
- ◯ Sports / Outdoor
- ◯ Jewellery / Watches / other Accessories
- ◯ Household
- ◯ Electronics
- ◯ Media / Gaming
- ◯ Cosmetics / Personal care
- ◯ Grocery
- ◯ Food / Beverages
- ◯ Drugs / Pharmaceutics / Health
- ◯ Toys
- ◯ Furniture
- ◯ Gifting / Decoration
- ◯ Hardware / DIY
- ◯ Mass Merchandising / Mixed assortment
- ◯ Other

4

We are a ...

*

- ◯ Pure online player (e-commerce only)
- ◯ Pure offline player (physical stores only)
- ◯ On- and Offline player (omnichannel approach)

5

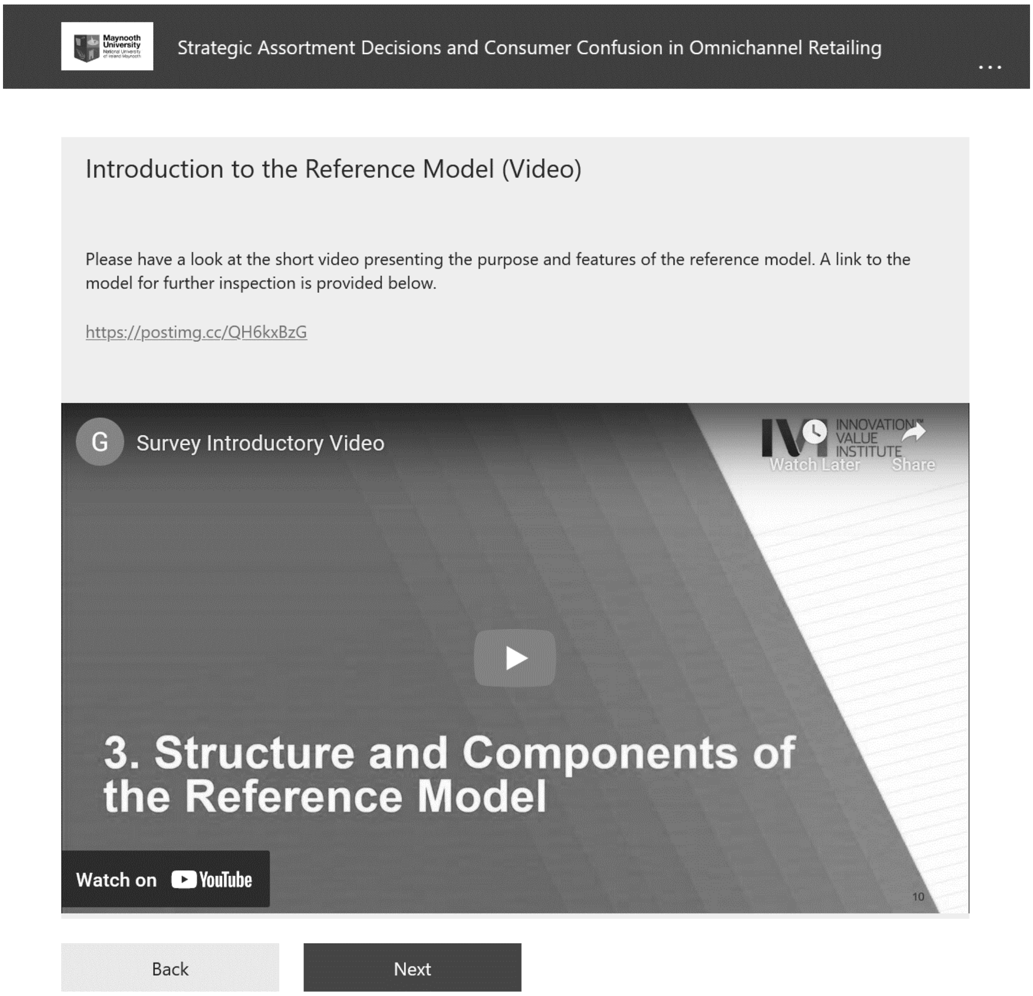
Please state whether you are involved or familiar with Strategic Assortment Decisions within your organisation.

*

- ◯ Involved or familiar
- ◯ No involvement or familiarity

Next

Section 2



(video link: https://www.youtube.com/watch?v=4AZqoIN7UYk)

Section 3

Strategic Assortment Decisions and Consumer Confusion in Omnichannel Retailing

* Required

Quality of the Reference Model

Please have a look at the questions on the quality of the model below and state your perception of each aspect.

You can always open the Reference Model for inspection here:
https://postimg.cc/QH6kxBzG

6

Question *

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
The reference model represents the domains **correctly**.	○	○	○	○	○	○	○
All the elements in the reference model are **relevant** for the representation of the domains.	○	○	○	○	○	○	○
The reference model gives a **complete** representation of the domains.	○	○	○	○	○	○	○
The reference model is a **realistic** representation of the domains.	○	○	○	○	○	○	○

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Section 4

Strategic Assortment Decisions and Consumer Confusion in Omnichannel Retailing

* Required

Usefulness of the Reference Model

Please have a look at the questions on the usefulness of the model below and state your perception of each aspect.

You can always open the Reference Model for inspection here:
https://postimg.cc/QH6kxBzG

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Question *

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
Using the reference model would improve my job **performance**.	○	○	○	○	○	○	○
Using the reference model would enhance my **effectiveness** on the job.	○	○	○	○	○	○	○
Using the reference model would increase my **productivity**.	○	○	○	○	○	○	○
Using the reference model would enable me to accomplish tasks **more quickly**.	○	○	○	○	○	○	○
Using the reference model would make it **easier** to do my job.	○	○	○	○	○	○	○
I would find the reference model **useful** in my job.	○	○	○	○	○	○	○

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Section 5

Strategic Assortment Decisions and Consumer Confusion in Omnichannel Retailing

Thank you for your time and support.

Please consider contacting me if you want to be provided with the survey results or if you are interested in the topic.

Thank you for taking the time to complete this survey.

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Appendix F-7: EVAL 4.3 Quantitative Survey Descriptive Results

Table 58: *EVAL4.3 PSQ frequency distribution (in %)*

Indicator	Statement	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
Correctness	The reference model represents the domains correctly.	0.0%	0.0%	0.0%	0.0%	17.4%	52.2%	30.4%
Relevance	All the elements in the reference model are relevant for the representation of the domains.	0.0%	0.0%	8.7%	0.0%	52.2%	30.4%	8.7%
Completeness	The reference model gives a complete representation of the domains.	0.0%	4.3%	4.3%	4.3%	39.1%	43.5%	4.3%
Authenticity	The reference model is a realistic representation of the domains.	0.0%	0.0%	0.0%	0.0%	13.0%	26.1%	60.9%

Table 59: *EVAL4.3 PU frequency distribution (in %)*

Indicator	Statement	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
Performance	Using the reference model would improve my job performance.	0.0%	0.0%	0.0%	8.7%	8.7%	60.9%	21.7%
Time	Using the reference model would enable me to accomplish tasks more quickly.	0.0%	0.0%	0.0%	4.3%	8.7%	30.4%	56.5%
Easiness	Using the reference model would make it easier to do my job.	0.0%	0.0%	0.0%	4.3%	8.7%	30.4%	56.5%
Effectiveness	Using the reference model would enhance my effectiveness on the job.	0.0%	0.0%	4.3%	4.3%	4.3%	52.2%	34.8%
Productivity	Using the reference model would increase my productivity.	0.0%	0.0%	4.3%	8.7%	30.4%	47.8%	8.7%
Usefulness	I would find the reference model useful in my job.	0.0%	0.0%	0.0%	8.7%	4.3%	56.5%	30.4%