Exploring Determinants of Self-Service Technology Success in German Food Retail:

A Retail Technology Manufacturer Case

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Abstract

This study explores strategic success determinants of self-service technologies (SSTs) in the German retail food industry of quick- and self-service restaurants from the perspective of a retail technology manufacturer. The current state of the academic literature primarily focuses on explaining influencing factors on the customer adoption rate of SSTs by consulting information systems success models and related technology acceptance theories. The underlying theoretical frameworks are based on DeLone and McLean's updated Information Systems Success Model and on the third version of the Technology Acceptance Model. Variables related to customer experience and satisfaction are predominantly put into the focus of research projects available. Little attention though is being paid to non-customer-oriented success dimensions covering *information quality* or *system quality* of the SSTs under observation. Moreover, businesses developing and providing SSTs to retailers seem to be disregarded in the existing literature as well.

As a single-case study design, this research programme seeks out to explore strategic SST success determinants via insights gathered from a major retail technology manufacturer delivering SST solutions to food retailers in Germany. Based on the data collected in semi-structured interviews conducted with industry experts from senior and top management functions in the company, strategic SST success factors are identified and aggregated into an overarching model of SST success for the retail food industry of quick- and self-service restaurants in Germany. The core focus thereby is on self-ordering kiosks and self-checkout solutions as the most commonly used types of SSTs in this market. A pilot study was executed prior to the main study and demonstrated the methodology and research strategy to be appropriate for the research project, which bases its conceptual framework on the updated DeLone and McLean's IS Success Model and concepts found in the third version of the Technology Acceptance Model.

This research project contributes to the academic literature by providing a detailed collection of SST success determinants and dimensions relevant in the German retail food industry of quick- and self-service restaurants, which are arranged in a newly developed SST Success Model for this concrete use case in German food retail. The results of this study are of value for retail practitioners adopting self-service strategies

and implementing SST solutions in store environments of quick- and self-service restaurants.

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Declaration

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List of abbreviations

Abbreviation	Meaning
AI	Artificial intelligence
ATM	Automated teller machine
IS	Information system
KPI	Key performance indicator
QR	Quick response
SLA	Service level agreement
SST	Self-service technology
TAM	Technology Acceptance Model
UI	User interface

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1 Introduction

This research programme is about the exploration of strategic success determinants of self-service technologies (SSTs) in German food retail of quick- and self-service restaurants. The identification of SST success factors is accomplished via a detailed single-case study of a major German retail technology manufacturer. This chapter sets out to describe the context in which the research project is situated. Furthermore, key insights on SSTs in German retail and related success models are provided as to illustrate the theoretical background of this study. The introductory overview concludes with a summary of the research strategy applied and a demonstration of how this research programme contributes to the academic literature and to professional business practice.

1.1 Context of the study

This study focuses on self-service technologies and sets out to identify strategic success factors of SSTs in German food retail. SSTs in general can be characterised as a form of technology, which enables users to request a certain service without interacting with store personnel (Meuter *et al.*, 2000). Most commonly, SSTs in the form of automated teller machines have become a regular part of everyday life. The number of installed and operationally functional automated teller machines (ATMs) in Germany was at about 95 000 devices in 2019 (Best, 2020b). The core function of ATMs is to allow customers to withdraw cash from the bank for payment purposes. Apart from this key feature, banks have introduced a variety of additional services available via ATMs, such as options to perform basic account-related activities or to issue money transfers. Making use of ATMs is nothing new to consumers and has turned into a standard way of completing bank- and cash-related actions.

In the retail industry, SSTs are being introduced by retailers more rapidly into an increasing number of different branches. Traditionally, retailers have been operating in a multi-channel distribution network, which provides various distribution channels to customers apart from the physical store location. This network is built around having an online presence, a phone-based channel or mobile ways for consumers to interact with the company and purchase goods (Piotrowicz and Cuthbertson, 2014). Corresponding logistics and operations of retailers need to be in support of these additional distribution channels as to provide services and products to customers across all streams. This

strategic orientation requires retailers to rethink their operating model and have multiple sales channels supplied and maintained (Heinemann, 2011; Hübner, Holzapfel and Kuhn, 2015). Looking at the ongoing trend of digitalisation, retailers aim at providing customers with a large option of touchpoints in online-based media channels such as social networks, blogs, chats or digital advertisements (Straker, Wrigley and Rosemann, 2015).

With the inclusion of more channels into the distribution network of retailers a change in mindset is necessary to cope with the rising complexity of products and services being offered across a multitude of different streams. This development calls for an integrated approach in retail omni-channel management to successfully design, operate and fulfil the myriad of distribution options (Verhoef, Kannan and Inman, 2015; Wollenburg, Holzapfel and Hübner, 2019). Omni-channel management is a discipline driven by technology and innovation that involves a continuous setup and evaluation of information systems used by retailers to offer services and products to customers. Retailers are faced with fast developments in both, information system (IS) options and changing customer behaviour in this new area of Smart Retailing (Hosseini, Röglinger and Schmied, 2017; Pantano and Dennis, 2019).

In this context, retailers discovered the possibilities of SSTs as a strategic opportunity to provide services to customers independently from time, location or even from the availability of store personnel. This form of information system makes up an effective and profitable addition of technology to the omni-channel distribution mix, since it allows retailers to implement a further set of touchpoints covering a specific combination of service options for consumers. SSTs can be placed at multiple steps throughout the customer shopping journey thereby fulfilling a concrete need for both, the customer and the retailer. The customer journey can broadly be divided into three major phases, starting with the pre-purchase stage, moving on to the actual purchase phase and closing with post-purchase-related activities (Lemon and Verhoef, 2016). SSTs have demonstrated to be a valuable enhancement of the distribution network to meet specific customer demands across all steps of the journey. SSTs have been successfully put in place by retailers for example to shorten customer waiting times in situations of high customer volume in the store. Moving the service and product ordering functionality away from store personnel towards self-ordering kiosks frees up resources and has customers issue orders autonomously from store assistants via

dedicated terminals thus significantly reducing waiting times in front of cashier-staffed desks (Collier *et al.*, 2015; Inman and Nikolova, 2017). Introducing self-checkout solutions allows customers to finish the payment process themselves and can lead to increased customer satisfaction and loyalty with the company (Demirci Orel and Kara, 2014; Jackson, Parboteeah and Metcalfe-Poulton, 2014; Wang, Harris and Patterson, 2017).

1.2 Rationale of the study

It is critical for retailers to evaluate the success of any SST implementation within their overall distribution and store network. This evaluation covers the adoption rate of SSTs by customers and also touches upon the operational and fulfilment-related benefits for retailers. The theoretical baseline for IS success assessments within the academic literature is predominantly to be found in the updated IS success model by DeLone and McLean (DeLone and McLean, 2003). Researchers apply DeLone and McLean's IS Success Model to retail scenarios while adjusting the model to the specific scope under observation. The key goal in this field primarily is to describe and understand the customer adoption of SSTs as a way of measuring SST success. Further details about DeLone and McLean's IS Success Model are outlined in chapter "2.2 Information systems success models".

Examining customer behaviour relies on additional theories to draw upon, which are centred around the Technology Acceptance Model (TAM) and its updated iterations (Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). With a combination of the IS success model and constructs of TAM, researchers set out to explain customer-oriented dimensions such as experience, satisfaction, loyalty or technology trust in retail, hospitality and other industries (Collier and Sherrell, 2010; Oh *et al.*, 2016). As a result of these endeavours, studies on customer adoption and technology acceptance are plentifully available in the academic literature. A complete overview of TAM and its relation to IS success is provided in chapter "2.3 Customer adoption of SSTs". For the conceptual framework of this study, the third version of the Technology Acceptance Model is primarily considered.

Having a concrete overview of customer-centric success dimensions is of key value for retailers, but falls short on further success requirements retailers have when embracing an SST strategy for their distribution networks. The integration of SSTs into an existing

(omni-) channel system requires evaluations with regards to possible impacts on implementation efforts for retailers, on operation and maintenance issues or on security measurements when ordering and checkout processes are involved. This area of strategic success assessment for SSTs in retail is, to the knowledge of the researcher, underrepresented in the literature. The importance of the subject though is apparent considering the domains affected for pursuing an SST implementation strategy in retail.

This research programme sets out to exploratively identify the strategic success determinants of SSTs in retail. The core focus is on German food retail as a way to specifically analyse the success factors in one of the various retail industries. Given the manifold characteristics of the food branch itself with sub-domains such as groceries or wholesale for example, this study concentrates on the area of food being ordered and served in quick- and self-service restaurants such as fast food chains. This level of focus allows for the research project to deeply investigate success variables of SSTs being deployed in this specific sector of the industry. Within the SST classification scheme provided in the course of this study, two major types of SSTs are highlighted, which cover two essential business functions in a self-service restaurant environment – self-ordering kiosks and self-checkouts. Self-ordering kiosks operate as technological assistants guiding customers through the ordering options and helping them issue food orders in the store. They provide a tableau overview of the available food menus and items, which can be chosen from for the desired meal. The items ordered via self-ordering kiosks usually require processing by some sort of kitchen or food preparation area within the store. After completion of the order, the food is handed out to the customer for consumption. Self-checkouts provide an efficient way for a customer of paying for the already picked up food items without having to wait in line at an cashier-operated checkout desk. Technical scanning features accompany self-checkout devices and enable the customer to scan the items within the shopping basket before finalising the payment and checkout transaction via the self-checkout. Further discussions around SST classification schemes are covered in chapter “2.1.4 Classification”.

The main focus of interest of this study revolves around the self-service scenarios in German food retail illustrated above. SST characteristics are closely explored upon on a strategic level as to investigate which dimensions drive success for retailers running SSTs in their distribution networks. This research programme adopts the perspective of a major German retail technology manufacturer that provides SST solutions to retailers.

This organisation designs, implements and operates SST devices for leading retailers in food and other industries such as fashion or home furnishing business. Taking this perspective allows the researcher to gather strategic insights from senior industry experts supplying food retailers with complex SST solutions tailored to the needs of the respective retailers. This research project promises to generate results on SST success dimensions from a unique angle, which is unseen in the academic literature to the knowledge of the researcher.

1.3 Research methodology and strategy

This research programme adopts a phenomenological approach as an overarching philosophy of research. Following a phenomenological viewpoint allows the researcher to exploratively generate results in a relatively uncovered area of research with the intention of building a possible theory about the data gathered. The researcher takes an interpretive perspective as a way to make sense of the research situation thereby developing a comprehensive understanding of the meaning (Gill, 2014). The approach of this study is not to verify an existing theory based on large-scale hypothesis testing (Bell, Bryman and Harley, 2019; Saunders, Lewis and Thornhill, 2019). Given the underrepresentation of SST success models in German food retail in the academic literature, this study seeks out to identify strategic success variables and dimensions in this field thus providing the foundation for the development of a corresponding SST success model. A positivist approach would be more appropriate, if it was for the application and validation of an already existing success model in the industry as a means to verify the relationships posited within the model. This research programme aims at understanding the prevailing strategic success determinants by exploring the underlying meaning and interdependencies with further influencing factors. An interpretive stance with a phenomenologically-oriented approach facilitates the execution of this endeavour and is therefore adopted in the course of the research project.

Within a single-case study centred around a major German retail technology manufacturer this research project focuses on creating a rich picture of SST success determinants in German food retail of quick- and self-service restaurants from a strategical viewpoint. This research programme thereby concentrates on the following two goals:

1. Identification and aggregation of strategic SST success determinants and themes in German food retail of quick- and self-service restaurants,
2. Development of an extension of DeLone and McLean's IS Success Model for strategic SST success in German food retail of quick- and self-service restaurants.

The researcher has obtained an approval by the organisation under investigation, when it comes to accessing key stakeholders of the company for the gathering of strategical insights from SST applications in this specific branch of the retail industry. This represents a unique opportunity to explore a fairly uncharted field in SST research from an innovative angle, which substantiates the research strategy of employing a single-case study design (Yin, 2018).

The data collection technique is composed of semi-structured interviews, which are conducted with industry experts from the retail technology manufacturer holding senior and top management level positions in the business. Purposive sampling is applied to select major knowledge carriers from a multitude of functional domains ranging from sales, professional services to product and service development. Anonymity of the participants is ensured as to avoid a person-based traceability of answers given. The researcher follows a semi-structured interview guideline to allow the conversation to freely develop depending on the responses given by the interviewees while keeping an overall line of thought to establish a degree of comparability across the interviews (Bell, Bryman and Harley, 2019). The data elicited is reviewed via techniques related to thematic analysis. This qualitatively-oriented approach enables the researcher to investigate the meaning behind the responses collected and to extract the underlying strategic success factors of SSTs. Coding techniques are applied to properly capture the data gathered and comprehend the themes developed (Braun and Clarke, 2006; Miles, Huberman and Saldaña, 2019).

The researcher performs a pilot study as a small-scale test run of the main body of the research project to verify the appropriateness of the research design adopted and to validate the operational procedures involved in the execution of the data collection techniques. This test run is required to ensure the methodology put in place for the main study is in line with the research goals (Yin, 2018). The findings of the pilot study have proved the intended research design to be applicable to the situation under observation

and to support the pursuit of the defined research goals. Results of the conducted interviews have led to improvements in the interview guideline to account for possible misunderstandings, which might come up in the course of the conversations. The researcher has incorporated feedback from the pilot study participants into the wording of the questions to remove ambiguity and repetitions related to specific terms and expressions. The operational procedures planned concerning the setup, conduction and recording of the interviews themselves have been deemed successful via the pilot run.

1.4 Intended contribution and significance

The results of this study are of indicative nature as they provide insights gathered via a single-case study in an explorative manner. As outlined above, the intention of this research programme is not to test existing theories on SST success, but rather to collect data for the development of relevant strategic success factors in this type of application. The field in scope is relatively untouched in the academic literature, especially considering the perspective of a retail technology manufacturer, which is taken in this project. This study sets out to create a rich picture of a unique situation in the SST industry in German food retail thereby allowing for comprehensive findings to emerge from the environment under research. These findings make up the foundation for a theoretical contribution in this research area and for the generation of advices relevant in professional business practice.

The identification of strategic SST success determinants in German food retail from the angle of a retail technology manufacturer accounts for an addition to the theoretical knowledge in SST research. The currently prevalent success factors in the literature revolve around the core dimensions as described in DeLone and McLean's IS Success Model (DeLone and McLean, 2003). This study provides a significant contribution to this research field by explicitly outlining strategic success factors for an SST use case in a specific branch of the retail industry. Moreover, the determinants identified within the course of this research project are aggregated into overarching success dimensions detailing themes, which cover SST success criteria on a strategical level. This study thereby goes beyond the focus of customer adoption that is predominantly available in the existing literature of understanding SST success. Additionally, the researcher develops an extension of the IS success model by DeLone and McLean for a composition of SST success factors in German food retail of quick- and self-service

restaurants from a strategical viewpoint. As an outcome of the study, this research programme creates the SST Success Model covering strategic success determinants and dimensions in this specific branch of retail food industry in Germany. The model can be applied in future research scenarios by academics working in the SST field.

Considering the intended contribution to professional business practice, the findings of this research project are encapsulated into an SST Strategy Checklist directed at managers and professionals working in this type of industry. The insights gathered within the study are of value for both, manufacturers providing SST solutions to food retailers and to retailers themselves who are in the process of implementing an SST strategy into their store environments in the food market of quick- and self-service restaurants in Germany. In this vein, the research programme delivers a significant contribution to the professional retail business practice.

1.5 Outline of the thesis

This study is comprised of five main chapters. The first chapter marks the introduction into the overall background of the research programme and provides the core ideas of the applied methodology and strategy. The research goals are elaborated on as to give an outlook about the intended contribution of this study to the theoretical baseline as well as to the professional business practice.

Chapter “2 Literature review and theoretical framework” presents the literature review and explores upon the major themes relevant for this research project. SSTs as a form of information system are explained and characterised with regards to advantages and disadvantages for consumers and providers alike. Moreover, the development in the field of measuring IS success is outlined. Particular attention is paid to the updated DeLone and McLean’s IS Success Model, which stands out as a critically acclaimed and widely used model of IS success (DeLone and McLean, 2003). The application of this model in the area of SST environments demonstrates how the model can be transferred to the scope that is of key interest for this research programme. This chapter continues with an overview of how customer adoption of SSTs is grasped by academics and thereby showcases the Technology Acceptance Model and its updates (Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). Understanding the influencing factors of why and how customers interact with SSTs is relevant as to gain a complete picture of the success of SSTs. Concluding the literature

review, the researcher details the food retail market in Germany, which is under observation in this study, and develops a literature synthesis on the key themes presented.

Chapter “3 Methodology” explains the research goals defined for this study and connects them with the methodological approach adopted. The research strategy is highlighted by summarising the case study design followed within this project. At a detailed level, the data collection and analysis techniques are illustrated to provide an overview of how the findings are to be gathered and interpreted. Further information is stated about the pilot study included in the research programme and about the mechanisms involved with handling ethics-related themes and questions of data access and resources.

Chapter “4 Analysis” starts out with a walkthrough of the pilot study performed prior to the main body of the research programme. The operational procedures employed are explained and it is shown how the results of the pilot run have helped improve the effectiveness of the main study. The researcher then provides a detailed account of the data collected and analysed within the main research section on a theme-by-theme basis and draws a comprehensive picture of the investigation done and findings developed.

Chapter “5 Discussion” elaborates on the main themes explored upon in the course of the study and critically discusses the findings in view of the literature assessed. As a contribution to theory, the researcher develops the SST success determinants and dimensions as investigated within the research programme. Furthermore, a dedicated SST Success Model is generated as an extension of the updated IS Success Model by DeLone and McLean and discussed under consideration of the conceptual framework (DeLone and McLean, 2003). The chapter concludes with a presentation of the SST Strategy Checklist that is developed by the researcher as a contribution to the professional business practice in the field of SST success in food retail.

Chapter “6 Conclusions” presents a summarising overview of the study in the form of a synopsis. The researcher then outlines implications of the discussed findings for theory and for business practice. Eventually, the researcher details limitations of the thesis and also provides an outlook as to which future studies might be put into action based on the results of this research programme.

At the end of the thesis, there is a collection of appendices relevant to this study followed by the references included in this research project.

2 Literature review and theoretical framework

The following chapters elaborate on the key themes and models relevant for the scope of this research programme. Self-service technologies are characterised and reviewed with regards to their fields of application and concerning their advantages and disadvantages for retailers and customers. The DeLone and McLean's IS Success Model as one of the major models for the assessment of IS success is explained. This involves a comprehensive overview of the model iterations and their impacts on the research about SST success. After that, the customer adoption of SSTs is highlighted by examining the Technology Acceptance Model, its theoretical background and the updated model versions. The chapter concludes with a summary of the major subjects enclosed in the literature synthesis and the development of the theoretical framework for this study.

2.1 Self-service technologies

Self-service technologies have become an integral part of today's shopping experience. Users of SSTs can choose from a variety of offerings, each of them suited to specific consumption purposes or informative scenarios. It is essential for this study to clearly define SSTs as to provide a classification scheme for different forms of SSTs and to also discuss the characteristics of their application in retail practice.

2.1.1 Definition

Most prominently in the information systems literature, SSTs are defined by Meuter *et al.* (2000, p. 50) as being "technological interfaces that enable customers to produce a service independent of direct service employee involvement". This definition approaches SSTs from the perspective of customers who are seeking to have a service provided to them without actually engaging in any interpersonal exchange. The description of the service in question is built into the technological interface mentioned above. Via this interface the service is made available to be requested by the user. The service execution is then performed behind the SST interface without direct insight by the user.

Customers are interacting with SSTs as opposed to with service personnel directly. This form of interaction can therefore be achieved independently from shopping assistants or store employees and even allows for a non-time-restricted access (Dabholkar and

Bagozzi, 2002; Giebelhausen *et al.*, 2014). With SSTs being powered by technical solutions, which support long operating times even outside of regular business hours, customers can utilise the services provided practically at any time. This provides companies implementing SSTs with a distribution channel that does not need to be actively run by employees and can be positioned alongside traditional forms of distribution.

Furthermore, customers take an active part in the ordering and delivery of the requested service when utilising the SST, since they become an integral part of the shopping experience. This experience often enables customers to tailor the provided service to their specific needs and to choose between service options or variations throughout the ordering phase. Customers mark an important role in this process as they become truly involved in the actual creation phase of the service delivery that is provided by the SST. Being closely engaged in the process of ordering the desired service helps customers feel more related to the service offering they want to use (Curran and Meuter, 2005; Edvardsson, Enquist and Johnston, 2005; Davis, Spohrer and Maglio, 2011).

2.1.2 Rise and impact of SSTs

A multitude of factors contribute to the rising availability and usage of self-service technology in the retail industry. SSTs improve shopping experiences for customers by offering service functionalities of high convenience within the shopping journey. Retailers providing SST solutions to customers, for example in the form of self-checkout systems, grant their consumers a fast alternative of finishing their shopping without the need of having to wait in line at the regular cash desk. Working with a self-checkout system allows customers to self-scan their items and conclude the payment in an efficient manner while removing the efforts of having to interact with store personnel in the checkout line (Grewal, Roggeveen and Nordfält, 2017). This is especially relevant for customers who only purchase a handful of products they can easily scan themselves at an SST device thus expediting the checkout process (Litfin and Wolfram, 2010).

Moreover, the retail industry has adapted the concept of delivering experiences to customers as a way to offer new and exciting shopping activities (Lemon and Verhoef, 2016). This often includes interactive solutions of the retailers consumers can engage with inside the store and via internet-based access forms. Customers feel connected with

a retailer that offers innovative shopping ideas and possibilities for them to try as part of their shopping journeys (Riekhof, 2013). Considering the shift in retail of moving from a multi-channel delivery mode to a model of being available for consumers in an omni-channel environment also emphasises the growing importance of self-service technology for both, customers and retailers (Hübner, Wollenburg and Holzapfel, 2016; Juaneda-Ayensa, Mosquera and Murillo, 2016). Early signs of the solution centred around self-service ideas can be identified in the development of webpage functionalities such as web shops. Widening the traditional brick-and-mortar approach of retailers to an online presence that enables customers to browse for products and shop at their own time and convenience introduces the idea of self-service functionalities to a web-based format (Heinemann, 2008; Heinemann and Schwarzl, 2010). Retailers aim at being available for their customers across several channels regardless of operating hours thereby enticing consumers with multiple possibilities of engaging with the retailers' product and service offerings.

Alongside the importance of SST from a customer perspective, technology itself has continuously advanced throughout the last years and has demonstrated to be an enabler for the growth of SST usage in retail. Increased technological reliability has led to reduced downtimes and error situation, which might have hindered a retailer from deploying SSTs in stores. With SST devices being able to nearly operate 24/7 retailers feel more comfortable providing SST offerings to their customers. The user experience when engaging with self-service solutions has also improved thanks to customer-friendly designs and process flows (Niemeier, 2013; Anitsal, Moon and Anitsal, 2015). In this regard, SST solutions have marked a big step forward in delivering successful service encounters with enhanced accessibility options to customers with physical impairments (Castro, Atkinson and Ezell, 2012).

Concepts of self-service ideas have already been available in the retail industry with consumers being able to select their products from supermarket store shelves for example, but they have not been empowered by technological solutions. This approach was rather aimed at off-loading store personnel tasks to the customers by providing them the possibility to choose and collect their items on their own (Dawson, 2010; Riekhof, 2013). As technology has advanced, the notion of self-service has moved closer to being tied to technological concepts and ideas. Within the retail food industry, self-checkout systems have been introduced into the sector of grocery stores. A major

British-based retail player characterised its US market entry by declaring all checkout-lanes as being built around self-service technologies (Kim and Kandampully, 2012). Further European retailers operating with supermarkets as their store format have leaned on self-service technology as an enabler for various use cases concentrating on self-scanning of products or on improving the checkout process. These endeavours focus on achieving efficiencies through the usage of self-service technologies while also enhancing the service experience for customers at the same time. Offering improved services of high quality to customers, which help optimising operational store processes, also supports the increased emphasis of customers on reduced waiting time, faster service deliveries and streamlined checkout processes (Riel, 2012).

Retailers see huge advantages in the possibilities of SSTs as these solutions help attract new customers who favour innovative and interactive store experiences. Requesting a specific service or product via touch functionalities offered by a modern piece of technology connects with the hedonic mindset of consumers and oftentimes leaves a profound impression that connects with the retailer offering this device (Collier and Barnes, 2015). Customers are getting used to SSTs and the self-service nature of the offerings these devices provide and are more likely to experiment with different types of self-service technologies in stores (Weitz, 2010). Considering the fact that SST solutions can rather easily be scaled by adding or removing corresponding technologies, retailers face a cost-effective way of extending their distribution network. SSTs also lead to a higher automation level of service delivery, since retailers use them to handle various customer requests in a standardised manner (Davis, Spohrer and Maglio, 2011). The task of requesting a certain service is shifted from a traditional store employee, who might help a consumer in the process, to the self-service device, that needs to make the service ordering steps clear to the customer. This development of creating service encounters and deliveries in store environments further increases cost efficiencies for retailers and allows them to improve their service offerings and quality. Store employees, who formerly consulted shoppers, can now be assigned to different tasks across the retail store operations (Berry *et al.*, 2010; Bitner, Zeithaml and Gremler, 2010).

SSTs can be seen in a variety of industries and markets. The characteristics of SSTs are focused on providing concrete features and a portfolio of services relevant to the individual branch of industry they are in. Automated teller machines are one of the

prime examples of standardised SST devices with a global presence (Cunningham, Young and Gerlach, 2008, 2009). SSTs are also established in the airline industry in the form of ticketing machines (Lee and Allaway, 2002), at gas stations (Curran, Meuter and Surprenant, 2003), in the hotel business (Meuter *et al.*, 2000) and at department stores (Dabholkar and Bagozzi, 2002). Kiosks, checkout systems, ticketing machines and further forms of SSTs are widely in place across a multitude of industries that offer self-service functionalities to their customers (Inman and Nikolova, 2017). The interest of this study is with SSTs deployed in the retail food industry of self-service restaurants – typical use cases in this branch of retail revolve around self-ordering kiosks and self-checkout systems. There is a general review of available SST classification schemes in chapter "2.1.4 Classification" followed by details about these two specific types of SSTs within the German food retail context in chapter "2.1.5 SSTs in German food retail".

2.1.3 Advantages and disadvantages

SSTs are beneficial for customers as they allow them to make use of the offered services at their own leisure and based on their individual needs. If supported by the SST interface, customers are able to customise the service to their requirements, which thereby has them functioning as a co-creator of the service provision. Customers feel empowered, since they can independently from the availability of service personnel initiate and manage their own service requests (Davis, Spohrer and Maglio, 2011; Kelly, Lawlor and Mulvey, 2017). Service encounters of this kind tend more towards so-called "high-tech, low-touch" experiences as compared to the rather traditional "high-touch, low-tech" approach that is characterised by in-depth consultation and guidance via shopping assistants. This modern avenue of providing services to customers generates a tremendous level of control for the users and oftentimes has them be more engaged with the process of service co-creation and delivery (Wang, Harris and Patterson, 2013).

Selnes and Hansen (2001) claimed that moving the interaction with the technology to the forefront though happens at the expense of traditional customer-to-store-personnel communication, which in turn might even decouple the customer's emotional attachment to the company that provides the service. SSTs are implemented in store environments to help customers approach and complete a multitude of use cases. While SSTs still allow for a decent amount of customisation that customers can benefit from,

the core service offering is designed in a rather standardised way as to account for a wide range of possible applications. The overall service provisioning strategy follows a standard layout as a means to achieve efficiencies and to reduce costs for the enterprise (Meuter *et al.*, 2000; Weijters *et al.*, 2007).

As a consequence of the standardisation customers using SSTs might feel disconnected with the service they try to request and have provisioned to them. This can be due to a lack of understanding of the associated technology itself (Hilton *et al.*, 2013) or related to missing trust in the SST overall (Oh *et al.*, 2016). SSTs certainly provide valuable and unique ways for customers to interact with the offerings of a company, but they cannot fully replace the well-known level of comfort and support that is to be found in the human interaction between customers and store assistants. Retailers have recognised these potential shortcomings of SST usage and have set out to combine SST-based service delivery with shopping experience steered by humans. This mixture of having efficiency gains via technological interfaces offering standardised services and the expertise of store personnel supporting customers in their shopping endeavour is key for retailers to focus on (Salomann, Kolbe and Brenner, 2006; Dabholkar and Spaid, 2012). Building on that, retailers continuously integrate self-service solutions into those tiers of their multi- and omni-channel networks, which are best suited to be accompanied by technology-driven service encounters. By employing both, SST offerings and shopping possibilities under the guidance of store personnel retailers effectively draw on the benefits of all approaches (Verhoef *et al.*, 2009; Wollenburg, Holzapfel and Hübner, 2019).

Furthermore, having SSTs available in distribution channels enables retailers to dynamically adjust to variations in customer demand without modifying the presence of in-store personnel to meet changes in order counts throughout the day. Lines of SST devices in the store can easily be activated or disabled as required as to cope with the stream of customers (Curran, Meuter and Surprenant, 2003; Elliott, Hall and Meng, 2013). Productivity gains are higher with scalable SST infrastructure than with labour intensive training of store assistants (Bitner, Ostrom and Meuter, 2002; White, Breazeale and Collier, 2012). The scalable nature of SST solutions provides retailers with a straight-forward option of adapting to demand fluctuations and steering customer load to specific selling areas within the store as required.

Retailers see huge advantages in SSTs, when it comes to achieving efficiency with the delivery of services and inspiring customers to use new forms of service encounters powered by SSTs. SSTs serve as a medium to help retailers enlarge their portfolio of service offerings (Kokkinou and Cranage, 2015). Suitable candidates for an expansion are those services, which can easily be introduced to an audience via self-service solutions. This reduces the efforts of having to train in-store personnel as to offer service consultation towards customers. SSTs are a valuable driver for the creation of customer-centric services regarding design, implementation and overall delivery (Bitner, Zeithaml and Gremler, 2010). They are even found to be one of the key trends in the management of customer services (Forrester, 2017).

2.1.4 Classification

For a further analysis and understanding of the effects and success dimensions of SSTs it is required to gain a better overview of SST classification schemes. The assignment of SSTs to specific categories often depends on the perspective from which this assignment is done. Plus, the branch of industry, that is to be covered via the classification, also plays an important part as the type of SST depends on different fields of application available in that industry.

Meuter *et al.* (2000) provided a rather generic approach to a classification of SSTs based on two dimensions. Firstly, SST devices are categorised into their customer-centric purposes of which there are three: *customer services*, *transactions* and *self-help*. *Customer services* is an overarching term for any kind of service request the customer wishes to be provisioned, such as support for a shopping activity. *Transactions* can be interpreted as concise processes in the form of checkout operations for instance. *Self-help* features allow customers to obtain information on available products or services. Secondly, these three purposes are mapped against four possible major types of technology, which serve as the media for customers to interact with. The result is a matrix that allows for an SST to be accredited to a certain combination of customer-focused purpose and technology type. While the available types of technology are certainly rather dated (such as compact-disc), the categorisation based on the type of customer request remains current. Bitner, Ostrom and Meuter (2002) built upon the same classification scheme and replaced *self-help* with *education* since they put the focus on customers' self-learn intentions.

Figure 2.1 shows the above explained classification schemes in one integrated overview (Meuter *et al.*, 2000; Bitner, Ostrom and Meuter, 2002).

Figure 2.1: Classification scheme of SSTs - purpose and type of technology

Types of technology / interface **Purpose from customer perspective**	**Telephone / Interactive Voice Response**	**Online / Internet**	**Interactive kiosks**	**Video / CD**
Customer service	Flight information	Package tracking	ATM	-/-
Transactions	Telephone banking	Retail purchasing	Hotel checkout	-/-
Self-help / Education	Information telephone lines	Distance learning	Tourist information	Tax preparation software

Source: Figure by author as based on Meuter et al. (2000) and Bitner, Ostrom and Meuter (2002).

The following classification scheme introduced by Cunningham, Young and Gerlach (2008) establishes two different dimensions across which SSTs are categorised. First of all, there is the degree as to how separable the SST is from the service viewed from the customer's perspective. On the second dimension the level of standardisation is depicted, ranging from *customised* to *standardised*. This presentation clearly steps away from the focus on purpose and technology that made up the core of the classification approach by Meuter *et al.* (2000). Laying the concentration on the degree of customisation in combination with the service-to-technology relationship allows for interesting use cases to be covered and categorised. A service classification scheme developed by Cunningham, Young and Gerlach (2009) further extends the dimension of standardisation versus customisation and examines different types of service executions in general as opposed to different SST interactions.

Figure 2.2 presents the classification scheme by Cunningham, Young and Gerlach (2008) and highlights some exemplary fields of application.

Figure 2.2: Classification scheme of SSTs - service separability and level of standardisation

Standardisation / **Separability**	**Customised**	**Standardised**
Separable from product / service	Airline reservations	-/-
Moderately separable from product / service	Distance education	Retail self-scanning
Inseparable from product / service	Online brokerage	Interactive phone

Source: Figure by author as based on Cunningham, Young and Gerlach (2008).

A more recent classification approach by Rudolph, Schröder and Böttger (2012) combines the above mentioned schemes of having both, a customer-focused view on the purpose of the SST and a view on the level of standardisation. These two aspects make up the first dimension of the categorisation method. The second dimension is comprised of the physical location of the SST in question, which is either being store-based, non-store-based or a hybrid variation. This form of classifying SSTs bears the advantage of considering the locality of the SST that is under investigation while also drawing on the introduced dimensions of established models in the literature. Relating the purpose and the level of standardisation of an SST to the place the SST holds in the store layout or to the form it takes as a non-store or hybrid solution provides profound classification possibilities for researchers to work with. Overall, the classification scheme by Rudolph, Schröder and Böttger (2012) is more directed towards the retail industry.

Figure 2.3 depicts the classification scheme by Rudolph, Schröder and Böttger (2012), which contains the purpose of the SST and the level of standardisation as one dimensional axis and the physical location of the SST as the other axis.

Figure 2.3: Classification scheme of SSTs - purpose, level of standardisation and locality of the SST

Purpose of the SST / **Level of standardisation**	**Store-based**	**Non-store-based**	**Hybrid**
Standardised	Customer service		
	Transactions		
	Self-help		
Customised	Customer service		
	Transactions		
	Self-help		

Source: Figure by author as based on Rudolph, Schröder and Böttger (2012).

Introducing a classification approach based on the locality of the SST allows for a more granular differentiation between the technological solutions available in retail. Store-based SSTs are devices, which are installed stationarily in the store at a dedicated position in the retail space. They provide specific service solutions to customers at a well-defined stage within the shopping journey. Store-based SSTs are oftentimes located at key milestones of a customer's shopping experience, such as to offer information terminals to customers when they enter the store, to provide self-ordering kiosks for requesting of services and goods or to grant self-checkout possibilities at the checkout area of the store, when the customer is about to complete the shopping journey.

Non-store-based SSTs solutions can be understood as immaterial ways to supply customers with information and services independently from any physical presence of a device in the retail store. Common examples are related to catalogue information in various forms or service offerings presented to the customer via websites or mobile applications. Hybrid solutions combine elements from store-related solutions with

aspects of non-physical offerings as described above. Hybrid SSTs are not tied to a specific locality, but rather can be used in-store and outside of the retail environment. Mobile phones and applications need to be named here as key fields of application (Rudolph, Schröder and Böttger, 2012).

2.1.5 SSTs in German food retail

This research programme lays special attention to the food retail sector in Germany. The retail market of food can broadly be classified into the formats of conventional supermarkets, hypermarkets, convenience stores and discount stores, whose category ranges include food articles in different grades (Ahlert, Blut and Evanschitzky, 2010; Berman and Evans, 2013). Supermarkets offer a wide selection of food items primarily aimed at grocery shopping as to provide customers with articles covering meat, fish, pastries, fruits and other items necessary for daily and weekly consumption. The assortment of hypermarkets though already consists of a high percentage of non-food items not typically found in a supermarket. Convenience stores are located in neighbourhood areas, hold a reduced range of products mainly built around food items and follow the principle of providing an pleasant shopping experience for their customers aimed at fast pick-up and checkout. The main characteristic of discount stores is that they offer a limited selection of goods at the very low price end thus focusing on a differentiation strategy concentrating on aggressive price policies (Zentes, Morschett and Schramm-Klein, 2017).

This research project concentrates on retail food industry in the sense of self-service restaurants and quick-service restaurants and not in the notion of food being sold at conventional supermarkets or within other forms of grocery shopping. These forms of restaurants can be found with retailers, who provide self-service-oriented solutions to customers as a way to order food for consumption in their facilities. The ongoing incorporation of SSTs into the self-service restaurant sector in a rising field of applicable use cases is clearly identified as both, a current development and as a general trend in this type of industry (Riehle, 2019; Riehle and Wilson, 2019). These businesses usually come up with hubs inside their store areas, which allow customers to issue food orders. The food itself is then being prepared as a menu or regular food item in a kitchen area located in the store or restaurant. Hot meals usually need to be handled within the kitchen and are then handed out to customers via a pick-up counter. It is also possible

for customers to choose pre-packeted food products and directly finish the checkout themselves, since the food does not require any preparation by a cook inside the kitchen space. This type of food industry experiences a rise in the number of installed self-service devices as they provide a scalable solution of steering sales activities in the store (NCR, 2014; EHI Retail Institute and Horst, 2019).

Looking at the industry of quick-service restaurants for example, McDonald's and Taco Bell aim at offering self-service solutions to their customers as means to improve cost efficiencies and drive sales. SSTs in this regard are being deployed to the store network and are promised to lead to less dependencies on having store personnel available for accepting orders by customers and serving the food (Morris, 2018). The globally operating quick-service restaurant business of Wendy's deployed self-ordering kiosks in about 1000 franchise stores with the goals of offering fast order experiences to their audience and thereby improving cost structures (Thomson, 2017). Similar developments of extending the restaurant facilities with self-ordering kiosk can be identified with many of the major retailers in this quick-service restaurant market such as Burger King, Subway or Panera (Food Service, 2018; Kelso, 2019). The installation of self-ordering kiosks is also considered as an addition to the existing personnel and not as a replacement of the same. Distributing the workload of managing the influx of orders across store assistants and self-ordering kiosks in highly frequented phases helps reduce the associated manual efforts and frees up personnel for the actual preparation and serving of the food (Maras, 2017). Moreover, self-ordering kiosks enable customers to tailor their desired orders to their needs, when it comes to possible menu options and individual tolerability of included ingredients and allergens (Papandrea, 2019; Wheeler, 2020). Within the German market of quick-service restaurants, McDonald's and Burger King can be identified as the companies with the highest turnover results (Bundesverband Systemgastronomie, 2016; Lock, 2020b). Concerning the number of stores available, Edeka takes the first position followed by McDonald's, Burger King and Subway (Lock, 2020a). Edeka generally can rather be regarded as a conventional supermarket, but the retailer also provides quick-service food offerings to their customers alongside grocery shopping.

Self-ordering kiosks offer selection functionalities to users as a way to order specific products or services. In the industry of self- and quick-service restaurants, the purpose of these devices is to provide the customer with a tableau view of the food products,

which can be ordered within the food serving area of the retailer. The level of interaction with self-ordering kiosks is relatively high as the customer is required to actively choose from the available food items by engaging with the SST. This involves browsing through different food and menu options. Usually, the self-ordering kiosk goes along with integrated payment methods being available for the customer, such as credit and debit card or cash payment. In this case, the self-ordering kiosk needs to be secured against possible fraud attempts within the payment process. As an alternative to paying at the kiosk directly, there are options for the customer to issue the order using the SST but to pay at a cashier-operated desk.

Figure 2.4 shows double-sided self-ordering kiosks. Each kiosk is mounted on a pole and allows access from both sides as a means to increase customer usage on the available retail floor. These self-ordering kiosks are located in a McDonald's restaurant. They provide food menu information in a tableau-format to customers and support customers in the food ordering process. Upon payment of the order, the food details are sent to the kitchen area for preparation and subsequent handout to the customer.

Figure 2.4: Self-ordering kiosks in a quick-service restaurant

Source: Klein (2018).

Next to the solution of ordering food via kiosks, the self-service restaurant industry also offers self-checkout-focused solutions to customers. These self-checkout devices allow

customers to register the food items present in their shopping baskets via scanning techniques. After scanning, customers autonomously complete their shopping trips by paying for the food items at the self-checkout terminal thereby completing their purchase and checking out from the store. This process oftentimes takes place in a fast and contactless fashion, which is something customers increasingly pay attention to (Brouillette, 2018; Oracle, 2020). Self-checkouts can be separated into manually-oriented and automated variations. Manual solutions have the customer actively registering products via the self-checkout device for a checkout payment. In this scenario, the customer is tasked with scanning the collected food items as to record them for the SST. Automated self-checkouts though are enhanced via camera or sensor solutions, which capture the basket content of the customer dynamically. This reduces the level of interaction required by the user and facilitates the efficiency of the check-out process, since little to no manual scanning efforts are involved. Both check-out approaches need to be equipped with sufficient security measures as to prevent theft and to reduce the risk of fraud.

Figure 2.5 shows self-checkout terminals located in a German food retailer store. Customers can use these solutions to scan the food items present in their basket. The shopping transaction can be finalised by paying via the integrated card-based contactless payment option.

Figure 2.5: Self-checkout terminals in the store of a German food retailer

Source: RetailCustomerExperience (2021).

2.2 Information systems success models

The following chapters provide an overview of models available in the academic literature, which offer frameworks for the assessment of the success of an information system.

2.2.1 DeLone & McLean's Information Systems Success Model

The information systems success model by DeLone and McLean (1992) is one of the most cited success models in the area of information systems. Many academics have built their research programmes on the basis outlined by DeLone and McLean and adapted the success model to a large variety of different research questions and environments. The DeLone and McLean's IS Success Model therefore holds a key position when it comes to the development and understanding of a system that contains variables for the assessment and characterisation of information systems.

2.2.1.1 Theoretical background

The need for a deeper investigation on which variables influence the success of an information system came into the forefront during the first International Conference on Information System, when Peter Keen explicitly asked the audience to define the dependent variable in this field (Keen, 1980). DeLone and McLean replied to this question with their development of the DeLone and McLean's IS Success Model, which describes the dependent variable as being IS success.

DeLone and McLean set out to review works published in the management information systems field between 1981 and 1987 looking for references to forms of measurements with regards to IS success (DeLone and McLean, 1992). This literature review also included core theories and principles from earlier periods. They additionally drew on theories about communications as posted by Shannon and Weaver (1949). The research by Mason (1978) extended this theory and thereby served as a foundation for DeLone and McLean to better understand the hierarchies of information levels and to clearly describe the way the information is being processed throughout various stages of the communication.

Per Shannon and Weaver (1949), there are three levels of measurement, which cover the technical, semantic and effectiveness layer. Information, however it may be characterised in detail, conveys a specific functional message on the technical level.

This message requires a semantic context of interpretation to make sure the message is captured by the receiver in an effective manner. Mason (1978) further specified the effectiveness level by considering the overall influence the message has on the recipient and on the system itself. Building on this theoretical foundation, DeLone and McLean identified six dimensions of IS success: *system quality*, *information quality*, *use*, *user satisfaction*, *individual impact* and *organisational impact*.

Figure 2.6 shows the mapping of these six IS success variables to the effectiveness levels as described by Mason (1978); it also connects the variables with their corresponding level of information as available in Shannon and Weaver (1949).

Figure 2.6: Categories of IS success

Shannon and Weaver (1949)	Technical level	Semantic level	Effectiveness or influence level			
Mason (1978)	Production	Product	Receipt	Influence on recipient		Influence on system
Categories of IS success	System quality	Information quality	Use	User satis-faction	Indi-vidual impact	Organi-sational impact

Source: Figure by author as based on DeLone and McLean (1992).

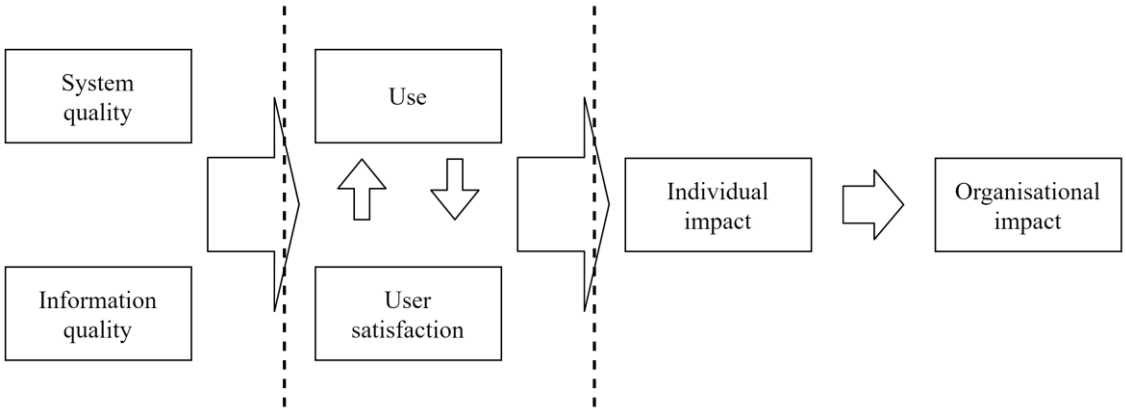
The technical level of communication is covered by the *system quality* dimension whereas on the semantic level actual information is being transmitted, as captured in the category of *information quality*. The effectiveness level is comprised of four dimensions with two of them (*use* and *user satisfaction*) looking at the interaction of recipients with information, and the remaining two (*individual impact* and *organisational impact*) representing the effects of information on the recipient or overall system involved. These variables can be measured independently from each other with IS success itself being defined as the dependent variable in the DeLone and McLean's IS Success Model.

2.2.1.2 Model characteristics

The DeLone and McLean's IS Success Model (DeLone and McLean, 1992) offers a set of success dimensions to work with when analysing and evaluating the effectiveness of an information system. The main goal of this model is to provide a simple yet holistic approach on measuring IS success as the dependent variable in an IS environment. The six categories of IS success offer independent ways of assessing an IS with the help of dedicated success measures for each of them. The DeLone and McLean's IS Success Model combines these categories into an overarching semantic level as to identify and characterise the success of an IS.

Figure 2.7 shows the DeLone and McLean's IS Success Model with the aforementioned six dimensions of IS success.

Figure 2.7: DeLone and McLean's IS Success Model



Source: Figure by author as based on DeLone and McLean (1992).

The six dimensions of IS success are arranged in a procedural way to support a flow of information throughout the information system. This goes along with the idea of information being created at a certain stage, then transported to a recipient and finally resulting in an effect on the receiver of the information. DeLone and McLean outline that an IS shows similar characteristics as a system of communication in this vein. Information is established, transformed and emitted from the system towards a consumer or receiver. In addition to the process-oriented representation of IS success dimensions, the model also provides the possibility for temporal and causal relationships to be identified. Only after a piece of information is generated or provided by the information system there can be an effect related to the actual usage of the IS;

due to the incorporation of *use* and *user satisfaction* into the consideration, *individual* and *organisational impacts* can emerge (DeLone and McLean, 1992).

The category of *system quality* serves as means to describe the information system that is in scope. Typical measurement variables in this context have been identified by DeLone and McLean and cover for measures such as accuracy of the system and of the data it generates. Reliability and efficiency of the system are suitable measurements as well. The dimension of *information quality* complements this view by concentrating on measurements surrounding the format, clarity, relevance and understandability of the data (DeLone and McLean, 1992). The *use* dimension focuses on the level of interaction between a user and the information system. *User satisfaction* provides insights into the experience the user has with the information system. Both dimensions can be measured by investigating the frequency of access and amount of connect time for instance or satisfaction and enjoyment with the IS respectively (DeLone and McLean, 1992).

Combining the above mentioned dimensions, the IS success model by DeLone and McLean sets out to identify the impact an information system has on both, the individual and the organisation alike. *Individual impact* can be understood as having proper information awareness and decision effectiveness. Considering the wider impact on the organisation as a whole, measurements around operating cost reductions or overall productivity gains are critical (DeLone and McLean, 1992).

Table 2.1 shows an overview of the six categories of IS success together with a collection of suitable measurements. This collection covers a sub-set of the measurements available in DeLone and McLean (1992).

Table 2.1: Categories and variables of DeLone and McLean's IS Success Model

System quality	**Information quality**
Data accuracy Data currency Database contents System accuracy System reliability …	Relevance Usefulness Informativeness Understandability Format …
(Information) Use	**User satisfaction**
Amount of use/duration of use Amount of connect time Number of functions used Actual vs. reported use Recurring use …	Satisfaction with specifics Overall satisfaction Information satisfaction Enjoyment Software satisfaction …
Individual impact	**Organisational impact**
Information understanding Learning Accurate interpretation Problem identification Decision effectiveness …	Operating cost reductions Overall productivity gains Increased revenues Increased market share Return on investment …

Source: Table by author as based on DeLone and McLean (1992).

2.2.1.3 Application of the DeLone & McLean's IS Success Model

The IS success model by DeLone and McLean received wide attention amongst the academic community as it provided a parsimonious framework for IS researchers to explore (DeLone and McLean, 1992). After the publication of DeLone and McLean's IS Success Model in 1992 researchers tried to empirically test the suggested interdependencies in various settings. Throughout the time span from 1993 to mid-1999

there were more than 100 citations in well-established management information systems journals referring to this IS success model (DeLone and McLean, 2002). Researchers in the IS field focused on understanding to which extent the processual and causal relationships presented by DeLone and McLean turned out to be supported by empirical data in different environments.

Seddon and Kiew (1994) applied the DeLone and McLean's IS Success Model in the context of a university departmental accounting system by using a slightly modified model as originally presented by DeLone and McLean. The category of *use* was replaced by *usefulness* as to more accurately account for the actual usefulness of the IS experience instead of measuring variables about system use, which might not reflect the usefulness itself. The relationship between *usefulness* and *user satisfaction* was turned into a unidirectional link with *usefulness* impacting the satisfaction of the user and not the other way around. Seddon and Kiew (1994) argue that an increase in *user satisfaction* does not lead to a higher level of *usefulness* of the IS in question. Moreover, they introduced a new IS category of *system importance* to provide a situational dimension that covers the relevance of the IS under observation. The evaluation of their collected data demonstrated strong support for the validity of the IS success model by DeLone and McLean especially with regards to the categories of *system quality*, *information quality* and of the introduced dimension of *usefulness* provided as influencing factors of *user satisfaction*. The contextual addition of the *system importance* was found to have a key impact on the *usefulness* of an IS as experienced by a user (Seddon and Kiew, 1994).

Researchers paid critical attention to the causal and process nature of the IS success model by DeLone and McLean. Ballantine *et al.* (1996) for example argue that *individual impact* cannot be measured as a consequence of *user satisfaction*, but rather the other way around. There needs to be a certain level of impact registered on the individual as to determine any form of experienced *user satisfaction*. This point of criticism is often found in studies trying to apply the DeLone and McLean's IS Success Model to practice (Myers, Kappelman and Prybutok, 1997). With this model containing a multitude of dimensions and proposed variables researchers face the challenge of clearly understanding and accounting for whether or not a certain characteristic is caused by or simply follows a specific variable in a temporal sequence.

In an attempt to partly account for this issue, Ballantine *et al.* (1996) suggested utilising the DeLone and McLean's IS Success Model by taking a broader perspective on the success dimensions via environmental, integration and implementation filters. This approach led to the development of the 3-D Model of Information Systems Success and would serve as a means to manage the uncertainty of causal and process determined relationships by setting the level of analysis straight. This model introduces a wide set of variables across three filtering layers. It is questionable though, if the application of a rather complex 3-D model with various perspectives to take or consider yields more concrete results when it comes to the success of an IS than the parsimonious approach suggested by DeLone and McLean, which is clear to grasp and allows for an adaptation to the research scenario at hand. Myers, Kappelman and Prybutok (1997) shared the criticism of causal- versus process-related interpretations of the model as well, yet they straightforwardly extended the success model by investigating the *workgroup impact* for their research programme as a mid-level of analysis between the impact on individuals and impact on the organisation. Further evaluations of the challenges arising with the causal and processual nature of the IS Success Model by DeLone and McLean as identified by Seddon (1997) are dealt with in chapter "2.2.2.1 Development of an adjusted success model as a response to critique".

Grover, Jeong and Segars (1996) established an extension of the DeLone and McLean's IS Success Model after a review of academic papers concentrating on information systems. They added a perspective to the model that considers the market measures related to the IS effectiveness. The other dimensions of the IS success model were found to be supported by the literature and remained functionally untouched. Grover, Jeong and Segars (1996) relabelled the success dimensions offered by DeLone and McLean into several measures building towards IS effectiveness keeping the original model fundamentally intact. Saarinen (1996) modified DeLone and McLean's IS Success Model in a way that he included the development process into the effectiveness evaluation; the motivation behind this approach was to elaborate the organisational impact of an IS. A similar procedure with a modification of DeLone and McLean's IS Success Model and subsequent analysis of IS effects on an organisational level was followed by Mirani and Lederer (1998). IS success was explored in the context of user-developed applications with modifications of the success model relating to the additional category of *perceived system quality* and *intended use* as opposed to the

category of *use*. Findings here demonstrated medium to strong support of DeLone and McLean's IS Success Model (McGill, Hobbs and Klobas, 2003). Next to that, research data collected via a success assessment of a student information system further underscored the validity and accessibility of DeLone and McLean's IS Success Model (Rai, Lang and Welker, 2002).

A trend can be identified in the findings published by researchers as they firstly apply the DeLone and McLean's IS Success Model and then implement adaptations to tailor the success model to a specific environment and setting. Overall criticism often is connected to the difficulty of interpreting the IS success data in a causal or processual manner. General support for the model itself exists, and respecifications are made when required as was advised to do so by DeLone and McLean (1992) in the first place.

2.2.2 Updated DeLone & McLean's Information Systems Success Model

The original IS success model developed by DeLone and McLean was subject to a multitude of applications in practice and several respecifications to concrete use cases and environments. The critical feedback expressed by researchers in the IS domain was followed up upon by DeLone and McLean and led to the creation of an updated IS success model (DeLone and McLean, 2003).

2.2.2.1 Development of an adjusted success model as a response to critique

One of the key points of criticism of DeLone and McLean's IS Success Model addressed the issue with the model being a combination of process- and causal-related interdependencies. Both of which were difficult to separate and account for when applying the model to practice. This aspect was raised by many researchers and found careful consideration by Seddon (1997) who tried to re-work the success model in a way that would allow for a better controlling of the variables involved.

Seddon (1997) laid emphasis on the dimension of *IS use*, which generates a set of consequences of various forms that impact the overall IS success model. These effects can be related to the individual working with the IS or to the whole organisation. Seddon (1997) also introduced a feedback loop by reincorporating the *user satisfaction* measurements into future expectations about the *IS use* as experienced by the user. He replaced the category of *use* with *perceived usefulness* thus reaffirming the accentuation on the user perspective and removing the causal influence of *system use* on impact

dimensions, which Seddon believes to be misleading. In fact, this adapted model of IS success consists of two single models both connected via a learning loop – a model of *IS use* and an updated DeLone and McLean's IS Success Model.

DeLone and McLean (2003) acknowledged the call by Seddon to obtain clarity between causal and process variables. Yet they questioned the explanatory power of Seddon's model of IS success and use, since in their view the combination of two models undermined the original attempt of providing a concise model of IS success. They did not go along with Seddon's line of argumentation that *system use* was not suitable for measuring success-related figures in a causal interpretation. In the minds of DeLone and McLean (2003), using an IS would indeed be a decisive factor of success measurement. Understanding the success of an IS while controlling for the variables involved in the examination of an IS would remain a key requirement for any researcher to consider – having an overly complicated IS success model at hand as proposed by Seddon would not lead to more clarity about causal and processual effects (DeLone and McLean, 2002, 2003).

Seddon *et al.* (1999) worked intensively with the IS success model by DeLone and McLean and found the model to be lacking a contextual perspective that would enable researchers to adapt the success model to specific environments and interest groups, namely the type of system at observation and the stakeholders involved. DeLone and McLean (2002, 2003) agreed with the comment and supported the inclusion of this two-dimensional viewpoint proposed by Seddon *et al.* (1999) for assessing IS success variables. Similar feedback on DeLone and McLean's model was published by Whyte, Bytheway and Edwards (1997) and Jiang and Klein (1999) who underscored the importance of setting the correct context and situational measurements as to yield reliable results about the IS success that is being investigated.

Considering the scientific response to the DeLone and McLean's IS Success Model, the need for a revised version surfaced that would address the issues raised. DeLone and McLean (2003) implemented additions to the original model of IS success. Inspired by the argument of Seddon *et al.* (1999) to incorporate a contextual role into the analysis, DeLone and McLean rephrased the success dimensions of *individual impact* and *organisational impact* into one combined category of *net benefits*. This purposely rather broad term leaves the evaluation of the impacts of an IS up to the researcher who has to

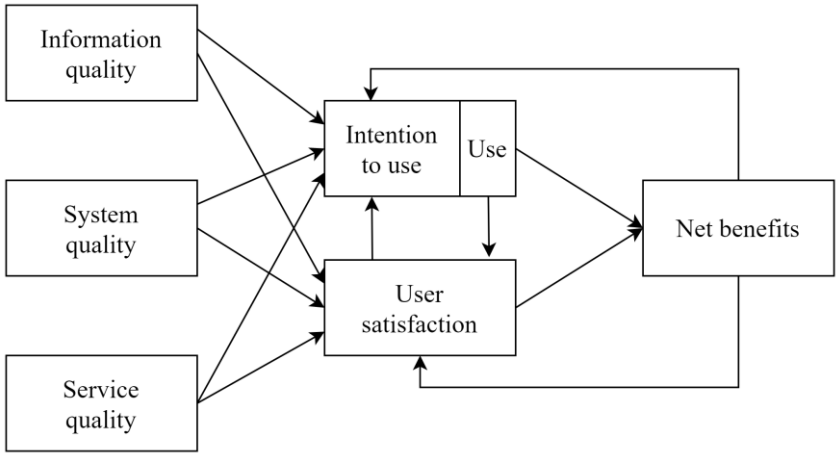
put the IS assessment and measurements into a suitable environment and establish the correct measurements.

A second modification of the IS success model was achieved via the introduction of the *service quality* dimension. DeLone and McLean (2003) recognised the changing nature of information systems including a constantly growing set of service-related features and possibilities for users. Despite the challenges related to identifying specific ways of measurement for the service dimension, they found this extension to be worthwhile. DeLone and McLean (2003) requested researchers to integrate the *service quality* category together with contextually valid measures into their future IS endeavours. The SERVQUAL scale could be considered here as an instrument to describe and capture service-related parameters (Parasuraman, Zeithaml and Berry, 1988). The measures available in this scale though have seen intensive debate amongst academics with regards to definition and applicability (Parasuraman, Zeithaml and Berry, 1988; Parasuraman, Berry and Zeithaml, 1991; Pitt, Watson and Kavan, 1995; Jiang, Klein and Carr, 2002).

As a response to the point of criticism, that was raised by Seddon (1997) and touched the relationship between *use* and *user satisfaction*, DeLone and McLean (2003) modified their updated model in a way to capture the newly introduced category of *intention to use*. This new dimension was positioned right next to *use* and was supposed to better cover for and explain attitudinal variables of usage, whereas *use* represents behavioural variables. Both dimensions are subsumed under the success category of *use*. Via this addition of the model, DeLone and McLean planned to describe the causal and processual effects of use-related variables on IS success as well as the interrelation between increases and decreases in *intention to use*, *use* and corresponding *user satisfaction*. They also implemented a feedback loop from *net benefits* to both, *use* and *user satisfaction*, which would account for positive as well as negative effects on the usage of the IS (DeLone and McLean, 2002).

The updated model of IS success model by DeLone and McLean is depicted below in Figure 2.8 and shows the extensions and updates provided in the revision of the IS success model.

Figure 2.8: Updated DeLone and McLean's IS Success Model



Source: Figure by author as based on DeLone and McLean (2003).

As provided for the original model of IS success, DeLone and McLean (2003) also offered a set of measurement variables for researchers to work with when applying the updated IS success model to practice. Table 2.2 contains a set of variables per category of IS success.

Table 2.2: Categories and variables of the updated DeLone and McLean's IS Success Model

Information quality	**System quality**	**Service quality**
Completeness	Availability	Assurance
Accuracy	Adaptability	Empathy
Relevance	Usability	Responsiveness
Understandability	Scalability	…
Security	Interactivity	
…	…	

Use / Intention to use	**User satisfaction**
Nature of use	Repeat purchases
Number of transactions	Repeat visits
Length of stay	User surveys
…	…

Net benefits
Cost savings
Time savings
Enhanced customer support and services
Improved customer experience
Return on investment
…

Source: Table by author as based on DeLone and McLean (2003, 2004).

2.2.2.2 Application of the updated DeLone and McLean's IS Success Model

The updated model of IS success by DeLone and McLean received a large amount of attention in the academic community amongst IS researchers. Researchers sought out to put the model to test and verify the extensions in various environments. DeLone and McLean (2004) themselves applied their model to the use case of determining success in e-commerce systems, which led them to include specific e-commerce success measures in their IS success model next to the regular measurement variables. A study by Wang (2008) followed a similar approach by explicitly focusing on e-commerce systems. The research model used replaced the success dimension of *use* with *perceived value* and concentrated on the *intention to reuse* as a resulting success category instead of basic *net benefits*. Wang thereby adopted the approach suggested by DeLone and McLean as to employ specific modifications to the use case at hand when applying the IS success model.

DeLone and McLean's updated IS success model was applied to a multitude of environments and was mostly found to support the interrelationships between the success dimensions – while always making adjustments to the respective research object, researchers validated the success model in scenarios of mandatory information systems (Iivari, 2005) and eGovernment systems (Wang and Liao, 2008). In a paper about the success of a knowledge management system Halawi, McCarthy and Aronson (2007) purposely replaced the success category of *information quality* with *knowledge quality* to cater to the research project, whereas Alzahrani *et al.* (2019) concentrated on the success dimension of *actual use* in an attempt to understand the success of digital library systems.

When researchers worked on respecifications of the IS success model by DeLone and McLean they also developed fairly different success models with their own takes on a dedicated research environment. Sedera and Gable (2004) established a simplified version of the IS success model that was more suitable for the assessment of enterprise systems as opposed to the success evaluation of rather generic information systems. This model was later picked up again as to provide a new measurement approach to understand the ad-hoc IS impact instead of controlling for and evaluating temporal interdependencies (Gable, Sedera and Chan, 2008). Profound support for the DeLone and McLean's IS Success Model was obtained in a meta-analysis that set out to investigate the constructs of the model (Sabherwal, Jeyaraj and Chowa, 2006). Comprehensive and large-scale literature reviews also verified huge aspects of the model by DeLone and McLean, which makes it one of the most substantiated, applied and well-implemented success models in the IS field (Petter, DeLone and McLean, 2008, 2013; Petter and McLean, 2009).

2.2.3 SST success models

Researchers set out to examine SSTs in retail settings by applying IS success models as a means to understand and evaluate the determining factors of SST success. The success model by DeLone and McLean often served as a baseline for the arrangement of suitable success dimensions. This model was then adjusted to meet the specific needs of the research question and environment. Detailed thoughts were spent on the adoption of SSTs by the customers who used them in their respective situations. These thoughts touched on the motivation of the customers to approach the SST in the first place. They also covered the customer experience throughout the SST usage as well as the effects SSTs had on the satisfaction of the users afterwards.

Meuter *et al.* (2005) analysed the readiness of customers when it comes to using SSTs. They explored upon different sets of antecedent adoption variables, which influenced the willingness of consumers to try out SST devices and their features. These sets were made up of variables covering innovation-related aspects, such as complexity or observability, and of factors describing individual differences of the customers in question, such as previous experience with technology or technology anxiety. The researchers found that role clarity, motivation and ability comprised customer readiness as an important mediator in explaining the behaviour of customers engaging with SSTs.

Further studies in this field took attitudinal and situational aspects into consideration when investigating the determining factors of SST usage (Oh *et al.*, 2016). Based on an application of an extended version of the Technology Acceptance Model, the researchers explored a hotel check-in situation and found support for technology trust and technology anxiety as attitudinal variables as well as for waiting line length and service complexity as situational variables to have effects on SST usage. More details about this are presented in chapter "2.3.1 Technology Acceptance Model".

The importance of mediating factors for the adoption of SSTs by customers has also been highlighted by Weijters *et al.* (2007). In a research programme, that was building on TAM, they analysed the way a customer's attitude determines SST usage. Being moderated by demographic variables, attitudinal factors such as perceived fun or newness played a deciding role in understanding the adoption of SSTs. This finding relates to the study referred to above and illustrates the importance of grounding the research scenario on an underlying success or acceptance model while implementing suitable adjustments to the research situation under observation. The academic research in this field is wide-spread and predominantly concentrates on testing very specific influencing factors on SST adoption and usage in a well-defined environment. Situational variables regarding location convenience or perceived time pressure were subject of an analysis executed by Collier *et al.* (2015) in the area of grocery stores. Collier *et al.* (2014) furthermore explored whether a hedonic or utilitarian service nature associated with the type of self-service technology would be more appealing to customers using SSTs. Research on SST usage in the hospitality industry had also been carried out (Oh, Jeong and Baloglu, 2013; Rosenbaum and Wong, 2015; Wei, Torres and Hua, 2016).

Generally, there is a trend to be identified in the literature when it comes to the evaluation of SST usage and acceptance by customers. The theoretical baseline is mostly founded on DeLone and McLean's IS Success Model and TAM while introducing specific modifications to meet the requirements of the respective research programme. The results generated predominantly indicate a quite complex system of influencing factors, which drive customers' intentions to use and adopt SSTs. This is further complicated by the various research environments, which range from retail and hospitality to banking and further industries. The main structural approach is set out to explore and test the customer adoption of SSTs by drawing upon connected behavioural

theories and technology acceptance models. This even involves considering personality traits of customers engaging with SST devices (Jackson, Parboteeah and Metcalfe-Poulton, 2014; Lee and Lyu, 2016; Wang, Harris and Patterson, 2020). An extensive literature assessment of factors on SST acceptance including additional background information is provided by Blut, Wang and Schoefer (2016).

The existing literature on SST usage is characterised by a strong emphasis on how the adoption process of customers utilising SSTs can be described. This mainly focuses on customer experience (Meuter *et al.*, 2003; Verhoef *et al.*, 2009) and customer satisfaction (Yen, 2005; Robertson *et al.*, 2016). Both dimensions are customer-centric in a way that they provide insights into how SSTs affect the behaviour of customers before, when and after using SST offerings. Following this overall approach, main research objectives put the consumer first and allow for the investigation of various influencing factors of SST attributes and setups on customer behaviour and attitude. There is also research on how easily-accessible SST solutions can appeal to customers (Darzentas and Petrie, 2018) and on what kind of impact SST adoption has on older consumers (Lee and Lyu, 2019). On related occasions, researchers take a step aside from the customer-focused perspective and work on analysing the developments in customer loyalty with a certain retailer in correspondence with SST usage and adoption rate (Selnes and Hansen, 2001; Lee, Fairhurst and Lee, 2009). Lee (2015) reviewed the effects of service quality and interpersonal service quality on customers' retail patronage intentions with a research design centred around self-checkout systems and information kiosks in a retail setting.

2.3 Customer adoption of SSTs

The DeLone and McLean's IS Success Model together with its variations developed by IS researchers contains a major section that is focused on the acceptance of the information system by the customer who uses it. The success dimensions of *intention to use*/*use* and *user satisfaction* provide variables to assess the impact an IS has on its users. One of the key interests of researchers oftentimes is to gain insights into the way information systems are being approached, utilised and accepted by customers. Results about these aspects help understand the influencing factors of IS success with regards to motivation to use an IS and overall IS adoption. With the rising existence of SSTs as a concrete form of information system in a growing number of industries, the demand for

measures on success dimensions has increased as well. Explaining the behaviour of customers in their interaction with SST offerings in different branches of industries has been of major importance for academics and practitioners alike. The theoretical baseline for the analyses performed on the degree to which customers accept SST installations leads back to the Technology Acceptance Model originally formulated in its first version by Davis, Bagozzi and Warshaw (1989). Researchers have focused on exploring the SST adoption by applying combinations of TAM with DeLone and McLean's IS Success Model to research situations in business practice.

2.3.1 Technology Acceptance Model

The Technology Acceptance Model was developed by Davis, Bagozzi and Warshaw (1989) and describes user acceptance of technological innovations. TAM thereby extends the Theory of Reasoned Action, which was postulated by Fishbein and Ajzen (1975). The acceptance model introduces two key concepts: *perceived usefulness* and *perceived ease of use*. Both of which are said to influence the attitude of users towards technology and the resulting usage behaviour with the same. After a period of researchers working with TAM and sharing their criticism, a second iteration of the model was published (Venkatesh and Davis, 2000). This model was named TAM2 and contained a more granular definition of the construct of *perceived usefulness* that now comes along with five corresponding determinants. Venkatesh (2000) also further detailed the construct of *perceived ease of use* into anchors and adjustment factors. This extension though was not included in TAM2. Eventually, the updated determinants for *perceived ease of use* were combined with TAM2 and led to the development of TAM3, which also presents some minor modifications concerning the different variables used in the model (Venkatesh and Bala, 2008).

2.3.1.1 Technology Acceptance Model 1 (TAM)

The Technology Acceptance Model was one of the pioneer models in the research area of the perception and acceptance of technological innovations. As a theoretical foundation, TAM is based on the Theory of Reasoned Action, which itself formulates the premise of the *actual use* of a technology being dependent on the *behavioural intention* to use said technology. According to the theory, intention to use a system could be explained by a set of attitude-related variables and subjective norms of the

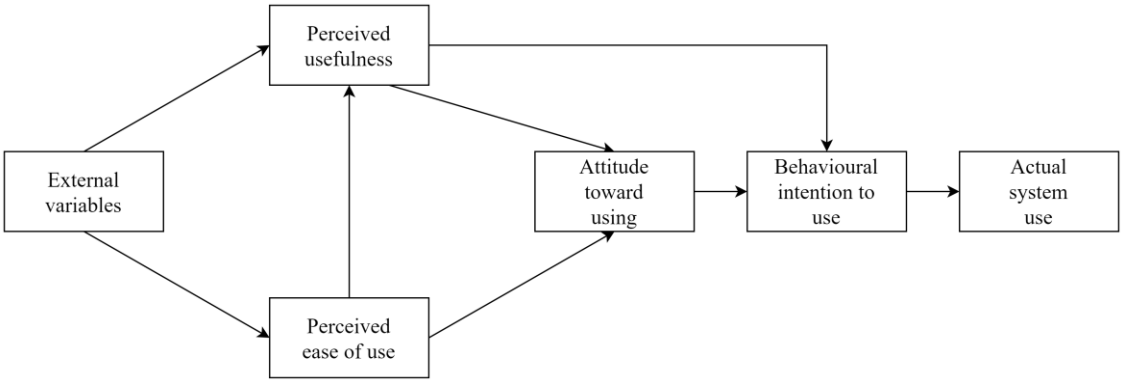
individual interacting with the technology (Fishbein and Ajzen, 1975; Davis, Bagozzi and Warshaw, 1989).

When developing TAM, Davis, Bagozzi and Warshaw (1989) took inspiration from the Theory of Reasoned Action and laid emphasis on the two constructs of *perceived usefulness* and *perceived ease of use*. They did however not include the dimension of subjective norm, which is present in the Theory of Reasoned Action, since this was in their opinion the most incomprehensible construct of the theory. TAM basically sticks with the concepts of *behavioural intention* and *actual use* and extends these dimensions with explanatory constructs leading up to them. The main drivers for the acceptance of technology as per TAM are to be found in the already mentioned dimensions of *perceived usefulness* and *perceived ease of use*. Both of which are influenced by external variables, which lack further detailed explanation as to what they are comprised of. *Perceived ease of use* is defined as impacting the *perceived usefulness* of a system and the *attitude toward using* that specific system. This relates to a customer for instance concluding from the seemingly easily to be used piece of technology to expecting a higher level of usefulness and to improving the overall stance towards that system. The construct of *perceived usefulness* directly affects the *behavioural intention to use* a system and indirectly the intention via the *attitude towards use* in general (Davis, 1986, 1989; Davis, Bagozzi and Warshaw, 1989).

The development of TAM contributed to the research field of technology acceptance and motivated researchers in this area to utilise, adapt and verify the acceptance model in different environments. Additional variables with regards to external influences had been introduced to better explain certain effects on attitude and behaviour of customers towards technological systems. A study performed by Koufaris (2002) on the behaviour of users in online shopping scenarios yielded a better understanding of the variables involved in this setting, whereas a more broader literature-based review executed by Straub (2009) focused on general theoretical constructs of technology acceptance.

Figure 2.9 provides a schematic overview of the Technology Acceptance Model in its original version (Davis, Bagozzi and Warshaw, 1989).

Figure 2.9: Technology Acceptance Model 1



Source: Figure by author as based on Davis, Bagozzi and Warshaw (1989).

2.3.1.2 Technology Acceptance Model 2 (TAM2)

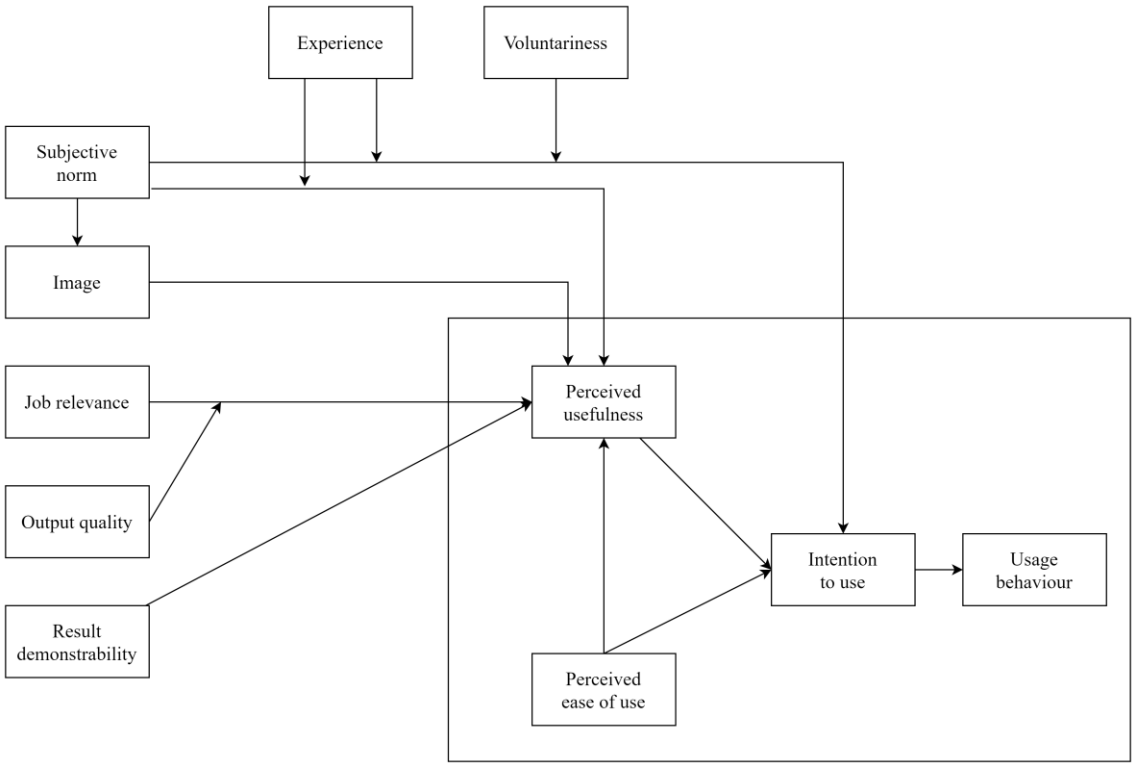
The original authors of TAM further developed their research and worked on a new iteration of the acceptance model. Venkatesh and Davis (2000) published TAM2, which modified and extended the initial model. As a key change, the two major constructs of *perceived usefulness* and *perceived ease of use* no longer affect the *attitude toward using* a certain technological system. Instead they directly impact the *intention to use* thus fully skipping the attitude-related construct, which essentially was omitted in TAM2. The concluding dimension remains practically unchanged, but is now called *usage behaviour* as opposed to *actual system use*. The above mentioned change though as to why the *attitude towards using* a system was completely left out for TAM2 remained rather unexplained in the publication.

Venkatesh and Davis (2000) responded to the point of criticism by researchers that the dimension of *external variables* lacked any kind of explanation and examples in the original model. In this regard, TAM2 provides a set of variables, which are categorised as external effects on the construct of *perceived usefulness*. Interestingly, the formerly absent dimension of *subjective norm* had now been included in TAM2 as an essential influencing part for *perceived usefulness*, the *intention to use* and for the external variable *image*. The effects of *subjective norm* on *perceived usefulness* are moderated by *experience*, whereas the influences on the *intention to use* are moderated by both, *experience* and *voluntariness*. Introducing the concept of *voluntariness* allows for differentiated analyses in case the use of a certain technological system happens on a volitional or forced basis. The construct of *perceived usefulness* depends on the

additional four dimensions *image*, *job relevance*, *output quality* and *result demonstrability*. All of these influencing factors solely impact *perceived usefulness* leaving *perceived ease of use* relatively separate.

Figure 2.10 shows the updates introduced with Technology Acceptance Model 2 (Venkatesh and Davis, 2000).

Figure 2.10: Technology Acceptance Model 2



Source: Figure by author as based on Venkatesh and Davis (2000).

The application of TAM2 in the field of IS research generated valuable insights for researchers concerning the acceptance of information systems in practice. This was due to the parsimonious nature of the model that provided comprehensible theoretical constructs for the design of suitable research programmes. When working with TAM2 in the field, adaptations to the respective use case were always required to yield more comprehensive results out of the data collected. Simply putting the model untouched to practice would not generate worthwhile findings. This stance of awareness is essential for IS researchers who are embedding success and acceptance models in their research projects as they need to ensure substantive data is gathered from within a suitable

perspective following the necessary model modifications (Lee, Kozar and Larsen, 2003; Venkatesh, Davis and Morris, 2007).

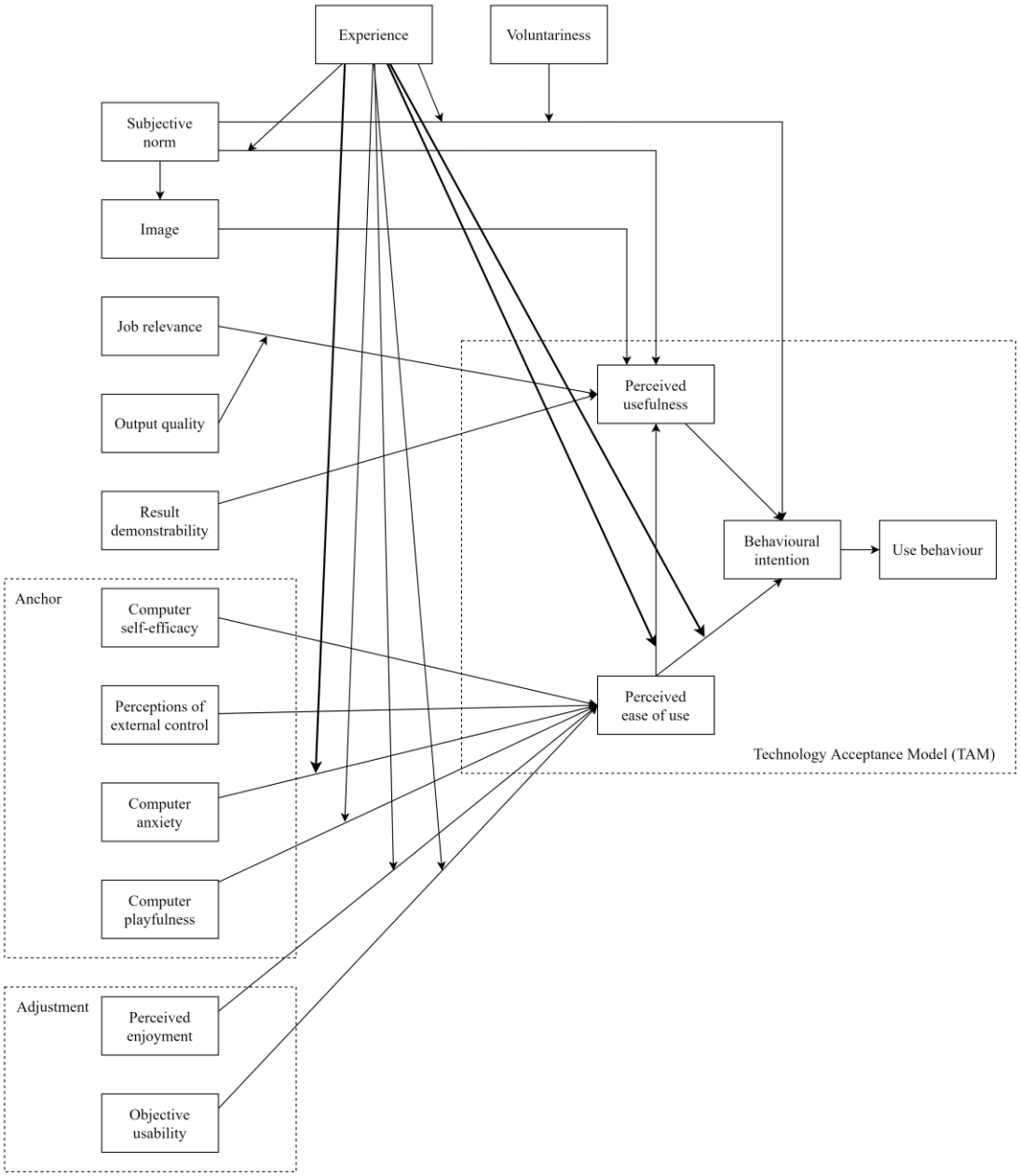
2.3.1.3 Technology Acceptance Model 3 (TAM3)

One of the key additions to TAM2 was the specification of the determinants relevant for the construct of *perceived usefulness*. Later in the same year as TAM2 was published, Venkatesh (2000) provided further information about the influencing factors of *perceived ease of use*, which was missing in TAM2. These factors were categorised as anchors on the one hand and adjustment factors on the other. With regards to TAM3, the main logic of this model iteration stayed the same compared to previous versions of the model. The construct of *perceived ease of use* received larger attention by the researchers in a way that it is now being affected by six specific determinants defined under two groups.

TAM3 follows the design idea of providing IT professionals with a toolkit to manage the determinants, which influence the IT usage of employees (Venkatesh and Bala, 2008). This is why *perceived ease of use* was further specified by Venkatesh (2000) and integrated into this version of the model. The adjustment effects of *perceived enjoyment* and *objective usability* are named as having an impact on *perceived ease of use*. The first of which describes the perceived level of excitement a user experiences when using a system without considering performance-related dependencies. *Objective usability* focuses on the level of efforts required to complete a certain task. The effects of both variables on *perceived ease of use* are moderated by *experience*. The four anchoring factors affecting *perceived ease of use* encompass *computer self-efficacy*, *perceptions of external control*, *computer anxiety* and *computer playfulness*. According to the authors, these variables would be more influential when it was about initial usage attempts with technological innovations. Over time though, when the level of *experience*, which moderates the impacts of *computer anxiety* and *computer playfulness* on *perceived ease of use*, rises, the effects would decrease (Venkatesh, 2000; Venkatesh and Bala, 2008).

Figure 2.11 shows the updated Technology Acceptance Model as TAM3.

Figure 2.11: Technology Acceptance Model 3



Source: Figure by author as based on Venkatesh and Bala (2008).

The level of *experience* also strongly moderates the effects of *perceived ease of use* on *perceived usefulness* and on *behavioural intention*. For a user, this underscores the importance of repeated interactions with a technological device as a way to generate experience and build up knowledge of the system. *Experience* therefore clearly stands out as an essential moderating variable when it comes to the understanding of technology usage and acceptance overall. It is important to note that both, *subjective*

norm and *image* impact the *perceived usefulness* of a technology alongside with the dimensions of *result demonstrability* and of *job relevance*, i.e. the grade to which a certain technology influences the execution of a specific task in the working environment. For a successful technology usage it is therefore advisable to adequately develop and communicate the intended purpose of a technology to its users so that the application of the solution within the respective field of business is comprehensible. The acceptance model furthermore includes the dimension of *voluntariness*, which moderates the effects of *subjective norm* on the *behavioural intention* to use a specific technological system – understanding the level of obligation as an initiating force to engage with a technology has to be considered. These elements of TAM3 have been adopted from the preceding TAM2 (Venkatesh and Davis, 2000; Venkatesh and Bala, 2008).

As with the previous versions of TAM, researchers set out to apply the updated model to specific scenarios. Agudo-Peregrina, Hernández-García and Pascual-Miguel (2014) worked on the acceptance of e-learning systems and adopted TAM3 to their research programme in the education field. Results gathered were in support of the relationships proposed by TAM3 with the exception of the *intention to use* a system and the *actual usage behaviour*. In a different study, Brandon-Jones and Kauppi (2018) analysed technology acceptance in the area of e-procurement and found the model to be confirmed by the data they investigated. As to accommodate for e-procurement specifics, they included variables on both, support and system-level dimensions to allow for a better interpretation of their research data. Demoulin and Djelassi (2016) put SST usage in a grocery store to the test. They extended TAM3 with situational variables to accommodate for factors found to be relevant in previous studies, for example waiting time or basket size. Results showed that the situational environment plays a large role in describing the SST usage behaviour of customers. Additionally, perceived behaviour control in the form of customers having a sense of self-efficacy when using SSTs was a key factor in understanding SST adoption.

2.3.2 Service quality measurements

A further important aspect of understanding the success of SSTs lies within the dimension of *service quality*. This construct is a key component of the updated DeLone and McLean's IS Success Model and has direct effects on both, *user satisfaction* and on

the *intention to use* or *use* in general (DeLone and McLean, 2003). It is therefore required to take a closer look at how *service quality* is defined and what kind of impact it has on the success and acceptance of SSTs.

Users interact with SSTs to access the service offerings these devices provide. The quality of the service stands in close relation to the experienced satisfaction level of the user and also affects future usage behaviour. As to better account for the impact of *service quality* on the SST success, suitable variables and measurement approaches need to be considered to evaluate this specific dimension. The SERVQUAL procedure of measuring service quality can be regarded as one of the major foundations for service quality assessments (Parasuraman, Zeithaml and Berry, 1988). The procedure defines the application of a questionnaire that consists of 22 questions each per two different perspectives – service expectations of a customer and a customer's perception of the service offering. Across five service quality dimensions (tangibles, reliability, responsiveness, assurance, empathy) this multiple-item scale provides an indication for both, customer's service expectations and the actually perceived quality of the service delivery.

SERVQUAL has been refined based on researchers' findings on the usage of this measurement scale in the field. Parasuraman, Berry and Zeithaml (1991) published a revised SERVQUAL scale with six of the previously negatively worded items now being rephrased as positively worded items in the updated measurement scale, which in its whole still is made up of 22 items. This tweak appears to be rather minor, but achieves consistency with all of the items being expressed in a positive manner thus allowing for a more straight-forward utilisation by the researcher and the interviewee. Researchers have put SERVQUAL to test by aiming at validating the proposed item scale with the focus on information systems (Jiang, Klein and Carr, 2002) and process improvement topics (McCollin *et al.*, 2011). Pitt, Watson and Kavan (1995) carried out an analysis on the applicability of SERVQUAL across different organisations and countries and found strong support for the validity of the measurement scale. A research programme focused on long-running studies provided evidence in favour of the validity of SERVQUAL as well and also highlighted the necessity for a company-wide emphasis on delivering high-quality service over an extended period of time, as opposed to concentrating on short-term effects. This strategy would have customers consistently experience well-designed service offerings (Watson, Pitt and Kavan, 1998). Overall,

results show that SERVQUAL, despite its apparently dated nature, is still viable for successful applications in the field, such as in the area of omni-channel retailing (Zhang *et al.*, 2019).

Widening the view for service-related measurement scales, Lin and Hsieh (2011) created and validated an assessment scale specifically for SST, the SSTQUAL. SSTQUAL takes the perspective of a customer and aims at measuring the service quality of SSTs. The scale is composed of 20 items across seven dimensions – functionality, enjoyment, security/privacy, assurance, design, convenience and customisation. Multiple statements per dimension are defined and applied in a questionnaire format for interpretation by a user of an SST. With the help of the aforementioned dimensions, a broad set of items is employed to understand the experience a customer has with an SST device. These items clearly showcase decisive attributes of an SST, which influence the customer's perception of the experience with the technological solution and the related service offering and provision. As an example for an application in the professional practice, SSTQUAL has been found to explain the interaction of knowledge workers with SST devices (Considine and Cormican, 2016). Apart from that, Demirci Orel and Kara (2014) evaluated the service quality of self-checkout solutions in a supermarket environment with the help of the SSTQUAL thereby reducing the measurement scale from seven to five dimensions, which would accurately describe the situation under research.

The SSTQUAL model allows for an assessment of SST service quality from a customer-centric perspective by closely investigating customers' experiences with self-service offerings. The emphasis thereby is set on the seven dimensions of the questionnaire detailed above, which predominantly cover how customers go through a service delivery that is provided by an SST. With the core themes of this study revolving around SST success determinants, which are not based on customer-oriented factors, the model of SSTQUAL does not support the overall direction this research programme is following.

2.4 Literature synthesis

The literature synthesis provides an overview of the key themes elaborated on in the preceding literature review. This chapter focuses on two major aspects relevant for the research programme – SSTs and SST success itself. The most important findings from

the review of the available literature are summarised and put into an overall context related to this study. Alongside with that, gaps are identified and described in detail as to build a theoretical baseline for the methodology-related section of this research programme.

2.4.1 Self-service technologies

The number of SST installations in various markets across the globe has increased throughout the last decade. The banking industry is one of the most prominent examples of self-service-oriented solutions with ATMs being deployed at a multitude of locations. Initially planned as an addition to existing store networks to fulfil cash withdrawal-related functionalities, ATMs now provide a growing portfolio of service offerings to customers. This increase of versatility underscores the significance of self-service solutions, which can be requested by customers and provisioned by companies regardless of time and place. Businesses see the benefits of SSTs, which can serve as a completely new way of distribution in their omni-channel environment. At the same time, customers enjoy the oftentimes exciting and interactive form of engaging with a company and their products and services (Meuter *et al.*, 2000; Collier and Barnes, 2015). The literature review showed a number of definitions for an SST, which capture the essence of this form of technology – a technological interface that allows a user to request a service independently from any traditional interaction with an employee of the company providing the service (Meuter *et al.*, 2000, p. 50). The general tenor in the different definitions follows this idea and goes along with the nature of SSTs, which are in scope of this research programme – self-ordering kiosks and self-checkouts. When it comes to the classification approaches available in the academic literature, some shortcomings need to be highlighted and discussed.

The classification system by Meuter et al. (2000) and Bitner, Ostrom and Meuter (2002) provides a customer-focused perspective by looking at the purpose of the SST. The different types of technology referred to though naturally require an update to current industry standards. The introduction of the thought of service separability and the level of standardisation in the classification scheme by Cunningham, Young and Gerlach (2008) allow for interesting considerations as to how much entanglement exists between the user and the service provision itself. This system opens the door for the categorisation of SSTs based on the level of customisation available to the customer.

The aspect of separating the service delivery from the SST might be neglected nowadays, when service provisioning often is completely independent from the device it is requested on. Most of the services, which can be requested via a smartphone, are usually not delivered to the user via the smartphone itself (for example reservation systems or food ordering). The third classification system touched on in the literature review was developed by Rudolph, Schröder and Böttger (2012) and combines the level of standardisation and the purpose of the SST (as already available in the model by Meuter et al. (2000) and Bitner, Ostrom and Meuter (2002)) with the physical location of the SST. This enables researchers to classify SSTs based on a combination of customisability, functionality and position within the retail space.

This research programme closely focuses on the German retail food market of quick- and self-service restaurants and pays deliberate attention to the SST types of self-ordering kiosks and self-checkout systems. In this context a comparative view of these two forms of self-service devices appears to be appropriate as a means to properly understand the individual characteristics of each SST type. Table 2.3 therefore shows a juxtaposition of self-ordering kiosks and self-checkout systems available in the German retail food industry of quick- and self-service restaurants.

Table 2.3: Comparison of self-ordering kiosks and self-checkout systems

Type of SST / **Dimension**	**Self-ordering kiosk**	**Self-checkout**
Purpose	Issuing of food orders for consumption in the store	Paying for food items picked up in the store
Stage within the shopping journey	Beginning / Middle	End
Location within the store	Close to the food serving area	Close to the exit of the store
Level of customer interactivity	High	Medium
Level of automation	Low to medium	Medium to high

Assisted by peripherals	Scanners	Scanners, scales, cameras
Fraud protection	Low	High
Support by store personnel	Customers can trigger an attendant intervention to request help	
Payment options	Mostly card-based, cash possible	

Source: Author.

The main difference between a self-ordering kiosk and a self-checkout system within the food retail sector of self-service restaurants lies in their purposes. Self-ordering kiosk allow a customer to issue food orders autonomously from store personnel by interacting with the kiosk device. Users can select food menus and items from the available food tableau visible on the kiosk screen. Upon paying for the chosen products, a corresponding order is sent to the kitchen area of the retailer, which can be picked up by the customer once completed. Issuing food orders is usually done close to the food serving area of the store and takes place at the beginning or middle of a customer journey. When browsing through the food items presented on the kiosk screen, the level of customer interactivity is high as it is required to actively select the favoured food items and menu compositions. As a consequence, the possibilities of automating food ordering tasks are rather low and usually not supported by further technical tools, since this is an active process performed by the customer. If necessary, customers can call for help by using a support feature of the self-ordering kiosk that is oftentimes integrated into the kiosk screen. Using this feature alerts an assistant who is located alongside the self-ordering kiosks as to guide customers in case of questions or problems. Self-ordering kiosks mostly do not require a special protection against fraud attempts given the fact that the food itself is being prepared in the kitchen area and not directly accessible to the customer for possible theft. Payment is done via integrated card-based or cash-based options available at the kiosk itself.

Self-checkouts offer a different value proposition to customers, since they provide a way for customers to pay for their food items at a defined location close to the exit of the store thereby skipping the queue at the cashier-operated desks. These systems do not

focus on accepting food orders by customers, but rather allow users to check out from the store independently from regular cashiers. Customers can use a self-checkout system at the closing phase of their shopping trip to scan the items picked-up within the store and pay for them directly at the self-checkout device. Self-checkouts predominantly rely on card-based payment options to accelerate the checkout procedure, but cash-based payment is also possible. Depending on tools, such as scanners, scales or cameras supporting the operation of a self-checkout system, the level of automation and required customer interaction can differ. Many self-checkout devices have a customer actively scan and scale products to make sure all items within the basket are correctly registered while some self-checkouts also come along with integrated camera solutions capturing the collected items automatically. This can lead to improved efficiencies in the checkout process and also raises the level of security against fraud attempts. As with self-ordering kiosks, customers can also make use of a help feature to request support by a store assistant.

2.4.2 SST success and adoption

The literature review examined the existing literature on IS success in general and SST success specifically. SST success models identified predominantly are based on the DeLone and McLean's IS Success Model (DeLone and McLean, 2003). This model provides a parsimonious framework for an assessment of the success of an information system. Applying this model to practice requires the researcher to adapt the dimensions of the model to the concrete research situation under observation. The literature review outlined this approach and highlighted various use cases of model applications to specific SST scenarios in retail. These scenarios predominantly focused on the SST adoption by customers using the SST while considering additional variables influencing customers' behaviour such as waiting time or basket size (Demoulin and Djelassi, 2016).

The analysis of the literature demonstrated that SST success is primarily investigated from the perspective of customers engaging with the SST. This research approach is valid and understandable as it is customers in the end who are using SST solutions in the retail space. Therefore it is important for retailers to gain insights on the background of the adoption rate. The examination of the adoption rate is mainly based on the theoretical framework established by the Technology Acceptance Model and its

revisions (Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). As shown in the literature review, TAM puts factors such as *intention to use* and *user satisfaction* in the foreground of the evaluation of technology acceptance. Researchers have made use of TAM-related constructs, combined them with the DeLone and McLean's IS Success Model and modified them accordingly to be applicable to assessing customers' adoption of SSTs in retail. Only looking at this aspect though neglects further influencing factors on SST success apart from the customer-oriented perspective.

The DeLone and McLean's IS Success Model contains the success dimensions of *information quality* and *system quality*, which affect the usage of an SST. These two dimensions are rather technology-oriented as opposed to customer-focused, as they describe the characteristics of the SST itself. The literature review showed that these constructs are primarily regarded as tools to adjust the success evaluation framework to the specific use case under investigation, such as referring to the quality of the knowledge management system in an according study as opposed to referring to the quality of the generic information (Halawi, McCarthy and Aronson, 2007). *Information quality* and *system quality* as success dimensions do usually not receive core attention in the customer-centric studies. They are merely considered as supplementary sets of influencing variables.

The research programmes identified and elaborated on in the literature review focus on the perspective of the customer when assessing SST success. The goals in this context are to describe and understand the customer adoption rate in different retail scenarios. This stance is supposed to provide retail practitioners with results and recommendations on how to improve the customer acceptance of and experience with SST solutions. The underlying assumption by researchers here is that retailers are predominantly concerned with customer adoption when deciding to install SST devices in their distribution network. As such, studies focus on the aspect of customer adoption. To the knowledge of the researcher, there is no literature available as to which further requirements retailers have – next to customer acceptance – in the course of preparing and implementing SST strategies. This notion ties back to the oftentimes slightly disregarded success dimensions of *information quality* and *system quality* in the SST field. Retailers pursuing the sourcing and incorporation of SSTs into their retail

organisation are likely to have additional concerns, requirements and success aspirations in technology- or software-related domains.

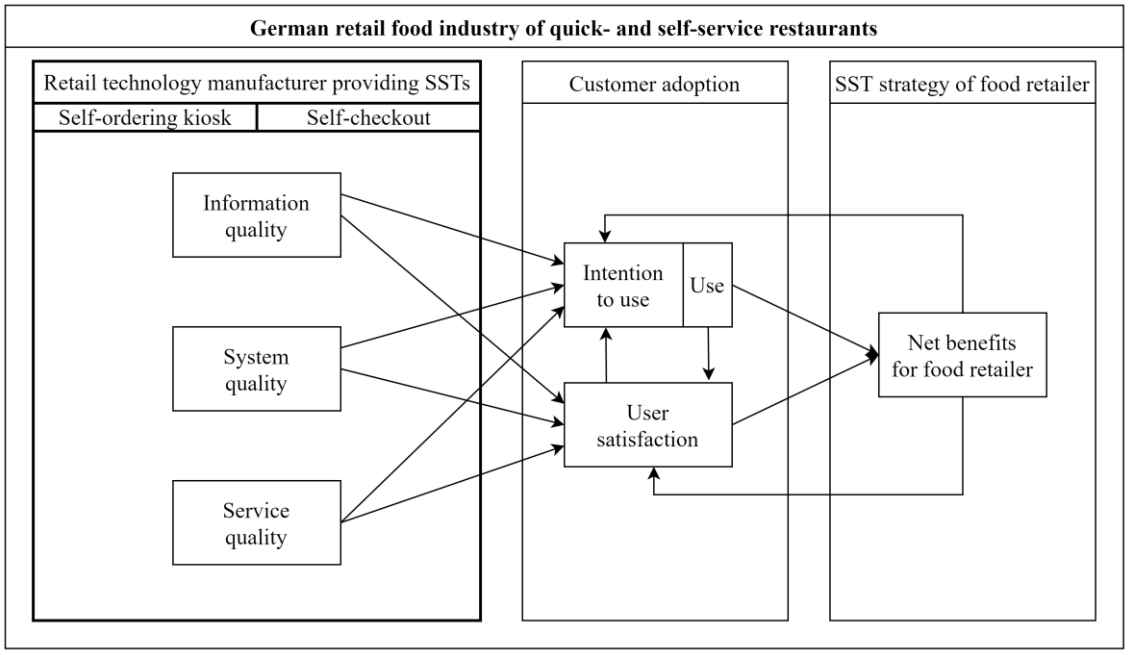
2.4.3 Conceptual framework

Summarising the above leads to the development of a conceptual framework that builds the foundation for the subsequent methodology section of the study. The conceptual framework encapsulates the core themes elaborated on throughout the literature review. As a key component, the framework consists of the types of self-service technologies present in the German retail food industry of quick- and self-service restaurants. These SSTs are of special interest for the research programme and therefore represent a vital section of the conceptual framework. Building on that section, this study investigates success determinants of SSTs in the German market of food retailers in the quick- and self-service restaurant branch. This is why the DeLone and McLean's IS Success Model serves as the second major building block of the conceptual framework relevant for the research programme (DeLone and McLean, 2003).

This study sets out to explore the SST success determinants from the perspective of a retail technology manufacturer that is providing SST solutions to food retailers in this specific industry. As outlined in the preceding chapters, retailers have to consider a variety of variables when it comes to the success assessment of SST solutions. Customer adoption is a key thought to bear in mind, but there are also further success dimensions to deliberately make room for in the course of introducing SST offerings to the food retail spaces of quick- and self-service restaurants. The conceptual framework accordingly reflects the taken perspective of this research programme, which is to identify and explore the SST success variables from the viewpoint of a retail technology manufacturer.

Figure 2.12 shows the conceptual framework as applied for this study. The individual components have been highlighted above and are further detailed in the course of this chapter.

Figure 2.12: Conceptual framework



Source: Author as adapted from DeLone and McLean's updated IS Success Model (DeLone and McLean, 2003).

The conceptual framework is based on DeLone and McLean's IS Success Model as a theorical foundation for the success dimensions of an information system (DeLone and McLean, 2003). On top of that, the framework has to consider the overall market relevant for this study – German retail food industry of quick- and self-service restaurants. The whole framework is encapsulated under this umbrella to illustrate the scope of this research programme and to put the success variables into the right context.

The three success dimensions defined by DeLone and McLean's IS Success Model – *information quality*, *system quality* and *service quality* – are subsumed under the perspective of the retail technology manufacturer that is providing self-ordering kiosks and self-checkouts to food retailers. These dimensions are relevant for both types of SST as they provide a set of success variables, which characterise the specific SST type. It is this section of the conceptual framework that is essential to the research programme. By adopting the viewpoint of a retail technology manufacturer the researcher aims at identifying success determinants associated with self-ordering kiosks and self-checkouts, which have an impact on the success of SSTs deployed in German quick- and self-service restaurants. The conceptual framework therefore clearly

highlights this approach and pays close attention to the success determinants related to self-ordering kiosks and self-checkouts as relevant for this research programme.

DeLone and McLean (2003) outlined the effects of variables from the dimensions of *information quality*, *system quality* and *service quality* on the customer adoption of information systems. This is reflected in the middle area of the conceptual framework that holds the success categories of *intention to use*, *use* and *user satisfaction*. These dimensions focus on how an information system is utilised and received by customers engaging with the system. The concrete success variables and interdependencies are closely connected with the Technology Acceptance Model 3 and its constructs (Venkatesh and Bala, 2008), which was elaborated on in the literature review. The main ideas in this field revolve around how and under which situations information systems lead to high adoption rates by users. It is important for retailers to deploy SSTs, which are well accepted by a large number of customers. This goes along with the strategy of food retailers to provide SST solutions to their customers in their quick- and self-service restaurants. The conceptual framework accounts for this goal by including the *net benefits* of DeLone and McLean's IS Success Model as the dimension with the concrete focus on food retailers.

3 Methodology

The following chapters describe the methodological approach adopted within this research programme. Starting with the research question and research aim and goals, the overall research strategy is outlined and followed up upon by the employed data collection and analysis techniques. The chapter concludes with an elaboration on the pilot study performed and on details related to ethical considerations and questions of data access.

3.1 Research question

This research programme concentrates on strategic success criteria of SSTs in quick- and self-service restaurants within German food retail. As outlined in the literature review and synthesis, existing academic interest has so far largely been circling around the customer acceptance of SSTs in various scenarios. For retailers providing SST devices to their customers, this perspective is critical, since it is important for retailers to understand the adoption rate and related influencing factors. Success of SSTs can certainly be evaluated by determining the customer acceptance rate of SSTs. Retailers implement SSTs in their self-service restaurants to incentivise customers to make use of these devices as a means to drive food sales. Therefore, a high adoption rate is of key interest for retailers.

Understanding the success of SSTs on a strategic level though can and should not be limited to the issue of customer acceptance only. This research project approaches the topic of SST success factors from a different angle as it concentrates on retailers' requirements when purchasing SSTs and including them in their food selling areas of quick- and self-service restaurants. Holding this viewpoint, the research programme focuses on trying to identify and understand the success criteria food retailers have in the pursuit of an SST strategy. As a way to embark on this idea, this study approaches a major retail technology manufacturer in the business of quick- and self-service restaurants to explore the strategic success factors food retailers have when implementing an SST initiative in their stores.

This research programme therefore raises the research question:

"From the perspective of a retail technology manufacturer, which strategic factors determine SST success in quick- and self-service restaurants of German food retail?"

This question is addressed to a retail technology manufacturer that cooperates with food retailers in the industry of quick- and self-service restaurants. The manufacturer provides SST solutions and advices to retailers in terms of SST design, implementation and maintenance.

As demonstrated in the literature review and synthesis, the key focus in the academic field of IS and SST studies has been with customer-oriented perspectives. Various papers focus on the adoption of SSTs by customers and provide insights on which variables affect the adoption rate to which degree. Accompanying thoughts describe the experience customers have when using SSTs. These research programmes illustrate the components of TAM-related constructs of *intention to use*/*use* and *user satisfaction* and their influence on actual customer behaviour in multiple retail- and non-retail-focused scenarios. Managerial implications and advices are highlighted and typically addressed towards retailers and companies adding SSTs to their omni-channel distribution networks.

The focus of this study is not with the widely covered customer adoption of SSTs. This research programme aims at identifying design characteristics and product features, which influence the success of an SST strategy in German food retail. The perspective in this study is centred around a retail technology manufacturer providing SST devices to retailers. This study thereby approaches the theme of SST success from a completely new angle that is currently not available in the IS and SST literature. SSTs certainly need to lead to a high customer adoption rate as they would otherwise render the overall use case of self-service pointless. Only considering the customer adoption rate though neglects the viewpoint this research programme is following – the perspective of a retail technology manufacturer. SSTs are produced to meet retailers' requirements and to provide a strategical business benefit to a retailer's organisation. Some of these requirements are formulated from a customer-facing perspective as to achieve a high adoption rate of SSTs. Next to customer-oriented concerns, retailers address key requirements to SST providers, which primarily deal with pure retailer-focused areas of interest as a means to support the implementation of their SST strategy. These requirements are naturally not congruent with all customer-facing demands and miss further attention in the literature. The following chapters elaborate on the research goals of this study and the research strategy in detail.

3.2 Research aim and research goals

The aim of this research programme is to explore strategic SST success factors in quick- and self-service restaurants of German food retail from the perspective of a retail technology manufacturer providing SSTs to food retailers. This aim clearly helps in establishing an answer to the research question discussed in the previous chapter. Within the setup of this research project, the formulated aim serves as a anker point for the subsequent definition of related research goals and techniques of data collection and analyses. The following provides further justification on the methodology of this research programme and illustrates how the planned methodology is in support of the overall research question raised within this study.

There are three main goals of this research project, which are highlighted below. The research goals are:

1. Identification and aggregation of strategic SST success determinants and themes in German food retail of quick- and self-service restaurants,
2. Development of an extension of DeLone and McLean's IS Success Model for strategic SST success in German food retail of quick- and self-service restaurants.

The first goal of this research project is to identify the success determinants of SSTs in German food retail. This study focuses on identifying which SST success factors exist in the self-service restaurant business of German food retail on a strategical level. The goal clearly is to generate an overview of the different success criteria, which are relevant in this specific field of retail industry. Building on the identified success determinants, the goal furthermore is to closely analyse the strategical themes as to aggregate the examined success factors based on overall characteristics discovered throughout the study. The analysed success determinants are grouped into overarching success dimensions, which consolidate multiple SST success factors into broader strategically-oriented themes. This exercise allows for a comprehensive consideration of the success factors and dimensions detected within the data collection and analysis phase.

Secondly, this research programme follows the goal of developing an extension of DeLone and McLean's IS Success Model (DeLone and McLean, 2003) specifically for

the self-service restaurant industry within German food retail. As a means to achieve this goal, the researcher consolidates the investigated SST success determinants into coherent dimensions, which can be integrated into the IS success model. These new success dimensions serve as an expansion of DeLone and McLean's model in a way that they account for strategical success factors relevant in the field of quick- and self-service restaurants in German food retail as explored from the perspective of a retail technology manufacturer providing SSTs to food retailers. Drawing upon the DeLone & McLean's IS Success Model as a baseline for a success framework on SSTs, this study elaborates on *information quality*, *system quality* and related success dimensions together with their corresponding variables. As an outcome of this study, the researcher develops a model about SST success as an extension of DeLone and McLean's IS Success Model for the concrete use case of SSTs in German food retail of quick- and self-service restaurants from a retail technology manufacturer's perspective.

This research programme seeks at exploring and defining success determinants as to provide a baseline for future testing and validation, which can be done by fellow researchers in similar and different scenarios related to SSTs. The extension of DeLone and McLean's IS Success Model, which is developed within this research programme, marks an entry point for future studies in this field. Given the character of this study as an initial endeavour in this widely uncovered branch of the academic literature, the results are expected to be indicative. The perspective of a retail technology manufacturer is unseen as well and puts a unique spin on the data insights generated. The development of an extension of a key IS success model with a specific focus on the strategic implementation of SSTs in German food retail of quick- and self-service restaurants promises to be of value for academics and for the professional business practice.

3.3 Research philosophy

There is a multitude of approaches available in the literature, when it comes to the definition of a specific research philosophy for a research programme. The research philosophy in general is about the researcher's belief systems, which are embedded within a specific research project. Saunders, Lewis and Thornhill (2019) describe research philosophy as being decisive for the development of research knowledge and the underlying understanding of knowledge itself. The research philosophy is an

essential factor in the way a research programme is designed and carried out, and also fundamentally influences the development of findings based on the collected data (Bell, Bryman and Harley, 2019). For every research project it is important to understand the philosophical stance of the researcher involved as to put the design, execution and evaluation of the research programme into the right perspective.

Alongside the term of research philosophy, a research paradigm affects the way a research programme is designed and put into action, since it holds the set of belief systems and general world views a researcher has (Guba and Lincoln, 1994). These systems describe how a researcher sees and approaches the world with regards to the definition and generation of knowledge. A research paradigm can be described as "a philosophical framework that guides how scientific research should be conducted" (Collis and Hussey, 2013, p. 43). This framework is especially relevant in the field of social sciences as it provides researchers with a guideline on how to view the environment and the people interacting with it (Langdridge, 2007).

Amongst the available research paradigms, positivism and phenomenology belong to the major research stances held by academics and adopted within the scientific literature. Positivism follows the epistemological theory of generating knowledge based on the observation of the world and then drawing conclusions from the findings detected. This approach can be characterised as structured and grounded on verifying hypotheses with the help of suitable data collection and analysis techniques. The results found are matched against the hypotheses as a means to verify the assumptions made by the researcher. Positivism sets out to explain measurable events and circumstances via empirical methods. The sample size in scope is mostly large and based on many data sets to allow for a validation of the hypotheses made via statistical standards (Bell, Bryman and Harley, 2019). Applying positivism as an empirical viewpoint in this context helps for the evaluation of observable and quantifiable data. Positivism struggles in the presence of complex systems with a multitude of dependencies and interferences between the variables involved, especially in the field of social sciences and business management. The interactions in socially complex systems are difficult to be captured by concrete hypotheses following measurable dimensions in a causal flow (Collis and Hussey, 2013).

The research paradigm of phenomenology provides an approach on how to design, capture and evaluate research programmes, which concentrate on a rather complex environment that is built upon socially-focused mechanisms (Bell, Bryman and Harley, 2019). In these systems the researcher tries to explore and interpret the variables and relationships between them without following an agenda of aiming to validate any kind of pre-formulated hypothesis on one or two specific linkages. The phenomenological viewpoint thereby marks an approach to research under the research philosophy of interpretivism (Cunliffe, 2011; Symon and Cassell, 2012). The idea is to gain a deep level of understanding of the complex situation under study by exploring and, to some part, interacting oneself with the research object or system (Collis and Hussey, 2013; Ritchie *et al.*, 2014). The researcher acknowledges the fact that a formal hypothesis test on causality cannot be accomplished holding a phenomenological perspective. The attempt for this research programme is rather to create a rich and comprehensive picture of a small study sample by interpreting and making sense of the data extracted while leaning to an overall more qualitatively-oriented approach with regards to data collection and analysis techniques (Benner, 1994). This interpretive research orientation is best suited when the research goal is to create an evaluation of a complex, possibly relatively untouched, research situation as a means to generate theories on how the factors and dimensions of the system operate and relate to each other (Bell, Bryman and Harley, 2019; Easterby-Smith *et al.*, 2021).

Next to positivism and phenomenology, there are further research paradigms, which can be characterised as residing in between these two widely-applied philosophical viewpoints by adopting certain parts of each of them. Critical realism holds a realist stance, when it comes to ontological questions and definitions. This means a critical realist acknowledges that there is in fact a world out there that independently exists without any observer making up its existence. In a critical relativist view, the world is captured through the lenses of the observer thereby creating an image of what is seen and experienced. Critical realists seek out to explore and understand the inherent structure of the world that causes events to be observed. By comprehending the systems involved in the generation of these observable events critical realists make sense of a research situation (Bhaskar, 1978; Collier, 1994). Investigating these events leads to the development of knowledge about the objects involved thereby establishing a context as

to how the objects function and interact with each other (Saunders, Lewis and Thornhill, 2019).

This approach widely contrasts with the research paradigm of social constructionism that follows the thought of the world being constructed by observers through the act of observing. Social constructionism in general follows a phenomenological viewpoint and posits that people form their own realities under the influence of social interactions (Saunders, Lewis and Thornhill, 2019). A social constructionist does not regard the world as existent without people constructing its existence through their own views and impacted by social events. This is a critical difference of social constructionism compared with critical realism. Further characterising the research paradigm of social constructionism, this philosophical view assumes the existence of elements of structures to be reliant on being experienced and constructed by people themselves. In a constructionist's world view, there is no reality aside from people constructing the reality by experience and interaction (Burr, 2015; Taylor, 2018). Without people observing and thereby building those elements or structures via social events and interactions, these objects would not exist (Berger and Luckmann, 1967; Hibberd, 2006).

Based on a careful consideration of the research philosophies available, a phenomenologically-oriented viewpoint allows the researcher to explore the research question in an interpretive manner and to evaluate the data gathered while aiming to understand the actual meaning behind the findings. Employing qualitatively-oriented techniques concerning data collection and analysis as ways to investigate and comprehend complex environments works well with an interpretive approach, which further outlines the reasoning as to why this research philosophy has been adopted. The following chapter elaborates on the research strategy outlined for this research project.

3.4 Research strategy

This research programme follows an exploratory-based approach focusing on a single-case study. As a research paradigm the phenomenological viewpoint is adopted. Since the goal of this study is to generate a rich picture of a unique situation, a research strategy concentrating on explorative manners as a means to identify, interpret and correlate the specifics of the single-case study appears to be more suitable than a positivist stance. The goal of this research programme is not to verify hypothesis-based

theories via large-scale data collection and analysis techniques, which resemble an approach associated with the positivist research paradigm (Saunders, Lewis and Thornhill, 2019). A positivist approach would have been more suitable, if the research goal had been to assess the effectiveness of an already existing model for this very specific research topic by observing the relationships as described by the model. Instead, the key objective of this study is rather to create a comprehensive explanation based on the exploratively gathered data from a single-case study as a way to develop a possible extension of a theoretical model. The case study in question requires a deep investigation to identify and interpret the intricacies of the systems and mechanisms involved. This is especially relevant as the research takes place in a complex environment including a variety of unexplored influencing dimensions, which need to be closely observed. With the adoption of a phenomenological perspective the development of a better understanding of the research situation is possible while allowing for insights and theories to emerge based on the performed exploration (Gill, 2014).

Generally, a research design describes a set of techniques employed by the researcher to collect and analyse data (Bell, Bryman and Harley, 2019). There are multiple designs available in the literature, which range from conducting surveys and experiments to approaches such as grounded theory or action research (Collis and Hussey, 2013; Saunders, Lewis and Thornhill, 2019). The method of conducting a survey is suited towards the quantitatively-based collection and evaluation of data (Saunders, Lewis and Thornhill, 2019). Surveys yield promising results, when the goal is to investigate data gathered from large-scale populations (Vogt, Gardner and Haeffele, 2012). Looking at the relatively unexplored nature of the research situation of this project, a qualitatively-focused approach appears to be more promising with regards to the gathering of data and execution of subsequent analyses.

Within the research strategy focusing on experiments the concept behind this method is to evaluate the relationship between two or more variables under relatively controlled conditions. This is required as to make sure the effects observed can be attributed to the variables under analysis. Causal links are examined in order to understand how changing independent variables influences the dependent variables (Hakim, 2000; Saunders, Lewis and Thornhill, 2019). Following this research strategy does not seem to

be of value for this research programme as there is no controlled environment in place in which specific effects in variable changes could be observed.

Action research is defined as a research method that is focused on investigating and understanding actions in a social context with the intention of trying to solve a specific problem (Lewin, 1946). The researcher closely collaborates with the research participants on identifying and describing a certain issue or research question. The goal is to develop a plan of action that is to be evaluated after a phase of implementation. With the analysed results available, the process starts again for a further iteration of the just described steps (McNiff, 2013; Saunders, Lewis and Thornhill, 2019). This research method does not fit to the research programme at hand, because it does not call for a closely arranged mode of working with research participants to approach a problem and develop a solution for it in an iterative setup.

Ethnography requires the researcher to become a member of the social field of the study thereby taking an active part in working with the research participants and closely engaging in the social contexts of the research field. The goal oftentimes is to comprehend social behaviour and feelings involved with the research topic. The researcher works together with the participants to understand their motivations and belief systems behind them. Ethnography is commonly being applied as a research strategy for studies related to the analysis of the behaviour of individuals or organisations with the intention of understanding the underlying motivations (Hammersley and Atkinson, 2019; Saunders, Lewis and Thornhill, 2019). This research project does not lay its focus on socially-influenced behavioural patterns or motivations, which would require the researcher to closely interact with the research participants in the field. Therefore, ethnography has not been regarded as a viable research strategy for this study.

The research design of this study is centred around the development and execution of a single-case cross-sectional study. The goal of this research programme can best be accomplished via the means of a case study with a single organisation (Stake, 2000). There is a unique opportunity for the researcher to design a case study based on a retail technology manufacturer, which is something that is unseen in the current literature. This cross-sectional case study provides the possibility for the extraction of valuable data and for the generation of a rich picture of the research situation (Eisenhardt, 1989).

A cross-sectional approach is favoured by the researcher over a longitudinal one as the research goal is to identify and assess SST success determinants and put them into relation in the light of German food retail from the perspective of a retail technology manufacturer. The focus is on the horizontal exploration in this field and not on understanding timely developments. The research design of a single-case study enables the researcher to deep dive into the situation under observation and to develop qualitative insights into the research question (Zainal, 2007; Yin, 2018).

3.4.1 Retail technology manufacturer

The design of the single-case study within this research programme concentrates on a detailed investigation of a German retail technology manufacturer. The organisation under research is a major player in the markets of retail and banking technology and services operating globally and within Germany. The concrete name of the retail technology manufacturer cannot be disclosed as anonymity of the business has been agreed upon for participation in the study. With about 20 000 to 30 000 employees present in a multitude of countries, the retail technology manufacturer provides technology and services such as automation and transformation to retailers, financial institutions and other industries.

The retail technology manufacturer is a key partner for retailers and has repeatedly been recognised as one of the largest providers of retail software sales in Europe (Statista-Research, 2015). With an average revenue of more than US $ 1 billion in retail for the last fiscal years, the company has delivered more than one million installations of electronic point of sale systems worldwide. The business under research is positioned as one of the leading providers of electronic point of sale systems, self-ordering kiosks and self-checkout systems in Europe and worldwide (Best, 2020a). The research programme is conducted as a case study of this retail technology manufacturer with a concrete focus on the German retail food industry of quick- and self-service restaurants. With the research organisation being one of the leading providers in the retail industry, a single-case study on the same offers to show a promising perspective on the success determinants of SSTs in this specific branch of German food retail.

3.5 Research method – semi-structured interview

The case study follows a qualitative research design regarding the collection and analysis of data. Since the goal of this study is to exploratively create a rich picture of

the research situation, techniques of predominantly qualitative character are better suited for this research programme (Bell, Bryman and Harley, 2019; Saunders, Lewis and Thornhill, 2019). Qualitatively-oriented methods allow for the analysis of complex systems and enable the researcher to gain a comprehensive understanding of the information gathered (Denzin and Lincoln, 2011).

Given the case study design of this research project, there are several methods available for the collection and analysis of data, such as conversation, semi-structured interview or observation based on focus group techniques (Miles, Huberman and Saldaña, 2019). This research programme concentrates on the technique of semi-structured interviews to elicit answers from participants in the organisation under research in a single-case study design. The format of a semi-structured interview promises to be appropriate for the study, since the qualitative nature of this data collection technique allows for thoughts of the interviewee to develop and emerge throughout the execution of the interview. This opens up possibilities for previously unthought of ideas to come to light and to elaborate on in the course of the interview (Creswell and Creswell, 2018; Yin, 2018). The focus is on the generation of rich and complex considerations expressed by the interviewee. While the formulation of this kind of responses is extremely valuable for this study, a certain level of standardised format is included in the interview design as a way to compare the results amongst participants. This approach provides the advantages of having both, an unguided section within the interview that enables the interviewee to articulate individual views and a structured part for a relatively systematic analysis of common thoughts across the interviews. Having the participant respond to openly formulated questions allows for insights into personal judgments on the research question, which can be elaborated on by the researcher during the analysis phase (Schultze and Avital, 2011).

Applying methods of research conversations with participants or concentrating on focus group techniques were both considered to be of less value for the research programme than the conduction of semi-structured interviews. Research conversations follow a rather free-formed nature when it comes to the elicitation of responses from participants. This is beneficial, if the researcher establishes a first contact with the research topic and sets out to generate initial findings (Snowden, 2000). With the focus of this study being specifically revolving around strategic SST success determinants in a dedicated field of retail industry, it seemed appropriate to reflect this orientation in a

more structured research method. Apart from the method of research conversations, working with focus groups was disregarded as a suitable form of data collection due to practical limitations in the organisational arrangements of engaging with multiple senior staff members at the same time (Carey, 1994). Plus, providing enough space for every key expert within the focus group panel to adequately express thoughts and ideas related to the research topic deemed to be rather unrealistic (Krueger and Casey, 2015). The development of insights into a distinct domain of knowledge could be better supported by interviewing key experts in the field in a controlled environment, which would create a possibility for the researcher to interact with the interviewee thereby drawing on the participant's knowledge via questioning techniques (Mack, 2005).

3.5.1 Sampling approach

The selection of candidates for the semi-structured interviews is based on a purposive sampling approach. Considering the emphasis on a strategic analysis as expressed within the goals of the research programme, it is required to extract senior expert knowledge from key stakeholders within the company who possess professional practice in their respective fields. The sampling logic therefore can be characterised as non-probabilistic (Palinkas *et al.*, 2015; Bell, Bryman and Harley, 2019). Interviewees are selected based on their functional role and area of responsibility within the organisation. Given the strategic scope of this research project, saturation is expected to be reached upon conclusion of the planned interview sessions with senior experts. The number of participants is grounded on the sampling approach described above as to elicit profound knowledge from interviewees who are working on a strategic level with food retailers in this specific field of the industry. The aim of this study is to generate a comprehensive picture of the strategic SST success determinants in German food retail of quick- and self-service restaurants from the perspective of a retail technology manufacturer. Obtaining responses from major stakeholders in this organisation covering different functional domains is of utmost importance for the research programme (Yin, 2018).

Since the researcher is provided with support in accessing key personnel within the organisation for the sake of the research programme, interview partners are selected looking at their functional responsibilities. Recommended sample sizes in this context range from one to about four dozen interviewees (Ritchie *et al.*, 2014). They also

require a careful consideration of participants' availability and overall restrictions regarding resource and time allocated to the research project (Patton, 2015). Targeting a sample size of about twelve respondents seems to be reasonable and manageable within the research scope thus providing a large baseline for the data collection. This also goes in line with the strategic scope of the research project as outlined above, since it is required to account for the fact that the number of experts available in this specific field is very limited. Including further, less knowledgeable participants in the data collection phase could lead to results of reduced value for the research programme. The list of participants covers interviewees from senior and top management roles across multiple functional segments within the company. These interviewees serve as partners for the researcher for in-depth interviews about SST success determinants in the field of self-service restaurants in German food retail.

3.5.2 Data collection

The data collection phase is centred around the design of an interview guideline that is used for the preparation and conduction of the in-depth interviews. The interviewer poses open questions to the interview partner, which leaves space for the interviewee to formulate own ideas as the conversation progresses (Ryan, Coughlan and Cronin, 2009). This interviewing technique is important as to allow for interesting responses to develop without narrowing down the possible avenue of answers for the interviewee. The core idea behind this approach is to enable the interviewee to openly share thoughts on SST success determinants and convey true meaning behind what is being said (Yin, 2018).

A further section of the interview guideline holds concretely formulated questions and statements regarding SST-success-related variables and dimensions. This set of items is necessary to establish a certain level of comparability between the results of the interview sessions (David and Sutton, 2004; Yin, 2018). The questions in this category show a more closed nature and are based on constructs identified throughout the literature review. The variables touched upon in this regard originate from the dimensions formulated in DeLone and McLean's IS Success Model, such as *information quality*, *system quality* or *service quality* (DeLone and McLean, 2003). It is possible to perform follow-up interviews in case a further specification or assessment of expressed ideas is required. Interview sessions are recorded by audio-tape to improve

the level of data capturing possible throughout the course of the conversation. Moreover, this recording technique enables the researcher to fully concentrate on the interviewee and on what is being said. Having the interview recorded on audio also facilitates the execution of the subsequent data analysis phase and is less prone to errors caused by misleading field notes (Curry, Nembhard and Bradley, 2009). Field notes taken by the researcher only serve as additional pieces of information outlining the functional area of responsibility of the interviewee. The main focus of the data collection and analysis clearly lies on the transcripts of the actual interview sessions themselves. The interviews are conducted in one round per participant stretched over the course of five to six months as to properly account for the availability of the interviewees and planning of the appointments.

Interviewees are explicitly asked to provide written consent to allow for the interview session to be recorded on audio while maintaining anonymity of the interviewee. Further details about this are outlined in chapter “3.9 Ethics” and available under “8 Appendix A: form of consent”.

3.5.3 Data analysis

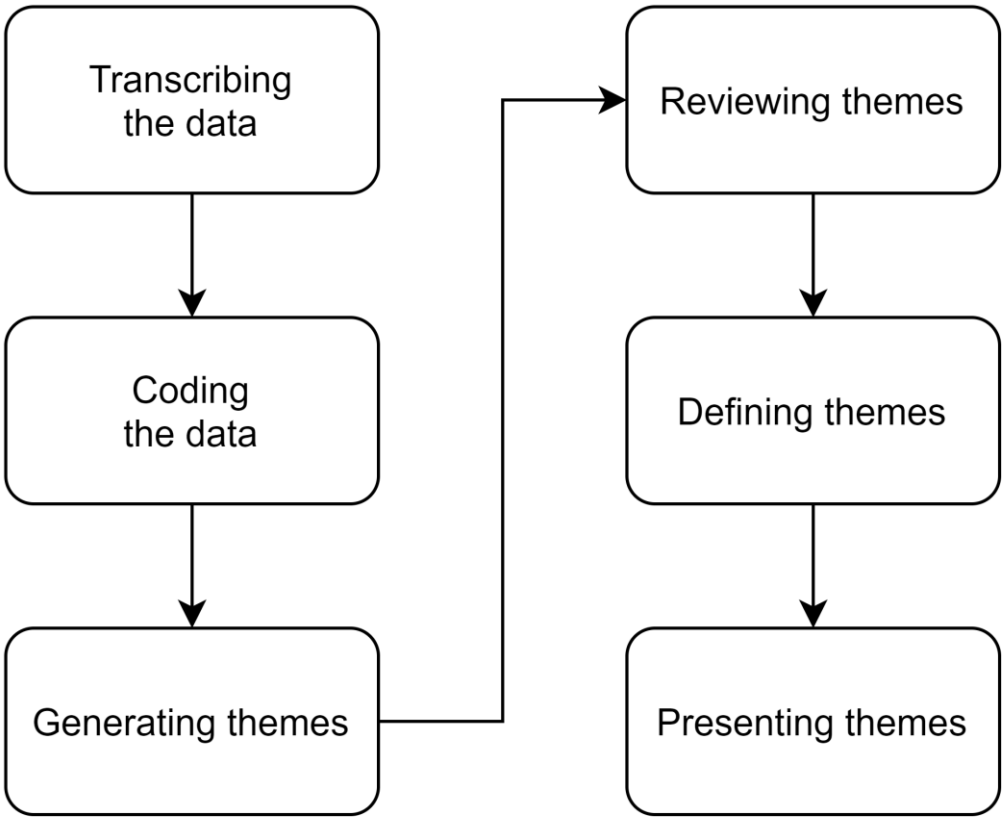
The data analysis techniques are mainly built on qualitatively-oriented approaches. This goes along with the overall research goal of making sense of a research situation and to create a rich understanding of the identified variables and relationships involved. The data gathered via the semi-structured interviews is processed via thematic analysis (Coffey and Atkinson, 1996; Braun and Clarke, 2006; Bell, Bryman and Harley, 2019). Considering the volume of the data collected within the interviews, analysis of the responses is to be done for each participant to comprehend the thoughts expressed.

For this study, the researcher adopts the following procedure of exercising the thematic analysis, which is based on the approach outlined by Braun and Clarke (2006). To begin with, the researcher transcribes the data collected within the interviews and sets out to carefully read the material as to digest and comprehend the participants’ responses. In a second step, the responses are assigned to suitable codes as a way to capture the quintessence of what is being expressed. Building on the developed codes, the researcher is then able to generate common themes and to inspect them for a clear representation of the data analysed. This approach allows for individual responses to be prominently identified while creating and maintaining a general framework of codes

and themes across the collected data. There is a balancing act at this stage between keeping key singular ideas identifiable and presenting widely applicable thoughts of consensus, which are emerging from the responses. It is largely accepted in the field of qualitative research that a judgment call by the researcher is based on subjective impressions in this regard (Patton, 2015). This procedure of performing a thematic analysis is concluded by the definition of concrete themes as developed by the researcher. These themes serve as a baseline for a close investigation and review of critical ideas encountered throughout the thematic analysis and they also form the underlying foundation for a comprehensive picture to develop (Connelly and Peltzer, 2016; Howitt, 2019).

Figure 3.1 illustrates the data analysis process applied for this research. The process is based on the thematic analysis flow of qualitative data analysis as described by Braun and Clarke (2006).

Figure 3.1: Thematic analysis



Source: Figure by author as based on Braun and Clarke (2006).

As outlined, the data analysis process begins with the transcription of the data received. After a phase of familiarisation with the data, subsequent steps concentrate on coding the responses and on generating adequate overarching themes related to them. The generation of these themes is based on a total amount of more than 200 individual codes, which are used for the data. When developing and reviewing the themes, the researcher works closely with the literature as a means to capture a fitting description and to make sure the themes are closely assessed with regards to their overall meaning in a wider context. Continuing further, the next phase marks the definition of themes together with their essential ideas and key concepts they entail. During this phase of the analysis the researcher refines the themes under observation in a way that every single theme represents a core concept as analysed in the collected data. The results of these analysis steps represent the major themes, which are subject to close investigation and further discussion. The model of thematic analysis as developed by Braun and Clarke (2006) consists of a final step in this regard that serves as place to critically analyse and present the findings, which are gathered during the exploration of the themes. Overall, the application of thematic analysis for the scope of this study goes in line with the qualitatively-oriented approach of the research programme and is in support of achieving the research goals defined.

The actual coding itself is mostly done manually with the incorporation of Microsoft Excel and NVivo, which serve as tools to properly keep track of the responses given and of how codes and themes are maintained.

3.6 Complementary data

In addition to the data collection via semi-structured interviews, company documents from the organisation are consulted to obtain supplementary information. This step serves as a way to improve the validity of this study by including further data sources and collections to the research programme. The researcher considers additional documents to cross-check the interview results with and to provide further information on the research question under investigation. These documents for example cover annual business reports, financial information addressed at investors, or product sheets about retail technologies. This collection of secondary data enables the researcher to add complementary insights to the data analysis.

When it comes to the handling of sensitive data available in company records, the researcher draws from the pool of documents, which are approved for external communication. This ensures that information is allowed to be shared. In case of emerging data, that is to be considered as confidential, the affected pieces are made illegible. This approach helps in establishing a solid data foundation for the study and allows for the research question to be viewed from different data source perspectives (Curry, Nembhard and Bradley, 2009).

3.7 Validity, reliability and generalisability

Internal validity addresses the trustworthiness of a study by considering to which degree the analysis of cause and effect has been thoroughly executed and demonstrated. This study achieves internal validity by grounding the methodology on an established conceptual framework that has been critically elaborated upon within the literature review. This framework guides the researcher as to how the variables under observation connect with and influence each other (Gibbert, Ruigrok and Wicki, 2008; Denzin and Lincoln, 2011). Moreover, the techniques used for the explanation building of the data gathered are related to themes and patterns found and discussed in the existing literature. This approach therefore contributes to the internal validity of the study (Eisenhardt, 1989; Yin, 2018).

The concept of construct validity covers the extent to which a research programme actually examines the themes it has been set up to investigate. Construct validity is established, when a study accomplishes to generate answers to the initially posed research questions while keeping integrity in the drawing of conclusions from the phase of data collection throughout the analysis of the data (Gibbert, Ruigrok and Wicki, 2008; Bell, Bryman and Harley, 2019). This study provides a valid baseline through its congruent definitions of research methodology, strategy and data collection and analysis techniques. These components build a cohesive picture of what the research project is built on with regards to an overarching philosophical approach and definition of research goals, which allows for an adequate reflection on the themes explored.

Reliability of a study is given when the results can be replicated by a different researcher. A complete level of reliability is difficult to achieve in business-related research because of the qualitative nature of studies in the social sciences and business field (Krippendorff, 2013; Bell, Bryman and Harley, 2019). This research programme

aims to achieve reliability of the generated results via consistency of the applied data collection and analysis techniques. The design of the semi-structured interviews comes with a high notion of rigour in the sense that the underlying construct of gathering, organising and evaluating the data is systematically approached (Curry, Nembhard and Bradley, 2009). The developed semi-structured interview guideline is a structured research instrument as it is based on theoretical frameworks available in the literature and elaborated on in the course of this study. Grounding data collection and analysis techniques on existing frameworks creates reliability of the research project (Brinkmann and Kvale, 2015). The researcher has access to the organisation under research, which might lead to researcher bias as the project is carried out. Bias in this area is prevented by posing open-ended questions to interviewees and leaving room for ideas to emerge independently from any possible interference of the researcher. Anonymity of the interview partners is kept as well to make sure there is no possibility of tracing answers back to individuals. This data collection approach is made transparent to the participants from the start to avoid confusion in this field.

The expression of generalisability is often associated with probabilistic generalisation in the research philosophy of positivism. When analyses are applied to a large volume of data, researchers aim to achieve external validity via statistical means based on certain confidence levels (Harre, 1981). The goal of this research though is not to establish a rule set that can be made use of for many scenarios, but rather to identify variables and dimensions, which might be out there ready to be explored (Bell, Bryman and Harley, 2019). This approach goes along with the research method of a single-case study, which can be interpreted as a way to form a theory and to build up a comprehensive picture. Given the major role the organisation plays in the SST retail market, deductions from this case study can be drawn and applied to similar situations and comparable cases to some extent (Gibbert, Ruigrok and Wicki, 2008; Yin, 2018). Moreover, the explorative nature of the single-case study method is built on a critically acclaimed and applied success model, which further increases external validity.

3.8 Pilot study

In addition to the above explained actions, this research programme relies on the preparation and execution of a pilot study to evaluate the design of the interview guideline with regards to validity and applicability to the research situation. A pilot

study in general should serve as a small test run of the research methodology planned for the actual main study. For a case study approach it is recommended to verify the selected data collection and analysis techniques with the help of a reduced sample size within a dedicated pilot (Yin, 2018; Saunders, Lewis and Thornhill, 2019).

The pilot study was conducted with the following goals in mind. Firstly, the pilot study was planned to verify the interview guideline developed for the semi-structured interviews. This check was required to find out how questions were received and interpreted by the participants and to gain insights on which possible constructs and responses could be elicited from the interviews. These findings are of key importance for successful data collection and analysis approaches within the overall methodological approach set for this research programme. With the results of the pilot study the researcher was able to fine-tune the interview questions by adding previously unconsidered thoughts and by rephrasing imprecisely worded sections. Results in this regard were incorporated into the final design of the interview guideline. Additionally, the planned data analysis techniques were employed and tested for applicability.

As a second goal, the scope of the pilot study covered performing a trial run of the operational procedures as planned for the main part of the research programme. This involved reaching out to participants for the semi-structured interviews and putting the organisational arrangements and processes to the proof of making sure data can be collected in an undisturbed and effective manner. The technical preparations concerning the communication way (telephone, video conference or face-to-face) and audio recording setup were tested as well. Details about the results of the pilot study are covered in chapter “4.1 Pilot study“.

The pilot study relied on a small sample size of interviewees as to account for the intended scope of the test run while considering time and resources available (Patton, 2015). The goals of the trial run could be accomplished by conducting two interviews with purposely selected participants from the organisation under research. The participants are senior experts in the field relevant for this research programme and therefore serve as appropriate candidates for the pilot study. The interviewees were approached by the researcher upfront and informed about the research programme and related research goals. In the course of the preparation of the interview session, the candidates were made aware of the anonymous nature of the data collection, and they

were informed about the written consent that is required for the participation in the research project. Questions related to this statement were handled before any interview session took place. Both, interviewees and researcher signed the form of consent during the preparation phase.

The organisational arrangements for the actual conduction of the interview involved setting an appointment with the interviewee based on the availability of both parties. The preferred choice of communication was decided upon and had to account for possible travel restrictions caused by the pandemic when meeting face-to-face. Video conferencing proved to be a suitable communication tool and helped establish a relationship between the participants and the researcher. The recording technique used captured the audio, which eased the transcription process in the aftermath of the interview session. This also reduced the risk of note-taking-related errors caused by the researcher and made sure exact responses by the interviewees were registered. Prior to the interview, each participant received an introductory two-page document created by the researcher that would allow the interviewee to learn about the research programme, the connected research goals and the context in which the research takes place. This document also serves as a form of consent informing the interviewee about the anonymity- and confidentiality-related arrangements of participating in the research project. These pieces of information were presented to the interviewee before the conduction of the interview as to lay the baseline for what the research project is about and to obtain consent from the research participant. This approach also helped establish a rapport between the participant and the researcher and facilitated the opening phase of the interview for the interviewee. The used document can be found in “8 Appendix A: form of consent”.

The researcher performed the interview by drawing on the interview guideline prepared upfront while also allowing the conversation to dynamically advance depending on the responses given. Staying close to the guideline though was of high importance to avoid departing too much from the general plan laid out beforehand. After the interview sessions were concluded, the researcher created the transcriptions based on the audio recordings as explained above. The transcriptions served as the groundwork for the data analysis, which is centred around thematic analysis and content coding techniques. The researcher made use of Microsoft Excel and NVivo to systematically identify and

document the results gathered from the analysis. Working with a structured spreadsheet also eased readability and subsequent categorisation of the findings.

3.9 Ethics

This study adheres to the ethical standards as issued and followed by the Edinburgh Business School, Heriot-Watt University. Every stakeholder, such as interview partner, is clearly advised in a transparent way about the research programme and goals related to it. Maintaining integrity of the data collection and data analysis techniques are ensured by the researcher. It is of highest importance to demonstrate professionalism with the research activities and to show trustworthiness and honesty with the data collection and evaluation throughout the complete course of the study.

The anonymity of the interviewees is ensured. The research programme is primarily concerned with the functional role and responsibility of the interviewee within the organisation and not with the actual individual. There is furthermore no plan of establishing a traceability of answers across the interviews up to single responses given by named individuals. As explained above, the functional role of the interviewee is of interest for the researcher and is used as a baseline for the data collection and analysis. The positions held by the participants are documented in a form that does not allow for any personal identification of the interviewees. This overall approach is clearly communicated to the interviewees upfront and it is required for each respondent to provide a written consent of participating in the research programme. This consent also includes a request for permission to record the interview session via audio-tape technique as to make sure data is correctly captured within the interview and can be feasibly analysed afterwards.

3.10 Data access and resources

This research programme focuses on a single-case study approach. The researcher received a written statement of support by the organisation under study that provides the researcher with access to interviewees from the company. A corresponding letter of support is available. When required, secondary data can be utilised as company documents approved for external communication to provide additional background information. Any data set being classified as confidential is to be made indecipherable or masked. The researcher confirms that the research programme is solely executed by himself without the inclusion of additional research personnel.

4 Analysis

The following chapters outline the results of this research programme with regards to the pilot study and the main study. To begin with, the findings of the pilot study are illustrated and it is explained how they affect the setup of the main study. This chapter concludes with an elaboration on the analyses performed within the main study phase.

4.1 Pilot study

The below explains how the pilot study was executed. After an examination of the data collection techniques and a subsequent analysis of the results gathered, this chapter reflects on the goals of the pilot study and provides a synthesis of the test run overall.

4.1.1 Participants

The pilot study was conducted with two participants who were purposely selected. Both participants hold critical roles within the organisation in product- and service-related functions surrounding the management of SSTs for food retailers in Germany. The participants are referred to as PS1 (pilot study participant 1) and PS2 (pilot study participant 2) from now on.

Table 4.1 provides an overview of the participants of the pilot study.

Table 4.1: Pilot study participants

Participant	**Position**	**Region**
PS1	Product Manager Self-Service Technology	Germany
PS2	Service Delivery Manager	Germany

Source: Table by author.

These two participants were selected to allow for the inclusion of different perspectives in the pilot run of the study. Interviewing experts from two functional domains was expected to provide a wider range of feedback instead of concentrating on one knowledge area only. Verifying the interview guideline from a product-oriented and service-oriented angle would facilitate the generation of varied responses.

4.1.2 Data collection

The researcher established contact with the two pilot study participants while also providing them with the introductory package prepared upfront. This package consists of a brief summary of the research programme including the corresponding research scope and goals. The document outlines the data confidentiality arrangements and contains a section for the interviewee to acknowledge the information received. The researcher offered the pilot study participants the chance to address further questions related to the research project itself or to the operational procedures involved. The information provided at this stage removed the need for further clarifications later on. Both interviewees provided their written consent on participating in the study. The introductory package including the form of consent is available under "8 Appendix A: form of consent".

The interviews themselves were scheduled based on the availability of PS1 and PS2. Both interview sessions were conducted in English. The researcher took notes during the interviews to capture thoughts related to the pilot run. The interviews lasted for about one and a half hours – the interview with PS1 covered roughly 100 minutes, and the session with PS2 concluded after about 80 minutes. The average interview duration of one and a half hours was mainly due to the structure of the interview guideline. While the questions were understood by the participants and did not require additional explanations by the researcher throughout the interview, the number of questions prepared turned out to be too high. The interview guideline was constructed of 25 questions with each of them expected to be handled in two to three minutes, which would result in a planned interview length of one hour. This initial schedule turned out to be flawed, since much more time was needed for the interviewees to properly elaborate on the questions raised. In the course of the pilot interviews the researcher decided to proceed with the session as to get an overall impression on the complete set of items present in the interview guideline. This approach was agreed upon with both interviewees once the mark of one hour was reached.

Considering this finding of the pilot study, the researcher had to shorten the interview guideline as to allow for a better handling of the questions within the interviews. Reducing the amount of questions would also lead to a more open discussion leaving room for the participant to express thoughts without having the pressure of covering all

questions in the available time. This change to the data collection technique could also lead to a better conversation flow in general, when the focus is on a manageable number of questions. After the interview session with PS1, the participant mentioned the impression of having dealt with similarly worded questions throughout the interview, which in essence were actually addressing the same topic. This left the interviewee wondering as to what the differentiation between the questions was. The researcher reviewed the interview guideline in the aftermath of the session and identified some occurrences of this issue. The original intention of the similarly phrased questions was to elicit responses related to success factors in general and then detailing them for the specific branch of retail this study focuses on. Given the concrete scope of the research programme on quick- and self-service restaurants in German food retail and the length of the interview guideline, it appeared appropriate to remove questions addressing too general themes. This would reduce the quantity of the interview items and at the same time help set the focus on the retail food industry in Germany.

Overall, the interview guideline was received very positively by the pilot study participants who understood the questions raised and were able to share their expertise on the topics addressed. None of the participants refused to reply to any interview questions. The execution of the pilot study also demonstrated that the participants felt more comfortable expressing their thoughts when the planned focus of the questions was laid on specific types of SSTs – self-ordering kiosks and self-checkouts. Especially PS1 appreciated the emphasis set here by the researcher, since there is a multitude of SST variations available PS1 is dealing with as a product manager. Concentrating on defined forms of SSTs enabled PS1 to better reflect on success factors in this specific area. This is also in support of the overall research programme, which specifically deals with self-ordering kiosks and self-checkouts in this branch of the retail food industry. PS2 was closely considering personal experiences with customers operating in the retail food market that is under investigation within the research project. With PS2 working in service delivery management, responses were given by elaborating on the requirements and specialities of food retailers in Germany. Including PS2 in the pilot study was beneficial as this allowed the researcher to affirm the field of attention of the study, which is centred around the application of self-ordering kiosks and self-checkouts in the German retail food industry of quick- and self-service restaurants.

4.1.3 Data analysis

As preparation for the data analysis phase of the pilot study the researcher created transcriptions of the audio recorded interview sessions with PS1 and PS2. The transcriptions served as the base for the planned content and thematic analysis. Microsoft Excel was made use of for a structured representation of the questions and corresponding answers. In addition to the documentation via a spreadsheet, working with NVivo turned out to be advantageous and allowed the researcher to execute the coding involved in qualitative analysis techniques in a transparent way and to comprehensively keep track of the evolving thematic categories. The responses given by the interviewees were investigated for the initial development of a set of codes. This approach led to the generation of codes as explored based on the gathered data without adhering to a pre-defined list of possible codes or categories. The below summarises essential responses collected and analysed within the pilot study.

Some key success factors of SST solutions emerged during the analysis of the pilot study data. PS1 for example referred to the following requirement self-service solutions need to meet:

"You have to ensure the solution is quick and easy to use."

The importance of this aspect also became apparent in the answer of PS2, which put the customer experience into the focus:

"From an end customer perspective, it is definitely about the customer journey. So it needs to be easy and simple to walk through the transaction."

Following up on these responses in the course of the pilot interview sessions, the researcher tried to elicit possible success factors by steering the interviewees' attention to software-related aspects of the self-service offerings. The goal was to understand by which means an SST device could be developed to support the demand for an easy-to-use solution.

PS1 referred to the fact that an SST device, in particular a self-ordering kiosk, has to offer a way for the retailer to configure the contents of the food tableau information present on the self-ordering kiosk screen in a simple manner:

"Maintainability of kiosk tableaus is important".

Addressing this question to PS2 within the pilot study, a similar response was received:

"They [i.e. the retailers] need to be able to replace pictures, to adjust prices, to stick together menus very individually – so that is really key."

Further developing these thoughts, accompanying ideas were given by both pilot study participants, which focused on the support for a media-rich presentation of the self-ordering kiosk. According to them, retailers were very interested in showcasing their food products on their kiosks in an attractive way while having control over the concrete setup and configuration of the kiosk themselves.

The researcher also tried to understand the participants' initial ideas around hardware-related success factors of SSTs. The responses in this field covered two major aspects. Firstly, the importance of the hardware representing the self-ordering kiosk or self-checkout system itself was stressed. PS1 labelled this by expressing the following:

"You need to have nice-and-shiny hardware with modern and large screens for end customers".

Secondly, PS1 also listed a set of peripheral hardware options required for a self-ordering kiosk and self-checkout device to be successful:

"A printer for the provision of a receipt, an MSR reader for loyalty or co-worker cards and an EFT device for card payments are key hardware factors to have in mind."

Throughout the pilot interviews the researcher asked the participants to elaborate on the benefits of self-ordering kiosks and self-checkouts in the area of quick- and self-service restaurants as based on their own experiences from working with food retailers in this industry. PS2 explained a major benefit of SSTs that would lead to an increase in the number of sales transactions given the available retail space of the restaurant:

"Small self-checkout systems allow retailers to equip the checkout area with a higher density of payment stations, which ensures a higher throughput."

Analysing these responses, the researcher worked on developing codes, which covered key concepts and ideas given within the pilot interview sessions. These codes could then further be extended upon during the main study phase of the research programme. In this vein it was required to condense the pilot study data to core and easy-to-grasp

dimensions, which could then be used for deeper analysis steps throughout the main study.

The data analysis within the pilot study led to the inclusion of two questions surrounding possible success factors, which were previously not considered and only emerged from the pilot interview sessions. When asked about retailers' concerns regarding a possible implementation of SSTs into their store environments, PS1 mentioned the need for integration capabilities of the SSTs. This factor relates to the way of how self-ordering kiosks and self-checkouts can technically be embedded into the existing store technology setup of the retailer. Next to the theme of technological integration as a success variable, the pilot interview sessions also revealed the need for an inclusion of asking for accessibility-related features of SSTs. Based on the responses given by the pilot study participants, retailers would show interest in SSTs, which are equipped with accessibility functions allowing physically-impaired customers to utilise the self-service devices. As a finding of the pilot study, these two success factors were captured and incorporated into the updated version of the interview guideline used for the main study. The guideline concludes with an openly-worded section as to offer the interviewee the possibility to share additional thoughts, which could not be expressed beforehand.

4.1.4 Synthesis

The pilot study proved to be an important vehicle in the course of validating the methodology planned for the research programme. This chapter reflects on the goals set out for the test run and draws a conclusion on the accomplishment of these goals.

One objective of the pilot study was to evaluate the data collection and analysis techniques envisioned for the research project. The collection of data revolves around the conduction of semi-structured interviews with senior experts from the organisation. The interview guideline defined prior to the interview sessions turned out to be suitable for the scope of the study and in support of achieving the overall research goals. Utilising semi-structured interviews as a means to collect data significantly helped to generate a rich picture of the situation under research and was found to be beneficial for the research programme. The evaluation of the pilot study already showed the need to include previously unconsidered success variables, which only emerged from the participants' responses. Some findings from the pilot study showed room for

improvement concerning the size of the interview guideline and the way of how questions were worded. The analysis of these results led to a refinement of the guideline by sharpening the focus via reduction and aggregation of included questions. Newly discovered success variables were incorporated into the set of questions based on the pilot study participants' feedback. The researcher put the planned data analysis techniques of content and thematic analysis to a test and found support for the application of this comprehensive way of investigating the collected data. It was possible to dissect the responses elicited and develop codes for an overarching analysis of the mentioned success factors and their relations. The execution and evaluation of the pilot study in general tremendously increased the purposefulness of the interview guideline and corroborated the utilisation of the data collection and analysis techniques planned for the main study.

As a second goal, the pilot study was put in place to have the operational procedures of planning and conducting the interviews verified. Within the preparation phase of the interviews, the researcher found the introductory package including the form of consent to be useful in outlining the scope of the research programme to the participants. This established a level of rapport between the interviewees and the researcher, and the document also stated the goals of the study together with the data confidentiality arrangements. The subsequent planning of the interview sessions could be done on an individual basis per pilot study participant. Recording the conversation on audio facilitated the actual conduction of the interview and allowed the researcher to better concentrate on the interviewee and to grasp the meaning of the responses given by the participants. In summary, the pilot study confirmed the validity of the operational procedures set out to be applied for the main part of the research project.

4.2 Main study

This chapter presents a detailed account of the analysis of the data collected within the main phase of the study. Firstly, the researcher provides an overview of the interview participants and then walks through the findings of the data analysis process. The responses given in the interviews are analysed on a theme-by-theme basis while building up to the development of SST success dimensions as identified throughout the analysis phase. The following chapters thereby contain a comprehensive summary of the SST success determinants discovered and elaborated upon in this study.

The focus is to evaluate the codes, which have been developed for the individual themes of the interview sessions. The researcher analyses the identified codes from a more broader perspective and seeks to find and analyse corresponding overarching themes associated with them. In this sense, the researcher goes through all the developed and reviewed codes with the goal of generating a thematically fitting description that could serve as a category to bundle certain codes in. This exercise is conducted for all codes as created within the data analysis and as outlined in detail in the following chapters. The results are presented and thoroughly assessed in the subsequent sections as a means to develop a summary of the investigations.

The researcher uses the findings of the data analysis to define and review strategic SST success determinants in the German retail food industry of quick- and self-service restaurants. The researcher thereby explains the identified success factors in the context of the respective success dimension they are associated with. The presentation here relies on the data collected in this study and on the theoretical knowledge base as discussed in the literature review. The focus is on the described SST types of self-ordering kiosks and self-checkouts as well as on the three highlighted success dimensions of the conceptual framework, which are *information quality*, *system quality* and *service quality*. They serve as the baseline for the analysis of the explored strategic SST success determinants and dimensions.

4.2.1 Overview of interviewees

The researcher conducted interviews with key experts in the field of self-service technologies and solutions. The interviewees hold important positions within the organisation of the retail technology manufacturer that served as a partner for the case study. It was important for the research programme to draw on the experience of senior experts in the SST market with German food retailers as this would be beneficial in creating a rich picture of the success determinants explored. The interview participants hold essential functions in the organisation, which allows them to provide valuable insights into the investigation of SST success in the food business of quick- and self-service restaurants in Germany.

Table 4.2 shows the number of interview partners arranged by their roles and functional positions in the organisation.

Table 4.2: Interviewees and their functional domain responsibilities

Functional domain	**Role**	**Interview participants**
Retail management	Vice President Strategic Projects	P1
	Vice President Professional Services	P2
Product management kiosk and self-checkout	Senior Product Director	P3
	Product Owner	P4, P5
	Product Delivery Manager	P6
Software and solution architecture	Development Team Lead	P7
	Solution Architect	P8
Sales and customer management	Customer Director	P9
	Key Account Manager	P10

Source: Table by author.

The domain of retail management is represented with two vice presidents functioning as interview participants. Their responsibilities within the organisation of the retail technology manufacturer cover managing strategic customer projects for the retail sector and entail the delivery of professional services to retail accounts. This includes having end-to-end responsibility for the provision of hardware- and software-based solutions towards key retail customers across various industries. In addition to that, there were also three interviews with senior experts from the product management team surrounding self-ordering kiosk and self-checkout solutions for the retail segment. The researcher talked to the senior product director in this field who is in charge of the overall product roadmap for everything related to self-service technologies in the retail sector. The discussion with a product owner, who is responsible for the concrete design and configuration of self-ordering kiosks and self-checkout systems, led to the collection of valuable insights as well as the session with a product delivery manager overseeing and handling the concrete provisioning of self-service products towards retail customers. The interview schedule also included an appointment with a team lead of the development department, who is accountable for the software-related engineering of self-service technologies and the corresponding system architecture. The insights of a solution architect who drives the continuous improvement of self-service systems and

their integrations into customer systems were also regarded as important input for the data analysis phase.

The data received from these sessions was expected to be more concentrated on the aspects of developing and designing specific software components of self-ordering kiosks and self-checkout systems. As a means to draw on the experience of senior stakeholders working in the sales and customer management departments, the researcher organised interviews with a customer director and a key account manager, both of which being responsible for all SST deliveries towards major retail customers in the food industry of quick- and self-service restaurants. Including their perspectives within the data collection phase was considered a unique opportunity to investigate the success determinants of self-service solutions in this specific field of the German retail market.

4.2.2 Software quality

This chapter covers a collection of strategic success determinants, which have been identified throughout the data analysis phase of the study. These success factors relate to the overarching success dimension of *information quality* as based on the definition in the conceptual framework. This category bundles various success variables together, which describe the characteristics of the information provided to a user at an information system. This success dimension as defined by DeLone and McLean (2003) in the updated IS success model holds the following variables, which have an impact on the information quality of an IS: *completeness*, *ease of understanding*, *personalisation*, *relevance* and *security*.

For the scope of this research programme further variables have been explored upon that contribute to the effectiveness of the information of an IS, in this case of self-service devices. The researcher walks through the identified success determinants in this context and analyse how they can be grouped into the dimension of *information quality*. In this vein, two themes have already been investigated, which serve as starting points for the further classification of this dimension. The themes of *user interface and experience* and *configurability* together with their data codes as developed within the data analysis phase are presented in the subsequent chapters “4.2.2.1 User interface and experience” and “4.2.2.2 Configurability”. Given the nature of these findings, the researcher proposes to label the overarching success dimension as *software quality* as

opposed to simply *information quality*. Referring to the term of software generates a more precise picture of what the underlying success determinants thematically are about. The analysis of the collected data shows that the core focus indeed is on software-related aspects of the self-ordering kiosks and self-checkouts. This is why this study defines the corresponding success dimension as *software quality*, which better suits the investigated research situation.

Table 4.3 presents an overview of the success dimension of *software quality* including the aforementioned themes of *user interface and experience* and *configurability*. Moreover, the individual success determinants are highlighted and analysed in the subsequent paragraphs.

Table 4.3: Success dimension - software quality

Software quality	**User interface and experience**	
	Age verification	Ease of use
	Artificial intelligence	Feature richness
	Avoided interventions	Flexible configuration
	Customer engagement	Upselling
	Configurability	
	Flexible configuration	Stock information

Source: Table by author.

The success determinants belong to the dimension of *software quality* because of their relevance for software-related features and capabilities of the investigated self-service solutions. The findings of the data analysis show that there are two major themes these determinants can be assigned to, which are *user interface and experience* and *configurability*. The determinant of *flexible configuration* refers to both themes, since a certain level of flexibility was identified as being a critical factor overall.

The conceptual framework as outlined after the review of the literature lays its foundation on DeLone and McLean's updated IS Success Model and further influencing models dealing with the acceptance of information systems (DeLone and McLean, 2003). As one of the key success dimensions *information quality* has been included in the conceptual framework, since it is a vital part of the IS success model developed by

DeLone and McLean. With the focal point of the analysis results being connected with software-related aspects of the information provided on the screens of the self-service devices, the researcher coins the term of *software quality* to better reflect this notion in the definition of the corresponding SST success determinants.

First of all, *upselling* has been defined as a success factor of SSTs in the retail food industry of quick- and self-service restaurants. This factor describes the set of features SSTs are equipped with in order to achieve a high level of upselling potential. Key experts interviewed have elaborated on the possibilities for food retailers to generate increased order sizes coming from customers using self-ordering kiosks and self-checkouts and on the chances to profit from higher revenues as a consequence. This has also been found to be supported by market reports from the industry (Klein, 2018; Kelso, 2019; Wheeler, 2020) and reviews of the impact of technology on sales in the restaurant sector (Kimes, 2008; Papandrea, 2019). The capability of SSTs to enable retailers to benefit from upselling ranks as one of the mostly requested features as investigated in the data analysis phase. Therefore, *upselling* has been recorded as a key success determinant.

The next two success factors deal with the *ease of use* that is associated with the software of the SST and the overall *customer engagement*. The analysis of the data showed that various components of the software of self-service solutions contribute to an improved ease of use for customers. These components mainly revolve around SSTs providing a simple and comprehensive user interface that allows for easy access and fast handling of the necessary actions on the screen. All of this is in support of offering the customer a straightforward shopping journey via the software of the self-ordering kiosk or self-checkout. This has been clearly investigated to be a major success determinant. Retailers need to ensure customers understand the purpose of the SSTs and are able to make use of them as part of their shopping activities. These two success factors can be connected with the literature reviewed about users interacting with and accepting technologies (Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). As such, the researcher discusses linking the success determinants of *ease of use* and *customer engagement* to success dimensions related to the customer adoption of a technology. Based on the findings of this study though it appears to be of more value to associate the identified success factors directly to the dimension of *software quality*. The software of the SST has been found to be a driving

force behind offering the customer a meaningful and effective shopping journey. This is made possible by software features, which are integrated into the self-service solution and provide a positive experience to its users. The study results also show that it is important for SSTs to give customers a high level of self-control and utility when engaging with self-ordering kiosks and self-checkouts so that the interaction between the user and device is further strengthened. Therefore, *ease of use* and *customer engagement* have been assigned to the success dimension of *software quality*.

Proceeding with further success determinants located in the theme of *user interface and experience*, the aspect of *feature richness* has been identified as a key success factor for self-ordering kiosks and self-checkouts. This term entails the requirement for SSTs to support a wide variety of functions and interactive media presentation on the user interface of the device. It has been found that retailers seek to present their food products available for sale in a prominent and visually appealing manner as to attract customers' attention and stimulate their appetite. This can be achieved by including pictures and videos in the user interface and by having them integrated into the customer interaction happening on the screen. The success factor of *feature richness* therefore is directed at increasing the customer usage of SSTs, which is made possible by deliberately implementing the underlying software functionalities of the self-service solution itself.

In the area of features, which can be embedded into the software system of self-ordering kiosks and self-checkouts, the study finds that concepts related to *age verification*, number of *avoided interventions* and *artificial intelligence* are critical to be addressed by the SST. The analysis demonstrates that it is of high importance for food retailers to be able to sell age-restricted products via self-service devices. In such a scenario the SST ideally comes up with the capability to support an age verification check as built into the software solution of the device. Not having the option to offer age-restricted items on a kiosk for example could hurt food retailers' revenue. Based on this finding of the research project, the success determinant of *age verification* has been included in the *software quality* dimension to indicate the significance of this functionality.

When it comes to how an age verification check can be performed in a self-service restaurant, the other two success factors mentioned above turn out to be relevant – *avoided interventions* and *artificial intelligence*. As a result of the analysis it has

become apparent that food retailers are considerably interested in avoiding any kind of disturbance that might occur while customers are using self-service solutions. One of the goals of an SST strategy is to gain benefits in terms of store efficiencies and process automations. With any disruption in the customer's shopping process the achievement of these benefits is at risk. This is why the researcher develops *avoided interventions* as a success determinant in this context. Software solutions have been identified to be a powerful vehicle to drive the operational effectiveness of self-service solutions thereby reducing the need for any form of manual intervention required by retail staff. Embedding technologies based on *artificial intelligence* in the design of the SST software can further help lower the number of manual steps within the customer journey. Prime examples here cover visual-based camera technology that allows for an age verification via facial recognition or identification check directly from the self-service terminal. The technological readiness in this regard appears to be in an overall early state that requires more attention, but has clearly been identified in this study to bear huge potential for food retailers (Angulu, Tapamo and Adewumi, 2018). As such, *artificial intelligence* has been added to the success dimension of *software quality* as a success variable.

Next to the just analysed success determinants belonging to the theme of *user interface and experience* there is a second theme within *software quality* that requires further attention. The results of this study have led to the development of the success factors of *flexible configuration* and *stock information*. Both of which are assigned to the theme *configurability*, whereas *flexible configuration* has been found to be applicable to *user interface and experience* as well.

The analysis of the collected data demonstrates that there is a distinct requirement by food retailers to be able to configure self-service solutions in a highly flexible way. Configuration possibilities are requested by food retailers as to manage the food products and contents shown on the self-service devices based on their individual preferences. The call to have these options available has prominently been found within the analysis and is therefore reflected in the corresponding success determinant of *flexible configuration*. The researcher has identified the need for SSTs to allow for the display of time-dependent food menus in the self-service restaurant area and to provide configuration features for the inclusion of means to achieve upselling. This ties back to the already examined success factor of *upselling* at the beginning of the chapter. For

food retailers operating in the quick- and self-service restaurant industry it has been investigated to be of significant value to work with self-service solutions, which carry a maximum level of *configurability* with them.

As an afterthought related to this requirement the success determinant of *stock information* has been defined as being a further factor that would have to be considered on its own because of its relevance for food retailers. Especially for self-ordering kiosks providing customers with a selection of food menus and products to choose from for ordering, it is essential to always show items to the customers, which are actually available for sale. Since retailers face times of high customer frequency in the self-service restaurants, self-ordering kiosks are required to integrate with systems regarding item stock information as to make sure a potential unavailability of products is correctly reflected on the kiosk screen. As a consequence, the results of the study show that food retailers demand SSTs to connect with internal warehouse systems that hold the information about the availability of food products in the respective stores. This requires a thoughtful integration of self-service systems with the fulfilment processes of the retailer (Wollenburg *et al.*, 2018; Wollenburg, Holzapfel and Hübner, 2019), which is why *stock information* has been defined as an SST success determinant.

The subsequent two sections of "4.2.2.1 User interface and experience" and "4.2.2.2 Configurability" provide further background information about the two themes of *user interface and experience* and *configurability* by showcasing the examined codes in detail. As an additional way of presentation, the findings are visualised in a table format, which is explained below and can be found as well in the following sub-chapters per individual domain. These tables provide overviews of the identified codes and their associated overall theme, which have been explored for this set of data. The number of coding references and the number of items coded per individual code across all interview responses are displayed in the table format. For each code the total numbers are presented. The codes shown here also go along with the information provided in "10 Appendix C: developed codes during data analysis". For each theme explored within the data analysis the tables present a summary of the examined codes attached to this specific theme. The codes displayed are sorted in descending order by the number of coding references.

4.2.2.1 User interface and experience

The data analysis shows that the structure and style of the user interface of self-service solutions are considered tremendously important for both, retailers providing self-service devices to their customers and to customers themselves using these systems. The researcher finds that the key experts interviewed very often referred to self-service systems having to offer a user interface to customers that presents a visually appealing overview of the available options on-screen. This involves an attractive presentation of the food products, which can be bought, and also a clear display of how the interaction on the device itself is supposed to be carried out by the user. As per the interviewees, food retailers seek for SSTs that enable a fast and intuitive customer journey based on a well-designed user interface. The customer experience needs to be as effortless and seamless as possible.

These responses have been turned into corresponding codes and describe the topics just explored – *user interface and experience*, customer- and retailer-focused features of the user interface as well as aspects related to how the user interface can support the store operations as a whole. The analysis of interviews demonstrates that upselling potential via self-service devices was received as a major success factor for retailers. As such, retail technology manufacturers equip self-ordering kiosks and self-checkouts with software that allows for the inclusion of upselling possibilities on the user interface.

Table 4.4 covers the developed codes, which relate to the success factors connected with the overall theme of *user interface and experience* of self-service solutions.

Table 4.4: Data analysis - codes - user interface and experience

Theme: user interface and experience	**Total**	
	∑ ref.	**∑ items**
Customer experience with user interface	18	16
Store operations and processes	14	11
Customer	13	13
Store operations of retailer	11	10
Customer-focused	8	8
Retailer-focused	5	4

UI and configuration possibilities	3	2
SST	1	1
Total	**73**	**65**

Source: Table by author.

Success factors in the area of *user interface and experience* follow the goal of providing a simple and fast shopping journey to customers when they are using self-ordering kiosks or self-checkout systems. P7, who is the team lead of developers implementing features for self-service devices, expressed this by stating:

"When the basic functionality for selling and payment is in place, I think the most requested features all relate to organising the customer journey."

The idea behind this is to offer the customer a seamless and easy-to-use workflow powered by the self-service offerings. The underlying software running on the self-service devices needs to go along with this approach and support the customer in every step of the processes happening on the screen. This would require a display that is easy to read and that holds key information accompanied by clear instructions on how to complete the shopping journey. P2, vice president professional services, and P3, who works as a senior product director for SST solutions, highlighted the importance of the kiosk and self-checkout software allowing for a straightforward shopping experience concluded by a fast payment.

The customer journey at a self-ordering kiosk begins with the kiosk presenting a collection of selectable food items to the customer. The customer interacts with the screen and browses through the different menus and food offerings. An appealing user interface positively affects customer adoption of SSTs and helps drive the success of self-service solutions. As per the responses by P1, vice president in strategic retail projects, and P3, this also includes the incorporation of pictures and short video clips to provide usage instructions or showcase certain products. Looking at SSTs from the viewpoint of a customer, respondents stated that the user interface and layout of the SSTs need to allow for a fast and intuitive handling by the consumer. This would apply to both, self-ordering kiosks and self-checkouts. Customer director P9, who is in charge of all deliveries for a key food retail account, explained this by responding as follows:

"From an end customer perspective, it is definitely about the customer journey. So it needs to be easy and simple to walk through the transaction."

A similar evaluation on success factors in this regard was issued by P3 who called for:

"Ensuring the solution is quick and easy to use for customers."

Throughout the analysis of the responses it became apparent to the researcher that self-ordering kiosks and self-checkouts preferentially need to entice customers into using them. This can often be accomplished by providing an easy-to-use device to the customer that promises a fast and intuitive workflow for processing the desired transaction in the restaurant. This finding corresponds with factors relating to *ease of use* and *perceived usefulness* as being important antecedents of self-service usage, which has been elaborated upon in the literature review (Collier and Kimes, 2013; Blut, Wang and Schoefer, 2016; Wang, Harris and Patterson, 2017).

The researcher found that the responses given in this context illustrate possible mechanisms of SST software and software-related technologies to properly manage the stream of customers in the store. Retailers seek to improve the process efficiencies of how food is being ordered by and served to customers. Both of which should be supported by frictionless self-service technologies and accompanying software solutions. P10, who works as a key account manager for a major food retailer, explained the underlying requirement retailers have as follows:

"I would say on a high level, technology is used and looked for anything that relates to interventions, meaning manual interventions of staff. Anything that causes an intervention is very interesting for the retailer to avoid. That, of course, depends on the retailer and on how many interventions they have and for which reasons they have those interventions."

Next to the core success criterion of presenting an attractive user interface to the customer, it is also vital to properly enable customers to select and configure the food items they wish to order on a kiosk when interacting with the kiosk software. P4, who works as a product owner in the area of self-ordering kiosks and self-checkouts, underlined how important it is to grant customers freedom of choice at a self-ordering kiosk:

"You need to offer the customers the possibility to choose between a multitude of variants, meaning they can adapt existing menus, e.g. by swapping and excluding certain side dishes or ingredients."

Interviewee P3 shared similar thoughts and talked about giving customers flexibility in the configuration of their meals, be it size, ingredients or options to combine food products. The discussion with P3 about these aspects led to the formulation of advices towards food retailers to include upselling opportunities in the user interface of the self-service solutions. Recommended items or special offers could be conveniently placed next to the menu configuration so that customers are enticed to take a look at the promotional offers. P7 referred to the features of SSTs as being a suitable form of driving upselling activities with customers by stating:

"There is much concern about visual effects hinting at potential upselling and cross-selling, sometimes even more than guiding the user. Like there are many requests from marketing to place animations for ads for example."

While interviewing P3 and P5, who work as product owners in the area of self-service solutions, it became apparent that retailers are actively looking for ways of yielding higher transaction volumes per customer via upselling. P3 stated:

"Upselling capability to increase basket size is very important for self-ordering kiosks."

Retailers seek for critical advantages in the course of implementing self-ordering kiosks in the retail store layout. For them, it is about increasing sales by achieving a higher order volume per consumer. Similar findings of higher basket volumes as a consequence of introducing self-ordering kiosks have also been reported by representatives of key players in the fast-food-chain and restaurant industry (Kelso, 2019).

Self-ordering kiosks especially can serve as a valuable form of enticing up- and cross-selling with customers using the devices – a development that has also been highlighted by Klein (2018) and Wheeler (2020). P7 explained this potential for extended upselling by referring to the large screen size of self-ordering kiosks that can be used for promotion and advertisement purposes:

"On a self-ordering kiosk, there is much more advertising possible and integrated into the ordering process, so the customer cannot choose to ignore the advertisements."

Two interviewees, P1 and solution architect P8, referred to use cases from their projects of working with food retailers who experienced an increase in order volume for transactions issued via self-ordering kiosks. The average size of the orders created at self-ordering terminals was said to be higher than with a manned store desk, which could be explained by customers feeling less observed when managing their own orders without the interaction with a cashier. Similar observations of high transaction volumes had been reported for major US-based quick-service restaurants (Papandrea, 2019; Maras, 2022).

The interview with P10 led to the development of the statement below:

"Definitely with self-ordering kiosks we see a trend of upselling possibilities. So we see that the average transaction value is higher than when standing in a normal line talking to a cashier there."

P3 further detailed this topic and showcased the following example:

"One key fast food retailer saw that basket sizes increase by ~25% when customers used a kiosk to order rather than a traditional point of sale lane with an attendant, finding the right business case for each retailer is key."

There are huge possibilities in this area retailers can benefit from. Working with feature-rich software that allows for a visually-appealing presentation of food items and inclusion of upselling mechanisms can lead to an increase in basket size. Moreover, innovative self-service technologies equipped with multifaceted software solutions help improve the service experience for customers. This aspect can be an important driver for users to engage with SSTs as was highlighted in the literature review (Wang, Harris and Patterson, 2013). Participants also touched on the increased level of self-control and self-determination customers ask for when engaging in retail shopping activities. Similar ideas relating to self-efficacy had been analysed and found to be meaningful by Demoulin and Djelassi (2016). The call by customers for the availability of self-service offerings was brought up in detail by P3:

"Consumers are now also demanding such technology, the added freedom, control and reduced interaction with staff are key drivers for consumers."

Customers enjoy having the option to use self-service solutions, which offer a user interface that is meaningful and easy to understand, as a way to bypass regular store personnel ultimately even speeding up their shopping process. This can lead to reductions in overall queue length and waiting time, which both, retailers and customers are interested in (Collier *et al.*, 2015). The benefits of reduced queues and faster shopping experiences for customers were also highlighted by P1 and P8, who both referred to the increase in sales for retailers as outcomes of these developments.

As a summary to software-related success factors of SSTs, a key component is to equip self-service systems with a user interface, that is appealing to customers and attracts their attention. The user interface mainly serves the purpose of enabling a smooth and simple shopping journey for customers while at the same time providing food retailers with a multitude of possibilities as to present their food menus in the way the wish. Upselling capabilities are highly important and should be supported by the implemented software technology. Furthermore, software was identified as a driver to automate store operations processes by utilising visual-based technology powered by artificial intelligence systems. Retailers seek for these systems to be incorporated into self-service offerings due to their potential of automating cumbersome tasks such as age verification or scanning of items. Artificial intelligence technology thereby reduces the number of disruptions and manual steps, which could negatively impact the shopping journey of customers and the overall throughput of transactions.

4.2.2.2 Configurability

For retailers it is key to have the possibility to manage the configuration of their self-ordering kiosks and self-checkouts by themselves. The analysis of the interviews has shown that there is a huge demand by food retailers in this area and that the provisioning of an effective configuration system can help drive the success of SSTs and their acceptance. The respondents have elaborated on retailers requesting the need to flexibly set up the food menus and items they want to offer to customers on a self-ordering kiosk or self-checkout system. This also involves a simple configuration of the food items aimed at upselling.

Next to the success factor of having configuration options for the self-service solutions, the interviewees have talked about food retailers demanding for their self-ordering kiosks to reflect the current stock information of the food products. This feature would allow for kiosks to always show items, which are actually available for purchase in the store. In case of stock problems for certain products, retailers expect this product shortage to be made visible on the kiosk so that customers don't buy items, which are not available anymore. Synchronising the information about food items being in or out of stock with the order terminal is therefore considered very important for the customer shopping experience. Retailers want to avoid accidentally selling items, which are not in stock anymore. From a software perspective, this requires efforts to make sure self-service solutions reuse existing business logic of the food retailer such as handling stock information of food items.

Table 4.5 presents the codes identified for the requirements raised by retailers, which ask for SSTs to provide a high level of *configurability* and flexibility, when it comes to the arrangement of the products and features available on the user interface of the self-service devices.

Table 4.5: Data analysis - codes - configurability

Theme: configurability	**Total**	
	∑ **ref.**	∑ **items**
Configuration	13	11
UI and configuration possibilities	6	5
Store operations and processes	1	1
Total	**20**	**17**

Source: Table by author.

The subsequent analysis addresses the challenge for food retailers to manage and maintain the food product information that is visible to customers on the self-service solutions. P9 elaborated on this thought in detail and drew on the experience with food retailers who actively require to be able to have the possibility to configure the displays of self-ordering kiosks:

"I think it is important to offer a management system for the configuration of the menus. That's really key. So the store needs to be able to really manage their kiosks on their own or do it on a country level for multiple stores at the same time. They need to be able to replace pictures, to adjust prices, to stick together menus very individually."

The researcher found matching responses in the data collected with interview participants P1, P2 and P5. Building on this data, retailers are interested in providing different menus to their customers depending on the time of day as to switch between offerings for breakfast, lunch or dinner. This is especially relevant, if retailers would like to offer different food menus throughout the day to have specific food products only available in a certain time frame. The analysis here clearly showed that configuration possibilities for retailers are key in this regard. Interviewee P10 expanded on this thought and raised the question from retailers as to how they can technically perform the configuration of the kiosk and self-checkout system. P10 emphasised the call for self-service systems to support flexible configurations while also considering the circumstances of the IT network of the food retailer:

"If cloud-based solutions are in place for doing the maintenance of the self-ordering kiosks, then this is also something that retailers demand so that they can do it from their network within the company, from wherever in an easy way."

4.2.3 System quality

The purpose of this chapter is to focus on the success dimension of *system quality* as defined within DeLone and McLean's updated IS Success Model and positioned in the conceptual framework (DeLone and McLean, 2003). As per DeLone and McLean, this dimension consists of the following success determinants: *adaptability*, *availability*, *reliability*, *response time* and *usability*.

The analysis of the collected data has led to the development of a wide collection of success variables being relevant in this context. The researcher introduces four themes, which are further elaborated upon in chapters "4.2.3.1 Hardware quality", "4.2.3.2 Integration", "4.2.3.3 Security" and "4.2.3.4 Payment". The term of *system quality* appears to be suitable for the research topic of this study and does not require an adaptation to the research scenario. Therefore the four themes can be adequately assigned to *system quality* as one of the major dimensions of the success model.

Considering the different characteristics of self-ordering kiosks and self-checkout systems in the German retail food industry of quick- and self-service restaurants, several success determinants have been identified and analysed. It has been found that the hardware configuration of the self-service device has a huge impact on the possible use cases, which can be supported by the SST in a retail store.

Table 4.6 provides a summary of the developed SST success determinants in relation to their corresponding theme within the success dimension of *system quality*.

Table 4.6: Success dimension - system quality

System quality	**Hardware quality**	
	Adaptability	Maintainability
	Age verification	Printer support
	Artificial intelligence	Scale support
	Hardware appeal and sizing	Scanner support
	Integration	
	Adaptability	Integration capability
	Security	
	Artificial intelligence	Security processes
	Payment	
	Card support	Smartphone support
	Cash support	

Source: Table by author.

The results of this study indicate several determinants are playing an important role when it comes to understanding the success of SSTs. The success dimension of *system quality* has been structured into four themes with each of them containing a set of success variables investigated in the research programme.

The analysis shows that there are success determinants related to the *hardware quality* of an SST itself. These factors describe characteristics of the SST hardware and also refer to attached peripherals an SST can be equipped with. The researcher identifies the success factor of *adaptability*, which is a variable that was also included in DeLone and

McLean's updated IS Success Model as part of the *system quality* dimension (DeLone and McLean, 2003). Based on the findings of the study, the importance of this determinant is high, since food retailers seek for self-service solutions, which can easily be adjusted to support different use cases and shopping scenarios in quick- and self-service restaurants. Remodelling existing SST hardware to serve different purposes is considered to be more economic for food retailers than purchasing new solutions. The aspect of *adaptability* closely goes along with the next success determinant defined that deals with the *maintainability* of SST devices. Food retailers expect to be working with SSTs, which allow for easy repairs by technology providers and also support the replacement of technical components, if required. This finding of the research programme adds to the existing determinants as available in the IS success model by DeLone and McLean by further specifying the concrete requirements by retailers in this field of business.

The analysis also clearly shows that the overall appeal and sizing of the SST hardware are vital success factors for both, retailers and customers alike. Therefore, the researcher defines *hardware appeal and sizing* as a success determinant in the *system quality* dimension. This determinant captures the identified need for large touchscreens as well as for good ergonomics with regards to usage. Moreover, there are various forms of SSTs, which can be installed in restaurants. These range from small self-ordering kiosks providing basic functionalities for a limited range of products to fully-equipped self-service stations offering checkout processes to customers. The concretely best choice depends on the use case that is to be supported from the food retailer's perspective as based on the intended customer shopping journey in the store. Providing appealing self-service solutions to customers operates on a rather hedonic level, when it comes to the user interaction with the device and might be a lever for enticing SST usage by customers (Blázquez, 2014; Collier and Barnes, 2015; Ahn and Seo, 2018).

The following set of success determinants has been found to be of relevance for SST success when considering possible peripherals, which can be attached to the self-service device. This set primarily consists of the success factors *printer support*, *scale support*, and *scanner support*. In accordance with the shopping use case, that needs to be powered by a self-ordering kiosk or a self-checkout system, varying peripherals are required to enable the desired shopping scenario. Scales and scanners are necessary to allow customers to input information into the system, such as weighing of items or

scanning of products or cards. Offering a printed receipt to the customer after a successful transaction at a self-service solution is a legal obligation in Germany, which is why *printer support* has been included as a success determinant in this domain (Bundesministerium der Justiz, 2017, 2021a). The researcher has also included an interesting aspect that was found within the analysis of the study results that deals with technology based on *artificial intelligence*. The collected data shows a possible field of application in having camera systems scan the basket contents of shoppers who are using a self-checkout system. This camera-based registration process would drastically remove manual steps from the checkout phase and allow for an automated solution to take place. Such techniques have been found to be in early stages of adoption by retailers and technology providers, but the potential here is considered huge looking in the future.

For the specific shopping use case in German food retail, that focuses on providing customers the possibility to buy age-restricted items via self-ordering kiosks and self-checkout systems, the success determinant of *age verification* has been identified. If this scenario is to be supported by the SST, food retailers operating in a self-service restaurant environment need to be aware of mechanisms to check for the customer's age as soon as age-restricted items, such as alcoholic products, can be bought by customers. The necessity to include this success factor in the *system quality* dimension becomes clear, when considering that any interruption in the ordering flow as a consequence of age verification actions reduces the efficiencies, which self-service solutions provide to retailers. Smooth and highly automated ordering processes are key for food retailers, which is why a deliberate setup of age verification measures is required. Combining the need for age verification checks with means based on artificial intelligence technology has been found to be an intriguing idea and foundation for a meaningful business case.

The researcher allocates two success determinants, *adaptability* and *integration capability*, to the theme of *integration*. The factor *adaptability* has already been included in the field of *hardware quality*, but can also be applied to the theme of how well an SST is able to successfully integrate with the IT environment of the food retailer. This is why *adaptability* is considered a decisive factor in terms of integration potential of SST solutions. The analysis of the research data shows that configurable self-service devices with support for effective system communication via application

programming interface technology significantly help in achieving a working integration with the retailer's systems.

This study furthermore has led to the development of two success determinants, which relate to the theme of *security* within the *system quality* success dimension. First of all, the topic of *security processes* was identified as being a critical success factor for the application of SSTs in quick- and self-service restaurants. The risk of fraud attempts by customers is clearly found to be solely associated with self-checkout systems. The investigations show that self-ordering kiosks are rather unaffected by potential theft, since food is only handed out to customers after a successful payment process has been completed. With self-checkouts being in the core focus of a food retailer in terms of security, it is required to align the store and staff processes in the restaurant to the presence of self-checkout systems. These devices need to be effectively positioned within the store as to make sure supervising of customers' activities via store personnel is possible. Achieving the right supervisor-to-SST-ratio in this regard is considered critical as well. The study finds that there is a balancing act to be made between granting customers self-control in their ways of using self-checkout solutions and ensuring security measures are put in place to prevent theft or fraud (EHI Retail Institute and Horst, 2015; Beck, 2018).

The just analysed success determinant of *security processes* can be accompanied by utilising technological features based on *artificial intelligence*. This research programme finds support for optimising the way of capturing collected food items at a self-checkout terminal by employing camera techniques working with artificial intelligence technology. With cameras observing which items are registered by the customer when using the self-checkout system, a further level of security can be added to the checkout process. This reduces the risk of items not being scanned by users, either on purpose or even by mistake. Therefore, the researcher has added *artificial intelligence* as a success factor to the theme of *security*, since food retailers can benefit from such SST solutions in customer journeys revolving around self-checkout scenarios (Kunchithapatham and Technology, 2020).

The success dimension of *system quality* also contains *payment*-related success factors, which are highlighted at this stage. As a result of this study, the success factors developed cover different forms of *payment*, which are relevant in the field of self-

ordering kiosks and self-checkouts in German food retail. Since German customers are likely to pay with cash, the aspect of *cash support* has been added as an SST success determinant (Brandt, 2017, 2021). Food retailers need to make a deliberate decision about providing customers with cash-based payment options. The retail experts interviewed in this study have referred to cost-intensive investments for food retailers, if they declare to opt for SSTs, which are equipped with support for cash handling. The initial costs upfront as well as efforts for maintenance have been characterised as being higher than with non-cash SSTs (Lüüs, 2019; EHI Retail Institute, 2021).

In contrast to cash-based payment, food retailers can choose to rely on customers to use their credit cards or debit cards to pay for their goods. The success determinant *card support* covers this area and serves as a factor to describe which types of card are to be enabled by self-service solutions. Using cards to finalise the transaction at a self-service device oftentimes comes along with the benefit of contactless payment. This aspect further drives ordering and checkout efficiencies, since less manual input by the customer is required. Paying in a contactless fashion can be regarded as a development in shopping behaviour that might attract more attention in the future (Ahrens, 2022; Statista Research Department, 2022). As a consequence, the researcher found the inclusion of *card support* as a success determinant essential so that food retailers can prepare their self-service offerings accordingly.

Continuing with the thought of card-based payment in a contactless way, a further related success factor has been identified as a result of this study. The aspect of *smartphone support* covers any type of payment that is executed by making use of functionalities available on the customer's smartphone. As an example, the food ordering can be initiated at a kiosk system whereas the actual completion of the payment transaction is accomplished via the smartphone. Online-based payment methods integrated into an SST can utilise the features of apps, which are present on the user's mobile device. This requires an SST to provide a sophisticated technical setup that allows for such scenarios to work in a restaurant. The benefits of SSTs supporting smartphones though are remarkable, since they offer flexible payment solutions to customers who gain a high level of self-control when interacting with self-service devices.

Within the subsequent chapters of “4.2.3.1 Hardware quality”, “4.2.3.2 Integration”, “4.2.3.3 Security” and “4.2.3.4 Payment” the researcher provides a detailed account of the codes related to the themes analysed and elaborated upon in this section – *hardware quality*, *integration*, *security* and *payment*.

4.2.3.1 Hardware quality

Firstly, interviewees underscored the importance of having SSTs with large touchscreens as to properly provide the information on the screen and to offer customers a simple way of interacting with the devices by touch. A wide selection of suitable peripheral devices has been referred to as well within the interviews. The application of these peripherals such as scanners, scales or credit card readers primarily depends on the shopping use cases, which need to be enabled by SSTs from an overall store perspective. As per the respondents, this is very dependent on the retailer and the requested level of flexibility to support specific shopping scenarios in the self-service restaurants. Based on the design of the customer journey, product features such as support for cash payment or for gift and voucher cards might be required as preferred or even mandatory SST hardware options.

Aside from the core properties and configuration of the SST hardware, the analysis of the interviews also demonstrated that retailers are interested in a small economic footprint of the self-service solutions that is cost-effective yet adaptable to various fields of use in the store. Flexible and reusable self-service solutions, which can be deployed to enable various functions in the store, were found to be key.

Table 4.7 provides an overview of the developed codes that relate to quality aspects of the SST hardware. This also covers connected hardware peripherals and aspects of how the SSTs can be positioned within the store of the retailer.

Table 4.7: Data analysis - codes - hardware quality

Theme: hardware quality	**Total**	
	∑ ref.	**∑ items**
Peripherals and integrations	21	19
Hardware	14	14

Retail store operations	7	7
SST	1	1
Retailer-focused	1	1
Customer-focused	1	1
Retailer and positioning in the store	1	1
Total	**46**	**44**

Source: Table by author.

Respondents talked about the necessity of SSTs to support a flexible footprint for the retailer in terms of overall costs and efforts associated with them. P2 emphasised this thought by further explaining that retailers are looking for a variety of options when they acquire SST hardware for their self-service restaurant areas. This would allow them to dynamically change the way of how they provide SST offerings to their customers. P10 also brought up that retailers frequently request a high level of adaptability and reusability:

"So the possibility to adapt these solutions to the specific customer journeys without having to buy a new solution is extremely important for retailers. The reusability of the hardware is a deciding factor in this regard so that you don't have to buy new hardware for cases of moving devices to different phases and purposes within the customer journey."

Moving to the aspect of dedicated hardware features, participants P5 and P7 argued that SST hardware is usually quite expensive compared with regular point of sale systems. As a consequence, retailers would deliberately call for flexible solutions to support their individual use cases in the stores. P10 further concluded that looking at it from a maintenance perspective, it is also critical for a retailer to invest into SSTs, which can easily be repaired or extended with better pieces of equipment, if required:

"How easy is it to break and fix the hardware? This is a deciding factor in retailers buying the devices because then they see, of course, the costs over time going down and not only the initial costs upfront."

The analysis also demonstrated that respondents regard large touchscreens as being a decisive property of SSTs devices retailers are asking for. Having a large screen size available allows retailers to prominently put their products into position on the user

interface towards customers. This was especially highlighted by P1 based on the experience of working with retail customers on a strategic level and by P3 and P4, both of which being responsible for questions of product design and characteristics. The requirement of having SST devices with large screens was even declared as an overall trend in the retail food industry by P9 who gave insights into the experience with a major business operating in the quick- and self-service restaurant branch:

"So looking at the retailer that I am working for, I think that self-service devices need to have a certain size from a screen perspective, because retailers want to present their products in a nice way and customers should have a good overview about what options they have to choose from. Retailers want to have large screens, that is a trend."

Table 4.8 presents the developed codes of hardware options and peripherals as investigated within the data analysis. The different codes are assigned to the SST type of either self-ordering kiosk, self-checkout or both. The vast majority of the hardware attributes discussed with interviewees is applicable to both forms of SSTs.

Table 4.8: Hardware and peripherals per type of self-service technology

	SST type	
	Self-ordering kiosk	**Self-checkout**
Hardware / Peripherals	Cash and cashless payment	
	Card payment	
	Gift cards and voucher cards	
	Online payment	
	Printer (receipt)	
	Quick response code scanner	
	Magnetic stripe reader	
		Product scanner
		Scanning via artificial intelligence (AI)

Source: Table by author.

Continuing with further hardware options, which can be associated to both types of SSTs, printers were mentioned by P2 and P4 as to give customers the option to generate a printout of their receipt after finishing the transaction on the SST device. This goes along with regulatory requirements in Germany of retailers having to provide customers with a proof of purchase on their demand (Bundesministerium der Justiz, 2017, 2021a). Respondent P4 explained the necessity for equipping SSTs with a magnetic stripe reader that is oftentimes used to scan loyalty or coworker cards. P4 further elaborated that depending on the type of card retailers have to be aware of what kind of scanning technology they require to support the various cards. These cards might be set up with a magnetic stripe, near-field communication technology or could even be based on quick response (QR) codes as mostly supported easily by mobile phones. In this context, P1 spoke about retailers reporting about their experiences with customers who predominantly use their mobile phones to present QR codes to the devices, which resemble their formerly physical cards. This would completely remove the necessity for the customer to carry the actual cards with them. P5 brought up the idea of customers showing a QR code, that is present on their mobile device, to the scanner of the kiosk as to redeem a certain coupon for their purchase.

Interviewee P5 furthermore stated that the decision about which type of scanner to use would mainly depend on the shopping use cases and customer behaviour in the store. Retailers need to be aware of how their customers shop and which concrete applications have to be supported by the self-service offerings as a consequence. P5 explained:

"Then, of course, everything that makes the experience as smooth as possible, so when you would like to scan a product that you just picked up at the self-checkout, you can easily add it to your basket by scanning the barcode."

Considering customer shopping journeys centred around self-checkout scenarios, P6 discussed the necessity for the retailer to understand the shopping basket of the customers using self-checkout systems. P6 works as a product delivery manager in the field of self-service solutions and stated:

"The size and equipment of self-checkouts must be geared to the clientele you are looking at. Are these customers who buy up to 5 items or are they customers who buy up to 20 items? Performance features such as checkweighers, fruit scales, hand scanners, etc. depend on this."

Since customers have already picked up the food items they want to buy when approaching the self-checkout station, retailers need to know the average number of items collected including their attributes as to properly reflect this with specifically designed self-checkout devices. Keeping in mind that the goal is to allow for an efficient customer journey, self-checkouts have to be equipped with suitable tools that customers can use to register the food items with the SST device in a simple way. This is why P6 elaborated on these features, which food retailers usually request and call for when providing self-checkout offerings to their customers. As per respondents P4 and P10, retailers are interested in SST solutions, which consumers can easily use thanks to the overall good ergonomics of the devices and attached peripherals.

For the specific processes of self-checkout interviewee P4 recommended:

"Retailers prefer integrated scanners for easy and convenient scanning of 'at hand' products."

These products, such as sweets or snacks, are usually placed in close approximation to the self-checkout device to promote upselling. With a self-checkout supporting an easy-to-use way of scanning these items retailers could significantly benefit from a product scanner that is directly integrated into the self-checkout system. As per P5, it should be straightforward and hassle-free for customers to add one of those items to the basket during the checkout process.

In general, interviewees underscored the importance of offering a seamless and intuitive way to customers of using the self-service devices. Any kind of disturbance should be avoided as to provide a convenient experience for the users. P9 highlighted a possible use case here that would dramatically improve and expedite the process of registering food items with the self-checkout. Technology in the form of artificial intelligence (AI) could help retailers in automatically capturing selected food items via camera solutions attached to the SST device:

"For self-checkout systems, it can be quite time-consuming for a customer to add all the items he or she has collected. One nice option is, of course, to enable an AI-specific device that specifically recognises the collected items on the tray. This fastens the journey and leads to fewer errors by finding the right product on the UI. This is an

option, which is not yet super available in the market, but the trend I think is also going into that direction."

Summing up the main themes identified when analysing the responses, it has to be noted that there are plentiful hardware features available as options for both, self-ordering kiosks and self-checkout systems alike. Many of these features mainly focus on improving the shopping experience for the customer with support for certain types of cards or via integrated scanning possibilities, which optimise the steps required to finish a transaction at a self-service station. Technology based on artificial intelligence was brought to the attention as a rising trend that might offer promising business cases to food retailers. In the area of automatically scanning and identifying food items customers collected retailers could see an increase of throughput in the quick- and self-service restaurants.

4.2.3.2 Integration

There are two major themes investigated during the analysis of how self-service solutions could successfully be integrated into the existing store landscape of a food retailer. To begin with, interviewees have highlighted the importance of self-service devices being able to support interface technology that allows them to communicate with different systems in the IT environment of the retailer. This would significantly decrease the integration efforts and provide the possibility for an effective deployment of self-service solutions into the already available store systems. Solutions built on cloud technologies have been named as a further approach on achieving a flawless installation together with the retailer's equipment and overall architecture.

Secondly, the analysis of the collected data shows that it is vital for a retailer to adjust the store processes in a way that the self-service solutions are properly integrated into the operational workflows. This involves deliberately designing the available store space to incorporate the new self-service devices and it also means working with the provider of the SSTs to make the installation process as smooth as possible. Furthermore, the researcher has identified offline capability as being a key success factor of SSTs. It is required for self-service solutions to be fully functional and available for customers even in situations of missing or poor network connection to different systems of the IT environment in the store. SSTs with support for offline

functionalities are found to significantly drive overall success for the integration with the retailer.

Table 4.9 presents the identified codes related to the *integration capability* of self-ordering kiosks and self-checkout systems into the IT environment of food retailers.

Table 4.9: Data analysis - codes - integration

Theme: integration	**Total**	
	∑ **ref.**	∑ **items**
Technologies	10	10
Retailer's organisation and processes	7	6
Total	**17**	**16**

Source: Table by author.

Condensing the collected data has led to the development of codes, which capture the essence of what the interviewees expressed. These codes have then been reviewed closely to understand the challenge of integrating self-service solutions into an IT environment of a food retailer. The analysis shows that there are two major perspectives to be considered here. The first one relates to the preparation of the retailer for an SST strategy in terms of store design, staff management and overall cooperation with a supplier of SSTs. This view addresses factors, which help improve the integration of SSTs into stores from a processual and organisational standpoint. The second one covers technology-oriented topics of ensuring proper integration on a software and hardware level.

As per the responses by P1, the layout of the available retail floor in the store plays an important role when preparing the deployment of self-service solutions. P1 continued to elaborate on this by stating:

"You have to think about store operation workflows in combination with none self-checkout."

When introducing SSTs into the store environment, the existing layout already contains regular cash desks, which are operated by staff. New self-service systems need to be positioned in suitable locations within the store while reorienting the cash desks.

Options in this space are obviously limited by the available retail space of the store. Food retailers need to keep this in mind during the configuration and design of the selling floor. P4 recommended the following:

"You could have kiosks in a dedicated area, at best in front of the serving counter."

Throughout the subsequent conversation about this aspect, P4 further explained that the positioning of self-ordering kiosks at this location could work in favour of the overall customer flow within the store. Customers would be able to already identify the pick-up counters at which they can collect the food they order via the kiosk device. Existing equipment in the store might have to be repositioned to support this approach. The analysis also demonstrated that it is critical to embed staff into the conceptual design of where to position self-service devices. Supervisors need to be able to support customers using the self-service solutions while at the same time having the possibility to monitor the general stream of customers in the ordering area. Interviewees P2, P5 and P8 called for retailers to reserve enough space for this setup.

The second key perspective that drives the success of SST integrations with retail stores resides in the technological integration of hardware and software components. Looking at the technical challenges of connecting different solutions together with the goal of achieving a coherent and effective store operations mode, P9 provided a possible solution by outlining the following:

"From the area I work in, I think the key success is to work with the same or single provider, when it comes to the different deliveries like hardware and software, because this makes the integration much easier, if there is an existing solution already."

Working with the same technology and service provider could results in reduced integration efforts for a retailer. Ensuring a proper communication between the new self-service solutions and the already existing cash desks and server systems could more easily be achieved in a single-provider scenario. P8 raised a similar statement as P9 and said that a homogenous environment is preferred by food retailers, as it significantly decreases the costs of integration. This, however, is not always possible as there might be concerns from the retailer's side to be too dependent on one single partner providing the complete store equipment for managing the sales transactions.

Discussing this challenge for retailers with the interviewees resulted in further possibilities that could positively impact the integration activities. P3 provided the background as to why an integration of different pieces of technology often generates additional efforts and complications for the retailer:

"Software is the area that causes the most difficulty, providing a self-service software solution that's easy to integrate to the existing software environment or utilising the point-of-sale software to run the kiosk is key for an easy deployment."

Problems of integration could be addressed by integrating self-service solutions on top of the existing business logic that is used to operate the regular tills at the cash desks. This logic usually covers retailer-specific workflows as how to handle store operations of payment and accounting. Connecting new self-service devices to this software layer was a proposed strategy forward by interviewee P5. This could be achieved by utilising so-called application programming interfaces, which manage the tasks of establishing a reliable communication between self-service solutions and the IT environment of the food retailer. With a successful implementation, data can be exchanged without any problems regardless of the underlying technology or hardware of the devices involved. The researcher found this response in the interview data to be explicitly highlighted by P2 and P10, who both underscored the importance of SSTs supporting an application programming interface layer as a means for an integration with retailers' IT. P10 additionally introduced the idea of working with cloud-based technologies as a way to strengthen the flexibility and interoperability of the included solutions.

From a perspective of being responsible for successful product deliveries towards food retailers, P6 quite comprehensively summed up the essence of what is a critical success factor here:

"With regards to the software, the focus is on easy integration into the existing merchandise management system and the ability of the software to run on existing operating systems. The customer wants a homogeneous environment."

Next to the support for application programming interfaces, the researcher identified further aspects, which increase the integration success of self-service solutions for food retailers. P7 referred to the need of SSTs having to operate with master data such as product information or tax-relevant data in a standardised format. This could

significantly enhance the exchange process of data between all the self-service devices and systems of the retailer thanks to a commonly used structure of the data.

Considering the complexity of ensuring a working communication between all store IT devices is fully in place, retailers additionally demand the support for offline capabilities of all the solutions they offer to their customers. This would provide them with a further layer of making sure the solutions are up and running for their customers. P10 drew on the experience with a food retailer here:

"To give you an example that we have with our customer, there is still a definite requirement that all points of sales and all self-checkouts need to be offline-capable, meaning to be running by themselves, if necessary without network connection."

This requirement imposes a huge challenge for self-service solutions as they need to be completely functionable even without a communication to connected systems in the store. P10 further stated that retailers want to avoid any kind of disruption for their customers who are engaging with the different self-service offerings in the store. Having these devices available for customers is key priority. As a consequence, self-ordering kiosks and self-checkouts need to be designed in a way that allows for an autonomous operation in case of communication issues in the IT network of the retailer.

The analysis of the data collected for this area of SST success has exposed the following major success factors to focus on when integrating self-service solutions into an existing IT environment of a food retailer. The integration success can be increased by holistically considering and managing the introduction of SST devices from both, a store operations perspective and from the view of staff overseeing the new solutions. Positioning self-ordering kiosks and self-checkouts at the right locations within the store is as critical as enabling the personnel to incorporate the self-service solutions into the workflows of managing the ordering and serving of food. Moreover, integration from a technology standpoint comes along with multiple challenges, which include the support for stable communication of software and hardware as well as the capability of self-service solutions to operate flawlessly in an offline mode in case of connection issues in the store.

4.2.3.3 Security

Throughout the interview sessions and the subsequent data analysis it has become apparent that security-related concerns are mostly related to self-checkout systems and not to self-ordering kiosks. For the latter, any risk of potential fraud is reduced or almost eliminated as the customer firstly needs to pay at the kiosk before products are handed out. This minimises the possibilities for theft.

With self-checkout systems though retailers are considering various aspects of how to prevent customers from engaging in fraudulent behaviour, either on purpose or also by mistake caused by wrong usage of the system. Self-checkout devices themselves can serve as a way to reduce the risk in this regard by attaching them with security cameras to monitor customers' behaviour or with control scales to have customers correctly weigh selected food products. Technology based on artificial intelligence is identified as a potential lever to help drive the automated process of capturing the items collected at the self-checkout terminal. Interviewees have talked about placing cameras above the self-checkout system, which recognise the food products picked up by the customer. Upon identification, the products are directly registered with the self-checkout solution so that the chance for any potential mis-scan is significantly lowered.

Apart from technical solutions provided by the SST devices to address issues of security, the researcher also analyses process-related factors of ensuring the self-checkout operations are properly and securely handled. Interviewees have recommended putting in place supervisors to oversee the self-checkout terminals in order to make sure customers are using the devices correctly. Deciding on an adequate supervisor-to-SST-ratio here is critical and depends on the layout of the respective self-checkout area in the restaurant of the food retailer. Randomly performed spot checks are also identified as a suitable form of reducing fraud risk in self-checkout situations. In any way, close consultancy between retail technology manufacturers and retailers is considered as an effective form of enabling secure self-checkout scenarios.

Table 4.10 shows a summary of the developed codes that are assigned to the theme of *security*.

Table 4.10: Data analysis - codes - security

Theme: security	**Total**	
	∑ ref.	**∑ items**
Adaptation of staff and store processes	16	14
Mitigation via SST devices	10	10
Little to no risk	7	7
Store operations of retailer	3	3
Store operations and processes	2	2
Total	**38**	**36**

Source: Table by author.

When it comes to potential security risks for retailers in scenarios with self-ordering kiosks, the researcher has found that the responses of the interviewees showed a relatively clear picture. There was consensus amongst the respondents that there is little to no risk of fraud involved for use cases with self-ordering kiosks. Interviewees P4, P7 and P8 explained that customers would only be receiving the food items they actually paid for at the kiosk. Plus, the ordered food is generally handed out by store personnel, which further decreases the chance for possible fraud attempts. P3 laid this out accordingly:

"Generally this isn't an issue in order and pay solutions because the food has to be collected from a collection point."

Considering the SST type of self-checkout systems, the following observations were made throughout the data analysis phase. First of all, respondents noted that for self-checkouts the risk of fraudulent behaviour by customers is generally higher than with self-ordering kiosks. Since customers are usually unattended when scanning their collected food items at a self-checkout device, there is the potential for not registering certain products either intentionally or accidentally. P10 highlighted the overall context here and referred to discussions with food retailers:

"So we get a lot of requests for looking into how we can prevent fraud in this area, fraud on purpose or by mistake. It's important to distinguish between those two factors

as well – depending on how complex the self-checkout is built, it can also often happen that the customers just don't care and won't check everything exactly themselves."

P10 further elaborated that consultancy towards food retailers is important as to make them aware of security issues and advise them on how to address them. Potential ways of mitigating the risks associated with self-checkout systems being tricked by customers could be found in process adjustments related to store operations and staff management, but also in the setup of the self-checkout device itself. It is worth noting that as per P9 retailers account for this risk by including possible shrinkage in shopping use cases enabled and supported by self-checkouts:

"I think every retailer is basically calculating with a certain amount of mis-scans, because that's a little trade-off of giving that opportunity to the customer, but which by nature can lead to errors. As soon as you decide for it, that's the trade-off."

Shrinkage in retail is a major issue as it effectively means losing sales. Retailers therefore pay attention to technological solutions helping them in the reduction of possible shrinkage. Self-service solutions equipped with appropriate features to identify and even prevent this form of missing turnover could present a viable option for retailers to address this problem (Krafft and Mantrala, 2010; Niemeier, 2013; Beck, 2018).

The data analysis shows that retailers could allocate staff to oversee the self-checkout area located within the store as a way to lower the risk of fraud. Coworkers could provide supervision of the self-checkout lanes and also get in touch with customers supporting them throughout the checkout process. It is important though not to give customers the impression that they are being closely monitored. Respondents elaborated about the supervisor-to-SST ratio that plays a critical role here. Customers should be able to freely make use of the self-checkout systems with supervisors at the same time having an eye on the overall checkout activities in the store. P10 expressed the following in this regard:

"I mean what is the design on the floor, where do you position the self-checkout lanes, what is the visibility towards the supervisors who are looking to oversee that area? There we use our expertise to advise the retailers on what we believe is the scenarios with less fraud involved due to e.g. then the visibility of the self-checkouts. Then the

ratio of how many self-checkouts are being supervised by a person is something that we advise retailers on. To give you an indication – the setup is mostly leaning towards a 1:6 supervisor-to-SST ratio."

Overall, these forms of mitigating fraud risks mostly concern staff allocation and the arrangement of store processes to account for the presence of self-checkout systems. Interviewees P4 and P5 stated something similar about the challenge of reducing fraud risk in explaining the need of having store personnel overlooking and supporting customers alongside their shopping journeys. As per respondent P7 supervisors could also be tasked with performing spot checks in a regular frequency. This approach would allow for specific checks to be executed by staff without monitoring every single transaction closely:

"How to ensure all taken goods are paid without incommoding or searching the customers and spending too much time and money on it? Random spot checks by attendees are considered an economic compromise between risk and effort to reduce it."

As already indicated above, the data analysis furthermore has led to the development of codes and themes covering the setup and properties of the self-checkout systems themselves. To begin with, the hardware representing the self-checkout device has to be physically secured in terms of customers trying to break into the system directly. Respondents P1 and P2 discussed multiple factors to keep in mind here. These factors range from securing the self-checkout device and the accessible cabling to also safeguarding the user interface as to prevent technology-savvy customers from entering the operating system of the device. Similar statements were given by P4 who strongly called for SST devices to support a high level of hardening of the technology in order to permit any attempts on accessing the system internals.

The analysis of the interview data demonstrates that it is essential for retailers to properly design the process of how customers scan their collected food products at the self-checkout terminal. Both interviewees, P2 and P6 talked about equipping self-checkouts with suitable hardware-based options such as product scanners or checkweighers, which enable customers to reliably register their basket content with the device. Having easy-to-use and reliable peripherals in place here would dramatically reduce the risk of fraud or the number of accidental mis-scans by giving customers

effective tools to perform the scanning. This setup certainly helps improve the security and overall checkout experience for SST users, but still involves manual steps to be conducted by the customers. Respondents touched on this aspect as well and advised on incorporating technology based on artificial intelligence into the self-checkout device that would increase the level of automation. Camera systems could be utilised to handle the scanning of the food items available at the self-checkout station thereby eliminating the need for manual input by the customers. P9 explained the reasoning behind this as follows:

"If we use AI technology to scan the collected items, then this will of course reduce the risk of customers intentionally performing mis-scans of items, because the customer will see on the checkout screen what the camera detected. Retailers are giving the risk to the AI technology."

The idea is to place visual-based cameras above the self-checkout station to identify which items are being scanned by the customers. P2 and P10 outlined the benefits of this approach in stating that artificial intelligence would represent a scalable solution that could support a high number of self-checkout stations and lead to a significant improvement of the accuracy of items scanned. Senior product director P3, who is in charge of general product-related developments and designs, even went on to proclaim the following:

"For payment terminals there is a shrink risk, but this is low and AI will close this loophole in the immediate future."

As per the responses received by P4, a very prominent use case of a common security-related scenario in the area of quick- and self-service restaurants deals with age verification. If a food retailer's range of goods includes age-restricted items such as spirits and it's possible for customers to buy them using a self-service system, retailers need to make sure they comply with the corresponding sale restrictions. Respondents P2 and P6 touched on this topic as well outlining the importance of self-service devices having to support the sale of age-restricted products. P9 referred to this aspect as being one of the core reasons as to why the customer's shopping experience is paused:

"I think one bigger disruptor of kiosk solutions retailers have to cope with has to do with age restriction. Every time an item is scanned that requires an age restriction

check, an attendant needs to come, and that of course stops the process and requires a store coworker to come to the kiosk."

As a consequence, the coworker would then have to verify the age of the customer who is trying to buy an age-restricted product. This check results in a multitude of manual steps for both, customers and coworkers and tremendously slows down the overall shopping experience. The respondents P5 and P8 talked about a possible software-related approach to offset this break in the process and mitigate the impact on the workflows in the store. One solution lies in the implementation of facial recognition software as enabled by artificial intelligence technology. Self-service devices could be equipped with a camera system that determines the age of the customer trying to buy an age-restricted item. Such an approach would eliminate the need of coworkers having to stop their current tasks in the store in order to verify the customer's age themselves. As per P3 and P5 retailers are keen on these types of technologies, since they enable them to effectively utilise the available self-service systems for a large number security-relevant of use cases alongside the customer journey.

The analysis of the interview sessions has further led to the development of insights related to the prevention of fraud. This was something brought up by P2, vice president in the area of professional services, who stated:

"The software of kiosks and self-checkouts should support in identifying or even preventing fraud. Mis-scans by customers, of course either on purpose or by mistake, need to be shown on-screen."

The researcher continued to discuss this idea with P2 and explored the reasoning behind this. Food retailers would ask for options to make it fully transparent to the customer, who is using a self-checkout system, which items have been registered by the system. In case cameras detect an item that has not been manually scanned by the customer, there could be a message asking the customer, if all the contents of the whole basket were correctly scanned. Such a kind of message could help in reducing the fraud risk.

As a summary, the analysis of the responses to food retailers' security-related concerns about implementing self-service offerings in their stores results in some key findings. Critical success factors to reduce any potential fraud risks, or be it accidental mis-scans by customers, are mostly related to self-checkout scenarios and not to use cases

empowered by self-ordering kiosks. Important elements for retailers to consider revolve around the equipment of self-checkout terminals with suitable peripherals for registering collected food items or around the idea of employing visual-based camera technology grounded on artificial intelligence to automatically capture products at the checkout. Retailers are advised to evaluate and possibly re-work their processes of how store operations are handled by the available staff. This involves deciding on and ensuring a solid and effective supervisor-to-self-checkout ratio, which adds an extra layer of security by enabling overall monitoring and the execution of spot checks performed by personnel.

4.2.3.4 Payment

For the theme of *payment* three main codes have been identified during the data analysis phase. First of all, interviewees have declared that self-service solutions should support the traditional forms of payment such as cash-based or card-based transactions. These are the main types of payment as requested by food retailers with cash being primarily dependent on the country. For the case of Germany, cash has been identified to be a relevant payment form, that is favoured by customers. Given the legal requirements of providing customers in Germany with a way to pay via cash, SST devices are considered to support this feature as well.

Secondly, many respondents also have talked about retailer-specific payment methods, which are comprised of individual gift cards or vouchers. As a means to drive sales with self-service offerings and as a way to entice upselling, SSTs are expected to accept these custom types of payment. Finally, the researcher has found the mentioning of a possible trend in the collected data, which is about the rising call for the inclusion of online-based payment forms into the self-service solutions. Respondents have referred to food retailers asking for online payment methods, which are known to customers from the internet, to also be available on the SST devices.

Table 4.11 displays the data codes, which thematically belong to the category of payment.

Table 4.11: Data analysis - codes - payment

Theme: payment	**Total**	
	∑ ref.	**∑ items**
Traditional payment	22	21
Retailer-specific payment	7	7
Rising forms of payment	7	7
Total	**36**	**35**

Source: Table by author.

Amongst all responses, the interviewees clearly stated that retailers demand support for both, cash-based and non-cash-based forms of payment. The question of providing cash payment for self-ordering kiosks and self-checkouts appears to be vastly dependent on the country judging from the analysis of the interviews with P4, P7 and P9. In this context, P9 demonstrated the importance of having cash-based payment options:

"We still have very cash-heavy countries in the world. For those countries, cash is also an obligatory form of payment method that needs to be available to the customer. In case retailers don't offer cash-based SSTs, they need to have a cashier-operated desk in the store to accept cash payments."

This evaluation imposes a challenge for food retailers. Self-ordering kiosks and self-checkouts are oftentimes introduced as a way to increase the area productivity in the store and to achieve higher levels of efficiency. Leveraging upselling potentials on self-service devices is also key in implementing a successful SST offering for customers. Working with cash as a payment method might come along with the risks of slowing down the ordering process at a kiosk or the speed of how fast a transaction can be completed using a self-checkout device. Cash therefore could be seen as an obstacle in the strategy of accelerating and simplifying the ordering and checkout experiences for customers. In Germany, cash is considered a mandatory form of payment, meaning retailers need to offer cash-based payment options to their customers (Bundesministerium der Justiz, 2021b). This regulation can only be adjusted, if retailers prominently inform customers directly upon entering the store that cash can be used in a restricted way or not at all. German customers are leaning towards handling their

transactions via cash payments, which means such a limitation might not be in favour of the retailer and could lead to reduced utilisation of the self-service offerings (Brandt, 2017, 2021).

As analysed in chapter "4.2.3.1 Hardware quality", self-service devices support hardware options for cash-based payments. Equipping SSTs with cash appliances is possible, but leads to increased expenses for the retailer in terms of initial purchase costs and maintenance efforts in the long run. P10 detailed this as follows:

"If they [i.e. SSTs] are large, then they are expensive. If they have cash racks attached to them, they can be more expensive."

Looking at the investments for retailers to enable cash payments for their customers in self-service scenarios, focusing on adaptable SST devices could help increase the flexibility for retailers and to cope with customers' payment preferences. Having the possibility to adjust the support for certain payment methods is critical for retailers. Respondent P10 went on to explain:

"To give you an example – in year one, you can maybe have ten devices with support for cash and then in year two, due to the market development, cash is going down and you want to have only five SSTs."

Next to the subject of incorporating cash-based payment methods, the researcher also identified the requirements of retailers to have SSTs supporting cashless forms of payment. Most prominently, card-based media such as credit cards or debit cards range amongst the mostly requested types of payment methods. This was clearly elicited by both, P2 and P3 who declared card payment as being the most important option. Card-based media also include retailer-specific loyalty cards or gift cards. Interviewees P1 and P4 raised this point and referred to food retailers seeking for support of their dedicated card types. P5, P8 and P9 discussed this requirement in more detail by outlining that gift cards could be used by retailers as a means to promote self-service solutions to customers. Issuing coupons or gift cards attached to certain promotional events in the store could significantly increase usage of the self-service systems. P9 stated in this context:

"Retailers want to interact with customers by giving them the option to use gift cards or voucher cards."

Gift cards can usually be bought by customers with a pre-loaded amount of currency attached to them. They are often used as presents or small gifts for family members or friends to entice shopping activities with that specific retailer. Vouchers can be issued by retailers themselves towards customers as a way of promoting certain product sales. Having SSTs placed in the store, which provide support for these special forms of cards, allows customers to redeem their gift cards or vouchers directly at the self-ordering kiosk or self-checkout. As a consequence, retailers strongly demand for SSTs to allow payment via those forms of cards to benefit from the increase in turnover. The just analysed forms of payment are attributed to both, self-ordering kiosks and self-checkouts by the interviewees.

Overall, the analysis shows that contactless payment in general is gaining more relevance. This can also be observed based on statistical analyses carried out in Germany (Ahrens, 2022; Statista Research Department, 2022). Retailers wish for their customers to be able to pay at a self-ordering kiosk or self-checkout system without even entering any payment-related information such as personal verification codes. Instead, contactless payment is the preferred approach as a means to only hold one's card in front of the card reader and finish the transaction effortlessly. Respondents highlighted this idea specifically, since retailers would constantly be looking for ways to improve the shopping experience for customers by processes, which cause the least amount of friction or number of interruptions.

Continuing with the notion of contactless payment, P10 gave an outlook as to which types of payment methods are currently being identified as trend topics:

"What we see coming up now is what we like to call the 'new payment media types' driven by the online world, but also by in-store behaviour of shopping with your smartphone. We see a high demand for them coming up now with our customers and we see as well that this significantly increases over the next years."

The concept behind these new types of payment media is that customers rely on their payment accounts to be set up on their mobile phones. There are multiple payment solutions available depending on the respective country. At a retail store, customers then use their mobile phones to pay at the self-ordering kiosk or self-checkout. Usually the communication between the mobile phone and the self-service solution is processed via QR code data. The support for this type of technology is therefore considered a vital

part of any future-proof self-service offering as already highlighted in chapter “4.2.3.1 Hardware quality”. Using these new payment media types retailers enable customers to easily pay at any self-service system without the need of having to adjust to a limited selection of possible payment methods reliant on cash or specific types of cards.

As a summary of the theme dealing with payment options for SST offerings, the researcher has condensed the interview responses to a few key concepts, which drive implementation success of self-service solutions for food retailers in quick- and self-service restaurants in Germany. First and foremost, support for cash-based payment is considered a mandatory feature depending on national regulations and customers’ shopping behaviour. Retailers request SSTs to work with cash payment, but they would like to be flexible in the concrete configuration and adaptability of providing a cash-based payment option to customers, since this comes with increased costs. Secondly, traditional card-based payments such as credit cards or debit cards are staples, when it comes to offering payment methods to customers on self-service devices. They are complemented by retailer-specific card types covering gift cards or coupon functionalities, which aim at enticing upselling. The researcher also identifies contactless forms of payment as a rising trend for food retailers and customers alike as these types provide a high level of flexibility for both parties involved in processing the payment without lots of manual efforts.

4.2.4 Service quality

As part of DeLone and McLean’s updated IS Success Model, there are three variables mentioned for the success dimension of *service quality* (DeLone and McLean, 2003). These success variables are *assurance*, *empathy* and *responsiveness*. DeLone and McLean explain the introduction of the category of *service quality* into their IS success model with the rising importance of service-related aspects of information systems, which should be explicitly dealt with in parallel to the core properties already covered via *information quality* and *system quality*. Considering the focus of this study on self-service solutions the researcher also sets out to identify and describe success determinants associated with the quality of the service that is provided by the SST.

Based on the analysis of the gathered data two specific themes have emerged, which can be linked to the success dimension of *service quality*. These two themes cover success factors related to the *accessibility* of the self-service solutions for handicapped

customers as well as variables related to the overall *availability* of the devices from a technical and organisational point of view. Summaries of the underlying data codes generated can be found in the subsequent chapters “4.2.4.1 Accessibility” and “4.2.4.2 Availability”. From a service quality perspective, self-service solutions are found to be required to provide accessibility features for customers. This would allow for a wide audience to make use of these devices in self-service restaurant environments. Alongside with that, food retailers demand SSTs to be functionally available for their users and therefore rely on service level agreements with SST providers to ensure the solutions are up and running.

Table 4.12 holds an overview of the identified and explored upon SST success determinants, which can be assigned to the success dimension of *service quality*.

Table 4.12: Success dimension - service quality

Service quality	**Accessibility**	
	Accessibility support	Multi-language support
	Availability	
	Managed services	Reliability
	Offline capability	

Source: Table by author.

The success dimension *service quality* represents two major sets of success factors, which are connected with the *accessibility* and *availability* of the self-service technology as a whole. The term of service in the retail industry is often associated with broader concepts such as customer service, technology or fulfilment strategies in multi-channel and omni-channel networks (Kim and Kandampully, 2012; Wollenburg, Holzapfel and Hübner, 2019). As such, the matter of *service quality* needs to be explicitly outlined for the particular use case. For the scope of this study, the purpose is to investigate the collected data while specifically considering service quality-related aspects of SSTs as deployed in quick- and self-service restaurants in Germany.

The results of this study have led to the identification of *accessibility support* as a success determinant in this area. This factor covers the level as to which a self-ordering kiosk or self-checkout system deployed in self-service restaurants is equipped with

features aimed at increasing the accessibility for users. The concrete specification about how an SST is in support of accessibility functionalities depends on the respective type of self-service device. The findings of the research programme show that hardware-related solutions can be seen in the form of height-adjustable devices, which can be mounted at varying positions and locations within the restaurant. Moreover, possibilities for high-contrast settings of the screen or inclusion of audio cues providing instructions for customers can be integrated into the software system of an SST. A combination of both has been found to appear in the design of a keypad device that allows for frictionless navigation of controls on the user interface. The researcher therefore defines *accessibility support* as a success factor within the dimension of *service quality*. When talking about *accessibility support*, it is required to consider legal requirements and obligations put in place by governments, which further impact the need for the integration of accessibility features into SSTs. The investigation in this context demonstrates that with a rising number of required features it becomes more complex for SST providers to develop suitable technical solutions while also offering a moderate level of standardisation across the accessibility features.

The availability of the literature regarding the support for and implementation of accessibility features in self-service scenarios is found to be sparse. Investigations in this field appear to be in an early and rather experimental state as to evaluate effective solutions, which could turn out to be meaningful (Jokisuu *et al.*, 2015; Darzentas and Petrie, 2018; Petrie and Darzentas, 2018). The importance of this topic is high and this is why the researcher opted for including the success determinant of *accessibility support* in the *service quality* dimension of understanding SST success. With regulations being put in place, such as the European Accessibility Act and the Americans with Disabilities Act, food retailers need to have accessibility-related features in their view when embracing a self-service strategy for quick- and self-service restaurants (Americans with Disabilities Act, 1990; Official Journal of the European Union, 2019).

Next to the challenging topic for SST providers and food retailers alike to increase the accessibility of self-service solutions, a further success determinant has emerged from the results of the research programme. *Multi-language support* has been defined as being part of the *service quality* dimension in the success framework. As a finding of this study, the interactive controls available on the screen of the self-service devices

need to be translatable. This feature improves customer acceptance and is investigated to be a success factor even in local markets such as Germany. Support for the most relevant languages in the market can help increase SST accessibility for and usage by customers.

The second major theme within the success dimension of *service quality* revolves around factors related to the *availability* of self-service technologies. Considering the conceptual framework as defined in this research project, it needs to be stated that within the DeLone and McLean's updated IS Success Model variables concerning *availability* are assigned to the *system quality* dimension (DeLone and McLean, 2003). In detail, the two success factors of *availability* and *reliability* show up in this specific dimension as parts of the DeLone and McLean's IS Success Model. The argument can be made here that the availability of an SST depends on the characteristics of the underlying system components, which are rather to be found as belonging to *system quality* measurements. The researcher acknowledges this viewpoint, since it is essential to have a reliable system in the first place to arrive at a sufficiently high level of overall service availability of the complete solution. However, the question of having a self-service solution functionally up and running for usage by customers can better be answered by considering service-related manners of achieving a high availability of the whole service, not of the single system. Building on top of reliable SST system components is considered a prerequisite for ensuring the overarching service features as offered by the SST devices are available for consumption by customers. This is why factors related to *availability* and *reliability* are associated with the *service quality* dimension in this research programme.

The success factor of *reliability* has already been touched upon here and marks a key determinant in the process of setting up solid SSTs. This success determinant is further complemented by an *offline capability* of self-service solutions. The results of this study clearly demonstrate that food retailers put emphasis on their installed SSTs to be able to work in an offline mode. This ensures the offered services are available for usage by customers even in cases of technical connectivity problems in the store. Therefore, the SST success determinant of *offline capability* has been included in the dimension of *service quality*.

As a whole, the findings of the study have led to the development of the success factor *managed services* in the theme of *availability* of self-service solutions. The construct of *managed services* encompasses any form of agreement between a retail technology manufacturer and a food retailer receiving and utilising the delivered products and services. Usually, this concept goes along with the definition of so-called service level agreements, which both parties mutually define. These service level agreements (SLAs) dictate the expected level of *availability* of the SSTs and also describe actions, preventive ones as well as corrective ones, to secure the adherence to the agreements. Working with SLAs in a managed mode of service operations is identified to be critical for the success of SSTs in food retailer's store environments. Providing highly available solutions to customers is therefore key and considered an essential success factor in terms of overall *service quality*.

The two themes of *accessibility* and *availability* are further detailed in the following sections of "4.2.4.1 Accessibility" and "4.2.4.2 Availability" by presenting the codes associated with them in a summarising manner.

4.2.4.1 Accessibility

The industry experts have shared their thoughts and experiences from working with food retailers to make SST solutions accessible for customers. The analysis in this regard shows that it is considered very important by retailers for self-service devices to offer accessibility features that help make them usable and approachable by handicapped customers. This topic is expected to gain more relevance and attention in the industry and food retailers are looking for options with their technology providers to deploy accessible devices into their restaurants.

The interviewees have also made it clear that there are many ways of addressing the call for accessible solutions by either adjusting the SST hardware or the corresponding software. Available options here range from having sizeable SST devices, which can be mounted in varying positions and heights in the store, to providing special keypads or interfaces for accessing the controls on the screen. The investigations also demonstrate though that there is no common ground yet on how to implement accessibility features from a multi-national or global viewpoint. This remains an ongoing challenge for both, retail technology manufacturers and food retailers offering these solutions to their customers.

Table 4.13 provides an overview of the identified codes for the overarching theme of accessibility that has been explored upon within the data analysis phase.

Table 4.13: Data analysis - codes - accessibility

Theme: accessibility	**Total**	
	∑ ref.	**∑ items**
Solutions and approaches	11	11
Rising importance	11	9
Total	**22**	**20**

Source: Table by author.

To begin with, P9 clearly stated the rising importance of covering accessibility-related features in the design and delivery of self-service offerings:

"I think that accessibility features will get more and more relevant during 2022 and next years, because it seems that the European Union and other forms of governments and regulations are putting that much more into focus that handicapped people can access self-checkouts and in general, of course, other solutions. So that is a big trend."

As per comments by P10, equipping self-service devices with accessibility features is considered mandatory in some countries already, such as with the Americans with Disabilities Act in the United States (Americans with Disabilities Act, 1990). This indicates the importance of including questions of accessibility in the design and configuration of self-service solutions in retail. The analysis of the interview data showed that there appears to be no concrete and well-formulated idea of how the requirements in this context can be turned into specific product features. It seems to be especially relevant for retail technology manufacturers providing solutions on a multi-national level to different retailers and industries. P9 concluded:

"But looking on it from a global perspective, finding a standard will be difficult. I am pretty sure that we need to follow different approaches depending on countries and maybe try to find bundles of standards that we can implement by either adjusting the hardware or adjusting the software."

For smaller vendors supplying a specific branch of industry or country only, the challenge could be of lower impact, since the accessibility features could be more easily incorporated into the self-service devices and solutions. Covering legal requirements and retailers' interests while trying to define a level of standardisation across self-service offerings remains a demanding task for any supplier operating on a broader scale.

The interviewees talked about some solutions, which are already in place to cover accessibility-related requirements. Senior product director P3 showcased the available options:

"Our entire range has the option of being fitted with an accessibility keypad, which means the touchscreen can be controlled with a navigation system, the systems also have the possibility of headphones, high contrast screen changes and hearing loops."

The feature of equipping a self-service device with a keypad that allows the customer to navigate to every element on the user interface was also brought up by P7 and P8 in the course of the interviews. In addition to that, there could also be options for handicapped customers to activate a software function on the screen that moves the contents of the user interface to the lower part of the large touchscreen. This would enable them to better reach the sections of the screen to interact with. As per P5, retailers also need to consider the height in which they position self-ordering kiosks on corresponding poles or walls in the store. Having flexible solutions to lower or increase the height of the kiosks on these mounting points is strongly recommended and helps improve the acceptance of self-service technologies by handicapped customers.

P4 raised the aspect of enabling self-service solutions with support for multiple languages and easy-to-read literals and symbols on the screen. Food retailers should keep this in mind when deciding upon the layout of the user interface of a self-ordering kiosk for example. The information presented on the screen needs to be simple to grasp with possible actions for the user to take being prominently highlighted. P4 and P8 elaborated that this includes on-screen actions such as selecting food items, finishing a transaction or utilising a help button to call for an attendant. All of these accessibility-related aspects can significantly drive the success of SSTs and their acceptance by customers.

As a summary, the researcher identifies that the interest in and call for SSTs supporting accessibility-related options is huge and recognised on a global scale with a variety of regulations and use cases to cover for. There is, however, no best practice in the industry yet as how to effectively design and implement self-service offerings for retailers with accessibility features included. Current answers in this regard involve software- and hardware-related tools to increase the usability of self-service devices for handicapped persons, such as keypads, height-adjustable SSTs or software-based means to make the self-service systems more accessible. The analysis also demonstrates that the availability of accessibility-related features contributes to the success of SSTs and their acceptance by customers using them.

4.2.4.2 Availability

The core finding in the area of SST availability for retailers has been identified as being covered by the concepts of managed services and service level agreements between technology providers and food retailers. The interviewees have referred to the idea of defining specific service level agreements, which cover the contractually obliged availability level of self-service solutions delivered by technology manufacturers. This construct is required to make sure both parties align on dedicated levels of availability and on corrective actions that need to be taken in case of service disruptions.

From a technological standpoint, it is of critical success for self-service devices to operate reliably as to adhere to the service availability levels declared in the agreements. Offline capabilities of SSTs have been raised here as a viable way to ensure the systems are up and running in case of network failures. Respondents have also given examples of preventive maintenance methods that could be put in place alongside the actual SST device itself. Closely monitoring the status of self-service solutions and resolving technical incidents in a timely manner are key success factors for food retailers, as they want to avoid any kind of service failure and seek to provide fully-functional SSTs to their customers all the time.

Table 4.14 presents the developed codes that relate to the theme of *availability* of SST solutions.

Table 4.14: Data analysis - codes - availability

Theme: availability	**Total**	
	∑ ref.	**∑ items**
Managed services and SLAs	24	23
SST	2	2
Hardware	1	1
Retailer-focused	1	1
Total	**28**	**27**

Source: Table by author.

The analysis of the data collected for this topic has generated a set of codes, which are combined into a coherent picture of how high SST availability is addressed with food retailers. The consensus within the responses given by the interviewees lies in the definition of contractual arrangements between food retailers and retail technology manufacturers in the form of service level agreements. This has been especially highlighted by P1 and P2, who both are in charge of successfully delivering and maintaining self-service solutions for food retailers. P6 explained this as follows:

"High availability is ensured through the introduction of managed services including processes, monitoring, remote diagnostics and helpdesk."

These agreements define the targeted availability level of self-service solutions and outline processes of how corrective actions can be taken to fix operational issues. As per P4 and P7, there are often industry standards, which are referred to as a baseline for the service levels. These cover the average outage times of self-service solutions on a yearly scale e.g. and clearly describe instructions on how to raise and escalate any kind of operational problem with the responsible provider. Therefore, it is critical for a retailer to look for stable self-service solutions from manufacturers as to achieve a high uptime of the SST offerings. P3 added something similar to what P4 already discussed:

"Having robust solutions with low failure rates is the first crucial element."

The researcher received many responses touching on the capabilities of the SST devices themselves. To begin with, P4 referred to the requirement of having stable SST solutions with a high system reliability in place:

"Frequent system outages would heavily eat into the cost saving benefits as well as the customer experience."

Having stable systems is necessary as to allow customers to feel comfortable with the self-service offerings and to support increased turnover for the food retailer. Three interview participants – P1, P2 and P10 – elaborated on the success factor of providing retailers with reliable self-service systems in detail. They presented ways of how a solution ensuring a high level of availability can be made possible from a technological perspective. The analysis here showed that preventive maintenance measures make up a key element in securing a stable self-service infrastructure towards retailers. P10 showcased the process of how preventive maintenance works:

"It can also be done with more modern technologies, which basically look into going to solve problems before they really appear, meaning that there is analysis on the data, the log files onto the system, which really try to recognise a pattern potentially leading into an issue, which was known e.g. from other areas."

The main idea is to make use of technological tools to constantly monitor the self-service devices and spot any kind of irregularity, that might lead to a malfunction of the system. Upon identification of the failure potential of the system, corrective actions are initiated to solve the issue before it actually presents itself to the retailer or even to the end customer using the device. P1 explained the vast benefits of this approach, which enables a retailer to be always informed about the exact status of the self-service technologies. Working with methods of preventive maintenance and remote diagnostics helps ensure a high level of SST availability for the food retailer.

In parallel to the advice for retailers to take precautionary measures, interviewees P2 and P9 stated the importance of defining service level agreements between the food retailer and the technology manufacturer, which cement the defined availability figures. Agreeing on these service levels with retail technology providers comes with certain costs attached for the food retailer. Detailed costing was not discussed throughout the interviews as this is quite specific to the retailer and use cases covered by the service

level agreements. It needs to be underscored though that the higher the contractually defined availability level the higher the associated costs are. P7 illustrated this as follows:

"Retailers are aware that 100% uptime is impossible and each additional percent of uptime beyond 90% or 95% comes at a significantly higher price than the previous one."

Interviewees P5 and P8 referred to the requirement by retailers that self-service solutions are supposed to be working in an offline mode as well to account for potential network-related problems in the IT setup of the retail store. This additional layer of technical capability helps to make sure SST devices are available for customers and therefore marks a vital component of providing retailers with highly available self-service solutions.

Summing up the data analysis performed for the *availability* of SSTs, it needs to be noted that service level agreements between food retailers and retail technology providers are the essential contractual vehicle to define and ensure the desired level of SST availability. Key approaches to technically deliver highly available self-service solutions to retailers can be found in methods of preventive maintenance and in an overarching support structure to identify, troubleshoot and resolve incidents in a fast manner. There is a trade-off to be made by food retailers between the benefits of a stable and robust self-service offering for customers and the costs involved with putting these solutions and the underlying support services in place.

4.2.5 Store management and operations

In the course of the data analysis phase the researcher has explored a set of identified success variables, which could not be matched to any of the existing success dimensions as available in DeLone and McLean's updated IS Success Model (DeLone and McLean, 2003). The findings that emerge from the close evaluation of the collected data indicate that an additional success dimension needs to be created to properly account for the expressed themes. The data codes developed throughout the analysis were therefore arranged in two themes, which deal with *staff acceptance* of self-service solutions in the German retail food sector of quick- and self-service restaurants and with *staff*

management in this field. The individual codes are presented accordingly in chapters "4.2.5.1 Staff acceptance" and "4.2.5.2 Staff management".

It seems adequate to firstly bundle the analysed data codes into suitable success determinants, which could then be linked to these two themes. The success factors thereby represent a certain collection of data codes investigated in the analysis phase. In a second step, the researcher assigned these success factors to the overarching success dimension of *store management and operations*. This success dimension marks a new addition to the existing dimensions within the updated IS success model as laid out by DeLone and McLean and focuses on the themes related to staff and store processes, which were identified and explored upon for the concrete use case of SST success in the German retail food industry of quick- and self-service restaurants (DeLone and McLean, 2003). The focus of the dimension of *store management and operations* is to encompass the success variables, which have been examined for this specific field of application.

Table 4.15 provides the developed success determinants, which relate to the overall dimension of *store management and operations*.

Table 4.15: Success dimension - store management and operations

Store management and operations	**Staff acceptance**	
	Change management	Staff training
	Staff management	
	Staff reallocation	Store processes

Source: Table by author.

The success dimension of *store management and operations* covers factors, which describe the *staff acceptance* of SSTs and how these devices are introduced into retail stores. The theme of *staff acceptance* thereby leans closely towards the concept of customer acceptance of technology, which has been investigated in detail in the preceding literature review. For this specific use case, the key theme centres around SST acceptance by the retail staff and further illustrates the adoption process of how employees experience the implementation of a self-service strategy by their employer. The situation here is comparable to the subject of how technology is accepted and

utilised by customers as outlined in corresponding models of TAM and its two iterations (Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008). However, with the scenario at hand retail employees are not the targeted user base that is supposed to be interacting with the SST devices. Employees rather might be afraid of losing their job as they could be replaced by self-service solutions, which then take up the roles they were used to cover (Verhoef *et al.*, 2009). So the matter of *staff acceptance* of SSTs needs to be considered from a slightly different angle while keeping general constructs of technology acceptance in close reach.

In this domain, two major success determinants have been identified and explored upon in the research programme – *change management* and *staff training*. The success factor of *change management* covers the process of how food retailers plan and execute a strategy of adding self-service solutions to their restaurant facilities. This aspect is mainly concerned with employee-facing communication of incorporating SSTs into the workplace. The organisational perspective, that is adopted here, has already been touched upon in the literature review, when dealing with the impacts of an information system on the individual and the organisation as a whole. These two dimensions are parts of the original IS success model by DeLone and McLean (DeLone and McLean, 1992). With the release of the updated success model, DeLone and McLean (2003) included feedback by Seddon *et al.* (1999) as to consider a contextual perspective and therefore subsumed the question of which stakeholder is impacted by an IS into the dimension of *net benefits*. For the scope of this study, the researcher opts for a separate treatment of *store management and operations* via a dedicated success dimension as opposed to including the factors identified here under the rather general term of *net benefits*. This deliberate creation of a specific success dimension would allow for a concrete analysis of success determinants related to retail personnel and processes in the field of SST applications in quick- and self-service restaurants. *Change management* is found to be a decisive factor in achieving high *staff acceptance* of SSTs. The definition of careful communication and integration processes is required by food retailers to make sure the introduction of self-service devices into the existing work environment is well received by retail staff. This is especially relevant, if SSTs are supposed to cover job routines, which have previously been taken care of by store personnel (Kotter, 1995; Lauer, 2010).

This study also demonstrates that the success factor of *staff training* is critical in achieving *staff acceptance* of SSTs. The retail personnel has to be educated on the purpose and the handling of the SST devices. Food retailers need to make sure staff is competent in helping customers who are using the self-service solutions. This involves retail employees being trained to effectively support in cases of irregular situations at the SST devices, when there are error messages or unexpected system issues. The study shows that there is a necessity to have retail personnel around the self-service areas in the restaurants to offer consultancy to customers who might be rather unfamiliar with these types of technologies. Such training activities would enable staff to manage tasks related to supporting customers in the ordering and checkout processes (EHI Retail Institute and Horst, 2015; Riehle, 2019).

Within the success dimension of *store management and operations*, the researcher has identified two success criteria, which are assigned to the theme of *staff management*. These factors cover how *staff reallocation* in a self-service restaurant can contribute to the success of SSTs and help achieve better efficiencies of *store processes* overall. The analysis of the collected data clearly demonstrates that food retailers expect efficiency gains as a consequence of adopting an SST strategy in their restaurants. Depending on how self-service solutions are integrated into the store layout, a required change in the working routines of retail staff becomes mandatory. The success determinant *staff reallocation* captures the different possibilities in this regard and serves as a factor to effectively distribute the task structure of retail personnel in accordance with the newly added self-service devices.

The researcher explores concrete measures food retailers could be putting in place to benefit from a deliberate reallocation of staff. The potential for staff to execute different kinds of work tasks is huge given that personnel is freed up from traditional routines of accepting orders by customers and handling payment transactions. Both of these tasks are now predominantly covered by SSTs. The results of the study found that retail employees could be tasked with engaging in service activities with their customers. Enticing upselling or promoting special events in the store are found to be prime examples of how staff can interact with customers in the restaurants. Investigations in this area show that employees could find themselves in service-oriented roles of assisting customers alongside their shopping journeys and in roles of providing them for example with further details on food menus and ingredients. For the specific use case of

operating in quick- and self-service restaurants, the research project discovers that a change in the way of how the food is being prepared in the kitchen is likely required. Due to the fact that the order creation is primarily handled by self-ordering kiosks, the existing staff can shift from a mode of preparing food products to be held on shelves to a just-in-time preparation mode. Unassigning personnel from handling the order and payment processes creates the potential for food retailers to deliver food in an optimised way focusing on getting the food readily delivered to customers in the restaurants.

The above mentioned aspect of *staff reallocation* has been explored upon in detail in the course of this study and marks a major success factor within the dimension of *store management and operations*. The introduction of SSTs into quick- and self-service restaurants cannot be mistaken for a direct replacement of employees with machines. Instead, self-service solutions provide food retailers with the unique possibility of reallocating staff to those roles in the store, which are designed to deliver high-quality services and food products to customers.

The core premise of achieving a higher level of automation in self-service restaurants by adopting an SST strategy is also encapsulated in the success determinant of *store processes*. Redistributing tasks and working processes in the store by defining and following a suitable mixture of workforce and self-service solutions is critical for the success of SSTs in food retail. The analysis of the collected data demonstrates that efficiency gains rank amongst the mostly desired goals, when food retailers opt for a self-service strategy. A mere addition of SSTs to the restaurants without adjusting neither the allocation of staff nor the structure of the *store processes* regarding food ordering and preparation has been noticeably determined to be short-sighted. To account for the presence of self-ordering kiosks and self-checkout systems in the stores an adaptation of the operational processes to include these solutions is required (Kimes, 2008; Castro, Atkinson and Ezell, 2012; EHI Retail Institute and Horst, 2015).

As a way to display the explored data related to the themes of *staff acceptance* and *staff management* the subsequent two chapters of “4.2.5.1 Staff acceptance” and “4.2.5.2 Staff management” hold an overview of the identified codes in these contexts.

4.2.5.1 Staff acceptance

The analysis of the collected interview data has required the researcher to take a close look at the theme of *staff acceptance* of self-service solutions. The main ideas found within the interviews revolve around drawing food retailers' attention to the goal of making sure an SST strategy is well accepted by the staff working in the quick- and self-service restaurants. Sensitive communication in the course of an adequate change management approach is identified as a key method to improve the acceptance of SSTs by the retail staff. The experts have elaborated on the need for food retailers to carefully introduce self-service solutions into store environments by gaining *staff acceptance* early in the process. This could be achieved by clearly outlining the purpose of the SSTs, the shopping use cases they are supposed to support in the store and by also involving the staff in accompanying this strategy from the beginning. With such a setup of well-communicated activities food retailers could successfully implement self-service offerings and at the same time achieve acceptance by the employees.

Table 4.16 showcases the results of the coding exercise for the identified theme of *staff acceptance* of SST solutions.

Table 4.16: Data analysis - codes - staff acceptance

Theme: staff acceptance	**Total**	
	∑ ref.	**∑ items**
Change management	8	7
Staff	2	2
Total	**10**	**9**

Source: Table by author.

Utilising self-service solutions to manage the processes of ordering and payment leads to staff being freed up. Within the interviews the researcher has explored many options with the experts of how staff could be effectively reassigned to cover different tasks occurring alongside the customer shopping journey in the store. As per P5 and P9, this could involve providing support to customers when issuing orders, explaining how to use the new systems or even advertising sales going on in the store.

The analysis of the data also indicates that the possibility of redistributing staff across the store could also lead to the personnel feeling their jobs are at risk. Respondents P6, P9 and P10 explicitly touched on this sensitive topic, which arises for many employees, when the food retailer they work for implements a strategy around the introduction of self-service solutions. P10 shared lessons learned from working in self-service projects with retailers, which illustrate that coworkers are afraid of technology and automation possibly taking over their jobs.

During the subsequent discussions of how to address these issues P6 and P9 advised retailers to be extremely cautious in their way of planning self-service strategies and introducing these types of technologies into the existing store operations. As per the responses by P9, careful communication towards employees is key here. The introduction of a self-service strategy moreover needs to be accompanied by a sensitive change management approach. These two aspects have been identified as major success factors in the process of implementing self-service solutions as a retailer and gaining a high level of acceptance by the staff. P10 made it very clear that reallocation of staff away from ordering and payment towards more service-oriented roles of supporting customers in the store would still be up for the food retailer to decide:

"But it is always the retailers' decision on how they want to use the freed-up time that comes out of implementing these kinds of self-service solutions. We have seen it with different customers acting differently. If you want to save the maximum amount of costs, the staff costs can, of course, be reduced as well. If you don't want to do that, then you can offer more high-quality customer service."

The interview with P5 demonstrated that there is a general perception in the minds of customers that any form of technological solution brought into the store would predominantly lead to employees losing their jobs. P5 counteracted this perception by stating:

"One factor, which is really visible is that you think, from an end customer point of view, you could remove all of the cashiers that were engaged before, but that you actually have to shift personnel, because the customer journey as such is demanding a different kind of service, is something the end customers do not really see."

The staff of the retailer needs to be properly involved when introducing self-ordering kiosks and self-checkout solutions to the existing store landscape. The solutions require careful communication on the side of the food retailer as to make sure the store personnel is well informed and trained on what the new offerings mean for the operational workflows in the restaurant or retail floor overall. P3 stated two key success factors from experiences with food retailers:

"Getting staff acceptance and operationalising the solution in the correct way are critical factors."

Summing up the analysis of the theme of *staff acceptance,* implementing deliberate and sensitive communication as part of a change management programme is highly recommended to gain *staff acceptance* of the self-service solutions. Additionally, staff training is required to ensure employees are familiar with the self-service solutions and the overall strategy of the food retailer that surrounds the implementation of self-ordering kiosks and self-checkouts in the restaurant area.

4.2.5.2 Staff management

The researcher explores the theme of possible staff reallocation as a consequence or side effect of food retailers engaging in self-service strategies. As per the interviewed experts, retailers are faced with the question of how to effectively reallocate the existing staff in quick- and self-service restaurants, when SSTs devices are deployed. Self-service solutions usually cover order and pay activities, which have previously been handled by employees. An endeavour of adding self-service devices to the restaurants marks a huge change for the personnel, and the interviews show that it is up for the retailers to decide on the future work focus of their staff. With self-service offerings aiming at improving overall store efficiencies and increasing the level of automation, food retailers are tasked with remodelling the scope of work of the retail personnel.

Interviewees have shared their experiences of working with retailers in these situations. Key success criteria mainly point to the rising opportunity in this field for staff to turn into more service-oriented roles as opposed to simply handling the acceptance of orders and payments. This could be a tremendous chance for food retailers to provide high-quality services to customers alongside their shopping journey by assigning staff to corresponding tasks in this segment. Prime examples for new staff roles here are found

in offering consultancy to customers for food-related questions, in providing support to consumers about the use of SST devices or even in promoting special product sales in the store.

The analysis of the data furthermore underlines that the introduction of SST solutions is paired with a required adaptation of the food preparation processes in the self-service restaurants. Having self-ordering kiosks or self-checkout systems available in the store induces a change in the store operations of managing the order handling, the meal preparation and the delivery of the food to customers. The experts explicitly highlight the need for food retailers to be aware of how an SST strategy impacts the overall design of store processes and their execution from an operational perspective. This includes for instance to understand the customer journey in the store and to position the SSTs in effective locations to enable suitable shopping scenarios. Putting in place a well-constructed workflow mode in the restaurant, that amplifies the benefits of self-service offerings in combination with deliberately assigned work tasks executed by staff, has been identified to be a significant SST success factor.

Table 4.17 gives an overview of the data codes, which correspond with the theme of *staff management* when introducing SST solutions into quick- and self-service restaurants.

Table 4.17: Data analysis - codes - staff management

Theme: staff management	**Total**	
	∑ ref.	**∑ items**
Staff reallocation and training	28	23
Retailer-focused	25	23
Retailer and positioning in the store	9	9
Increased efficiencies	8	8
Customer-focused	5	4
Store operations of retailer	3	3
Staff	3	2
Total	**81**	**72**

Source: Table by author.

Respondents have raised the aspect of increased efficiencies for a retailer, that could be achieved by the introduction of self-service solutions into quick- and self-service restaurants. This relates to both, better store efficiency overall and higher productivity and efficiency of the staff. Interviewees P1 and P3 clearly referred to the reduction of queues in the store with self-service systems being available for issuing food orders. This completely changes how customers actually put in place their desired orders – P3 explained this as follows:

"The self-ordering kiosk overall takes tasks away from staff such as ordering and payment, which frees up their time for other tasks within the store."

P2 and P6 shared similar thoughts and elaborated on their experiences with retailers that the incorporation of SSTs into the store layout and processes could result in a reallocation of coworkers to perform different jobs. Working as a cashier behind a desk accepting orders and payments by customers could be exhausting for retail staff as per the insights shared by P10:

"If they have a manned station, they feel very pressured to keep KPIs [key performance indicators] meaning one customer has to go as quickly as possible after the next one, because it is about avoiding queues and guaranteeing then the throughput."

The analysis of the interviews has led to the generation of many possibilities for staff to engage with customers in quick- and self-service restaurants next to the traditional tasks of accepting orders and managing the payment. The introduction of self-ordering kiosks into restaurants of a major fast-food-chain retailer has also been regarded as a potential to redistribute coworkers in the store to focus on delivering high-quality services to customers (Peterson, 2017). P5 and P8 elaborated on the chance for coworkers to better consult customers about the details of the food offerings, to explain ingredients and allergens and to also promote special products, which might otherwise be missed by shoppers. Supervisors or attendants in general are required to help customers understand and use the self-service devices correctly. This thought was put into focus by P4 who underscored the importance of certain features of self-service solutions in this context:

"There must be an easy and visible way for the customers to ask for and receive prompt support, for example by highlighting a customer request via pole lights at the kiosk terminal or an alert sent to a central system or coworker's handheld device."

The exploration of this response show that a self-service device equipped with these kinds of alerting functionalities could help drive the success of their acceptance by both, customers who receive immediate support upon request and retail coworkers who need to find stability in their new roles of engaging in different forms of customer interaction.

The analysis also demonstrates that the number of self-ordering kiosks available for customers including their location and presentation in the store are decisive factors. This, of course, depends on the store floor of the food retailer, but interviewees recommend granting customers enough free space to engage with the devices on their own without feeling pressured or observed. Thoughtful placement of the self-ordering kiosks is a major success criterion to effectively reduce queues and to steer customer shopping activities on the given retail space. Studies performed on the impact of queues on customer behaviour in retail show that the length of the queue as observed by the customer is an important driving force in selecting a lane in the store (Lu *et al.*, 2013). Being confronted with long queues is considered as one of the most frustrating aspects of shopping, which steers customers away from the restaurant (NCR, 2014; Klein, 2018). Offering multiple lanes powered by self-service solutions can therefore enable customers to find a suitable station without having to stand in line. P9 raised the following statement in this context:

"There needs to be a certain amount of kiosks installed so that customers don't need to queue up, so that they can serve themselves quite easily."

This idea was also mentioned by P6, who called for food retailers to pay close attention to a good positioning of the self-service offerings to eliminate any potential hurdles for customers, which could stop them from using the devices.

Food retailers utilise self-ordering kiosks as a medium for the so-called "queue busting", a term expressed and elaborated upon by interviewee P4. Having self-ordering kiosks in place to accept orders from customers allows the food retailer to precisely distinguish between store operations related to the ordering and to the serving of food. This clear distinction is especially beneficial for retailers in phases of high customer traffic in the store and enables them to effectively handle the influx and volume of customers by smart line management (Klein, 2018). P4 referred to this as one of the key features food retailers in the quick- and self-service restaurant industry are interested in:

"You need a clear separation of payment process and order handling."

SSTs therefore can serve as a technological level inside the store that enables retailers to dynamically steer the customer flow in the given space and to cost-effectively allocate the retail staff. P9 explained this thought in more detail when responding:

"Personnel can be used in different places to serve the customers in different parts of their journey, but not necessarily only at the check-out, but even during their shopping journey. Maybe that's the opportunity that retailers see here."

Interviewees P3 and P4 stressed that especially in the area of quick- and self-service restaurants customers could benefit from the emphasis of handling orders and payment via self-service solutions. Having self-ordering kiosks manage the creation of the food order allows the staff to solely concentrate on the preparation of fresh food that is delivered just-in-time to the customer. P5 shared experience in this area of working with a food retailer that offers restaurants and canteens to customers:

"The complete operations around delivering the products to the customer are also moving from a perspective of having everything on stock to producing products for the customer as freshly as possible. This, of course, does require a lot of workforce concentrating on the food and getting the food freshly delivered to the customers."

With this change of store operation processes, retailers could be able to reduce the number of food menus, which are being prepared upfront to be available as stock items on the shelves due to the high demand for them. Focusing on a just-in-time delivery within the food preparation area of the store provides the benefits of handing out fresh meals to the customer and limiting the amount of overproduced items.

As per P2, SSTs could cover for potential shortages in staff availability and help increase the amount of sales transactions, which could be handled in a fixed retail floor space. Additionally, staff could also be allocated to focus on supporting customers throughout their shopping journey as opposed to concentrating on accepting and handling a large amount of orders. P7 stated the following:

"Processing-oriented food sale areas like canteens, fast food stations etc. benefit from the time savings when the customers can order and pay in an unattended way, focusing co-workers on preparing food when not handling requests in person."

The responses show a clear picture, when it comes to the challenge for a retailer of utilising the available retail space and handling food orders from their customers. Retailers see the benefits of SSTs as a technological solution to yield a higher number of transactions accompanied with an opportunity for a more customer-focused orientation of their staff. P3 attributed this aspect to the flexibility self-ordering kiosks and self-checkouts provide to food retailers by explaining:

"Ultimately self-service or self-ordering solutions enable flexibility with the retailer's environment, flexibility that their staff don't have to be behind a till taking orders and payments. This frees up staff to be in the kitchen making food, clearing tables or generally available to help customers. With high staff turnover and staff shortages this really safeguards the business."

The analysis of the interview sessions demonstrates that this is a major benefit retailers are focusing on as to increase the overall productivity and to achieve a more balanced total cost of ownership. Saving staff costs was often highlighted by the experts as being a major concern for food retailers. This was especially underscored by P4 and P10. Interviewee P4 anticipated the following:

"In the long run, investment costs for hardware will be more than offset by reduced personnel expenses."

Overall, the analysed data indicates that it is for the retailer to decide how to best allocate the store personnel to serve customers in a cost-effective way. Customer director P9 detailed the underlying business case for retailers here, when talking about the reasons for implementing SSTs:

"One is that they would like to use staff more efficiently that can lead to a reduction in staff, but it can also lead to a reorganisation of how staff serves the customer. So there is a business case behind that leads to the one or the other possibility for retailers for what to do with the staff."

Two respondents also raised an interesting idea that the researcher would like to elaborate on at this stage though it does not directly relate to features or properties of self-service technologies themselves. P1 and P9 talked about retailers asking for a kitchen management solution to support the processes of preparing food and organising the handout to customers. P9 drew on the experience with food retail projects, that

retailers are also looking for a kitchen management solution that handles the processing of food orders, once they are issued via self-ordering kiosks:

"What is helping the personnel in the store, if you're talking about a kiosk for which the serving of the food takes place after the transaction is completed, that there is a nice and easy-to-organise kitchen solution that the personnel can work with to easily manage the order entries and pick-ups."

Considering the emphasis put on this topic, the importance of this software solution seems to be closely tied to the success of self-ordering kiosks especially. Food retailers need to be able to have an overview of the orders issued by kiosks. Coworkers operating in the food preparation area of the kitchen have to know the contents of the orders and process the workflow of handing out the food to customers at suitable pick-up counters located in the quick- or self-service restaurant. Without this piece of technology, retailers might miss out on an essential part of ensuring a flawless end-to-end process of ordering and serving food to customers in a self-service scenario is in place.

This feature does not directly relate to self-ordering kiosks, but certainly requires further attention as it is a vital afterthought of implementing kiosk solutions in a store. As shown earlier, retailers are highly invested in improving the store efficiencies of ordering and serving food to customers. They are thereby also reallocating staff to different roles across these processes so having a kitchen management solution in place would likely work in favour of this approach. Such a solution could then be used to manage the incoming food orders and organise their preparation within the kitchen area of the retailer.

As a summary to this theme, the researcher concludes that the introduction of self-service solutions into quick- and self-service restaurants imposes the question on a food retailer of how to redistribute the freed-up capacities in store personnel. Depending on the overall strategy and goals of the food retailer this can on one hand lead to the reduction of staff, but on the other hand opens the door for possible reallocations of personnel to provide excellent services to customers. Leveraging SSTs as vehicles to manage orders and payments comes with the opportunity for retailers to engage with their customers at different phases throughout their shopping journeys. Staff could be tasked with offering consultation to customers or with promoting food products. Retailers could also establish new working routines in the food preparation area run by

the freed-up personnel as a means to produce fresh food for their customers in a just-in-time fashion.

5 Discussion

This chapter provides a detailed elaboration on the analysis findings and critically discusses their importance in consideration of the literature reviewed. The main purpose at this stage is to give a comprehensive account of the themes explored and to illustrate their overall impact on the field of understanding SST success. The conceptual framework as defined in chapter "2.4.3 Conceptual framework" combined with the findings of the analysis, which are presented in chapter "4.2 Main study", serve as the baselines for the subsequent chapters. The researcher firstly discusses the identified strategic SST success determinants, which leads to the development of an extension of DeLone and McLean's updated IS Success Model for the specific use case of SST success in the German retail food industry of quick- and self-service restaurants (DeLone and McLean, 2003). The discussion concludes with an examination of how the findings of the study relate to the professional business practice by presenting the SST Strategy Checklist as developed within this research project.

5.1 SST success determinants

Considering the research goals of this study, the following sections illustrate the determinants that contribute to strategic SST success in the German retail food industry of quick- and self-service restaurants. The determinants are identified and explored upon as based on the performed data analysis. The detailed discussion and evaluation of the success determinants and dimensions also tie back to the conceptual framework that has been defined by the researcher building on the available literature in the field of IS and SST success.

The findings of this study contribute to the theoretical knowledge by specifying the success dimension of *information quality* as present in the IS success model by DeLone and McLean in greater detail and thereby rephrasing it to *software quality*. This term contains a concrete focus on software-related strategic success factors of SSTs in the German retail food industry of quick- and self-service restaurants. The importance of upselling and configuration capabilities as based on software-related SST features is clearly highlighted as a strategic opportunity in this field, which enables food retailers to flexibly integrate their self-service solutions into valuable and effective customer shopping journeys. This study provides a detailed account of the identified and explored

upon SST success determinants belonging to *software quality* aspects, which marks a new addition to the literature of understanding SST success.

Referring to the strategic success determinants involved in the dimension of *system quality* several key findings need to be highlighted. The hardware of an SST plays a critical role, because it serves as a baseline for both, the technical components and capabilities as well as for the overall appeal to customers in terms of ergonomics. Food retailers have to choose from a variety of available hardware options including a huge selection of peripherals. The decisive factor here is to concentrate on SST hardware that enables the desired shopping use case in the self-service restaurant. The decision process of relying on the correct mixture of SST characteristics is accompanied by the challenges of properly integrating the self-service solutions into the store environment of the food retailer. Major success criteria here are to ensure that security processes in the restaurants are adjusted to the expected risks of possible fraud attempts in self-checkout use cases. Apart from that, the researcher developed strategic SST success determinants in relation to possible payment forms as offered by SST solutions. Depending on customers' preferences several methods can be relevant and have to be considered by food retailers as to provide a streamlined shopping journey to customers.

The researcher develops strategic success determinants belonging to the aspects of accessibility and availability of self-service technologies. These determinants make up the success dimension of *service quality* and provide insights into how accessible a certain SST device is for customers to use. The rising importance of offering handicapped customers with appropriate SST solutions is identified in this study and marks a vital area of opportunity and responsibility for a food retailer. Moreover, the success factors describe which constructs are in place from a retailer's perspective to achieve a high level of availability and reliability of the self-service offerings. Both of which can be achieved by implementing a robust mode of operations with a retail technology manufacturer based on managed services.

The results of this study lead to the development of a new strategic success dimension covering aspects of *store management and operations*. This dimension consists of success determinants, which describe the staff acceptance of SSTs that can be improved by implementing a deliberate change management strategy to accompany the introduction of self-service devices into quick- and self-service restaurants. Training

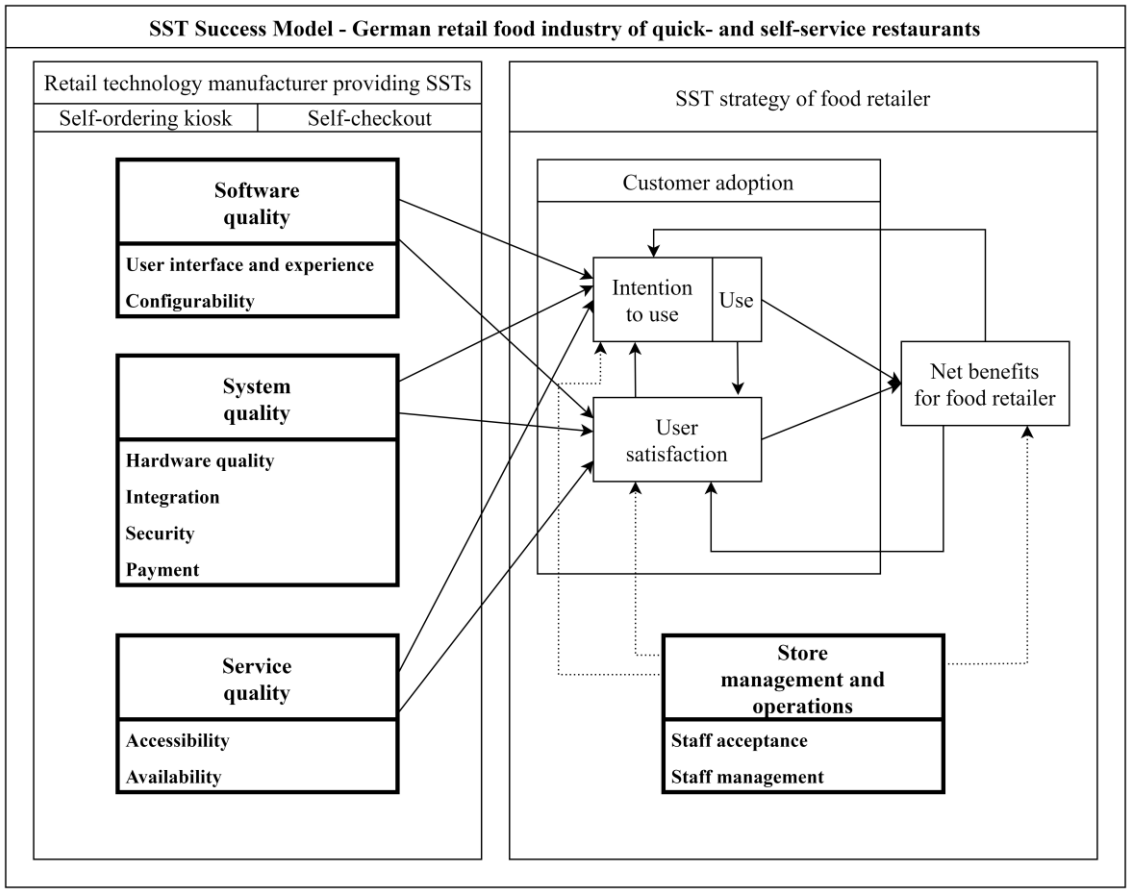
retail staff on handling SSTs and supporting customers in using them was found to be critical for success as well. Moreover, the researcher develops the two key success factors of staff reallocation and store processes and outlines how adaptations in these domains can significantly increase strategic SST success for German food retailers in the quick- and self-service restaurant industry. Self-service solutions are required to be effectively integrated into the overall customer shopping journey while accounting for processual changes in terms of staff and store operations. In light of these factors, the researcher acknowledges the existing literature in the area of IS implementation, which ranges from understanding impacts on an individual level up to the level of a whole organisation (Markus *et al.*, 1930; Markus, 1983; Lapointe and Rivard, 2007). This study itself does not lay concrete focus on this field and therefore directs to the available research for reference.

5.2 SST Success Model

As key contribution to the theoretical knowledge, the researcher discusses and showcases how the developed strategic success dimensions including their determinants are integrated into an extension of DeLone and McLean's updated IS Success Model for the specific field of retail industry under investigation (DeLone and McLean, 2003). The SST Success Model for the application in the German retail food industry of quick- and self-service restaurants is developed and outlined in detail within this research programme. This newly generated extension of DeLone and McLean's updated IS Success Model marks a result of this study and builds the groundwork for the completion of the second goal set out for this research project (DeLone and McLean, 2003). The researcher contributes to the knowledge base with the formulation of the SST Success Model that represents a specific focus on the German retail food industry of quick- and self-service restaurants. The components of the model are based on the analysis above concerning the identified strategic SST success determinants and dimensions, which are found to be relevant in this field of retail industry. In the following paragraphs, the researcher walks through the elements of the SST Success Model while also relating them to the conceptual framework, which has been defined at the outset of the study.

Figure 5.1 shows the SST Success Model, which is developed as an extension of DeLone and McLean's IS Success model in the course of this study. Success dimensions highlighted in bold indicate the researcher's contribution.

Figure 5.1: SST Success Model in the German retail food industry of quick- and self-service restaurants



Source: Figure by author as developed as an extension of the updated IS Success Model by DeLone and McLean (2003).

The core premise of the SST Success Model is to provide an overview of strategic success dimensions and their subordinate success determinants, which were investigated within this study to be important for the specific retail food industry of quick- and self-service restaurants in Germany. The researcher elaborated on data collected from a major retail technology manufacturer and developed success factors for the dedicated SST types of self-ordering kiosks and self-checkouts. The developed SST Success Model is a result of integrating the analysed SST success determinants and dimensions into a coherent picture that can serve as a model to describe and understand SST success factors in this research field from a strategical viewpoint.

The SST Success Model is built around two major components. The first one focuses on the types of SSTs in scope of this study – self-ordering kiosks and self-checkouts. These forms of SSTs are designed and provided to food retailers by retail technology manufacturers. Therefore the left hand side of the SST Success Model holds a section to reflect this. The second key element is with a food retailer that seeks to adopt an SST strategy in their self-service restaurants. This component covers retailer- and customer-specific success factors of how SST solutions are introduced into stores and received by users.

The retail technology manufacturer's view encompasses three success dimensions, which are analysed in detail in chapters "4.2.2 Software quality", "4.2.3 System quality" and "4.2.4 Service quality". These dimensions covering aspects of *software quality*, *system quality* and *service quality* serve as containers for the SST success factors identified and explored upon in this study. The researcher includes the dimensions as belonging to the section of the retail technology manufacturer, as it is mainly within the responsibility of the technology provider to comprehend and address the characteristics of SSTs, which contribute to the overall strategical success of the self-service solutions. This marks an adoption of the updated IS success model by DeLone and McLean to adhere to the use case under investigation in this research programme. As such, the conceptual framework also includes these dimensions to account for the perspective of the retail technology manufacturer. The conceptual framework though relies on the success dimension of *information quality* instead of *software quality*, the latter of which is developed as a result of this study to better reflect the analysed findings. The SST Success Model illustrates the three strategic success dimensions including their sub-categories. The arrangement of the dimensions and their relationships to each other is closely based on the information present in DeLone and McLean's updated IS Success Model, since an investigation on the interdependencies and the effects belonging to them was not part of the study (DeLone and McLean, 2003). The key findings of the research programme are captured as specific SST success determinants including the association with their corresponding success dimensions.

The section on the right hand side of the SST Success Model depicts the success factors related to the SST strategy of a food retailer. This headline appears fitting for the researcher as it provides a place to bundle success determinants, which are primarily concerned with the way of how self-service devices are actually integrated into quick-

and self-service restaurants of food retailers from a strategical perspective. The updated IS success model by DeLone and McLean summarises the effects of an information system on the party under observation by the term of *net benefits*. This dimension was also considered within the conceptual framework and is kept in the SST Success Model. However, the researcher implemented a deviation in the SST Success Model from the originally laid out conceptual framework. The dimensions of *intention to use, use* and *user satisfaction* were bundled under the term of *customer adoption* and contain the success variables, which characterise the elements of how customers interact with and accept SSTs. They were consequently moved into the field covering the SST strategy of a food retailer. The researcher found it to be worth keeping these essential success dimensions as an integral part of a food retailer's SST strategy. Throughout the analysis of the study results it becomes apparent that a consolidated perspective is required here as to best reflect the process of introducing self-service technologies into quick- and self-service restaurant environments. Achieving high levels of customer acceptance and usage of said SSTs is of major importance for food retailers, which is why the corresponding success dimensions covering usage factors are assigned to the overall SST strategy of a food retailer.

Next to the update of the theme of *customer adoption*, the researcher adds the new success dimension of *store management and operations* under the umbrella of a food retailer's SST strategy. The purpose of this dimension is to encapsulate the identified strategic success determinants concerning *staff acceptance* and *staff management*. These determinants have been closely analysed in chapter "4.2.5 Store management and operations". Implementing a strategy with the focus on self-service solutions in food retail requires an overhaul of the existing mode of operations with regards to staff distribution and food preparation. The researcher elaborates on these success factors in detail and develops the new success dimension *store management and operations* as a consequence. This dimension is placed within the SST strategy of a food retailer to prominently highlight the success determinants, which are analysed to be of significant importance. The SST Success Model is complemented with possible relationships between the different dimensions. The introduced linkages are highlighted in dotted lines as to indicate their function as proposed connections. Arrows shown in bold lines are derived from the updated IS success model by DeLone and McLean (DeLone and McLean, 2003).

With these rearrangements, the SST Success Model allows for a dedicated description of strategic IS success in the specific use case in the German retail food industry of quick- and self-service restaurants. The developed SST Success Model thereby addresses the second research goal of this study as it provides a concrete framework that contains the newly found and analysed SST success determinants relevant in this field. This model contributes to the literature and serves as an entry point for further investigations by offering a distinct SST Success Model that can be used on a strategical level to comprehensibly define and investigate success factors of SST solutions, which are implemented in German quick- and self-service restaurants.

5.3 SST Strategy Checklist

This chapter discusses how the findings of this study contribute to the professional business practice. The thematic focal point hereby is clearly with the retail food industry of quick- and self-service restaurants in Germany, but similar scenarios might be considered as well for an application. The following paragraphs concretely highlight how this research programme contributes to the business practice. The results of this study can be utilised by retail managers and enthusiasts of self-service devices working with SSTs and associated strategies of introducing these solutions to customers.

The researcher creates an SST Strategy Checklist based on the analysis of the data as performed in the course of this study. This checklist is aimed at retail practitioners who are managing self-service solutions in the German retail food industry of quick- and self-service restaurants. The contents of the SST Strategy Checklist might therefore be of key interest for chief information officers, chief technology officers and retail experts being responsible for the organisation of restaurant-related workflows and the design of customer shopping journeys as part of an overall self-service strategy.

The purpose of the SST Strategy Checklist is to provide practitioners working in the industry with a comprehensive overview of criteria, which were found to be relevant in improving the success of SST solutions in the area of quick- and self-service restaurants in Germany. These criteria are presented in the form of questions detailing certain aspects to consider or decisions to be made when adopting an SST strategy in this field of business. The checklist thereby relates the question items to the respective success determinants and dimensions as available in the SST Success Model that is developed and elaborated on in this research programme. With this checklist, retailers are equipped

with a guideline that navigates them through the major success factors, which require careful attention during the design and implementation of a self-service strategy.

In the course of the setup of a strategy centred around self-service technologies there are some key questions to be answered, which describe the general purpose and goals of the SST strategy. For this matter, the researcher develops a table overview that is depicted below. Table 5.1 shows checklist items covering how customer shopping use cases can be enabled by self-service technologies as part of an overarching SST strategy that is pursued by food retailers operating in the sector of quick- and self-service restaurants.

Table 5.1: SST Strategy Checklist - self-service technologies

Self-service technologies	
Which customer shopping use cases in the quick- and self-service restaurant are to be supported by self-service technologies?	
a) Self-ordering kiosk	
Use case:	Customers issue food orders using self-ordering kiosks with food being prepared in a kitchen area for subsequent handout to the customers.
Checklist items	**Related success determinants from the SST Success Model**
- *Which level of support for interactivity and multimedia usage is required to entice sales?* - *Do the food menus, which are offered at self-ordering kiosks, require a lot of customisation to be done by customers?* - *In which frequency is it necessary to update the food menus available on the self-ordering kiosks?*	Customer engagement Ease of use Feature richness Flexible configuration Upselling
b) Self-checkout	
Use case:	Customers collect food products throughout their store visit and use a self-checkout system to pay for the items in their baskets.
Checklist items	**Related success determinants from the SST Success Model**

- *Do the products customers collected require a lot of steps to register them at the self-checkout?* - *Are customers able to buy high-priced products, which need to be secured from theft attempts?* - *How large is the risk of customers trying to steal products at the self-checkout terminal?*	Artificial intelligence Scale support Scanner support Security processes

Source: Table by author.

The checklist items, which relate to the SSTs as elements of a food retailer's self-service strategy, address two specific customer shopping use cases. It is critical for a food retailer to deliberately define and outline the intended use cases, which are to be powered by self-service solutions. As elaborated upon in this study, the two use cases under investigation cover the food ordering process via self-ordering kiosks as well as the process of finalising the purchase of food products via self-checkout systems.

Firstly, the scenario of employing self-ordering kiosks to self-service restaurants is described by showcasing critical questions, which need to be addressed in the course of a strategy definition. The checklist items thereby serve as a means to point to exemplary themes requiring attention and considerate thoughts. This section also hints at which SST success determinants bear a connection with the mentioned checklist items. The second segment of the table addresses important aspects concerning the design of shopping uses cases centred around self-checkout operations. As with the previous customer journey, the relationship with SST success determinants involved is also presented. This checklist therefore provide a valuable baseline for retail practitioners to gain an understanding of how the shopping use cases in scope of an SST strategy can be supported by self-service technologies. The items presented above thereby refer to themes, which are specific for the respective use case of either self-ordering or self-checkout. Overall, the questions help to initiate further discussions and considerations surrounding the design of an SST strategy for quick- and self-service restaurants in Germany.

Moving on from checklist items tied to concrete use cases, the following paragraphs hold information about general aspects to consider when implementing customer journeys enabled by self-service technologies. Table 5.2 presents a collection of checklist items, which describe major subjects to keep in mind during the adoption of a

self-service strategy in German food retail. The goal of this section is to make retailers aware of which SST characteristics require close analysis and a decision on what kind of features are needed to which extent.

Table 5.2: SST Strategy Checklist - customer journey

Customer journey	
Which features and attributes of SSTs are required to support the intended customer shopping use cases in the quick- and self-service restaurants?	
Purpose:	Reviewing and comprehending strategic SST success determinants related to the success dimensions of *software quality*, *system quality* and *service quality* from the perspective of the targeted customer shopping journeys.
Checklist items	**Related success determinants from the SST Success Model**
- *Are the SSTs required to support only specific shopping use cases or should they be modifiable for different use cases in the restaurant?* - *At which locations in the restaurant are the SSTs supposed to be positioned?* - *Is there enough space available for staff to supervise and support customers using the SSTs?* - *What are the most common forms of payment customers use in the store?* - *Is there a need to provide customers with a printed proof of purchase after the finalisation of the transaction?* - *Can the SSTs be accessed by handicapped customers?* - *Does the information on the SSTs need to be made available in multiple languages?* - *Are customers able to buy age-restricted products?*	Accessibility support Adaptability Age verification Avoided interventions Card support Cash support Hardware appeal and sizing Multi-language support Printer support Security processes Smartphone support Store processes

Source: Table by author.

The checklist items primarily refer to the three success dimensions of *software quality*, *system quality* and *service quality* as available within the developed SST Success Model. The questions provide entry points into the thought processes of which SST features are critical for a food retailer to effectively enable the intended shopping journeys for customers within the self-service restaurant. Aspects of SST hardware and SST software as well as issues addressing accessibility, upselling potential and the desired level of configurability are covered in this overview. With this checklist, retail managers are able to identify strategical key SST success determinants relevant in this field, which helps them to estimate how the answers to the checklist questions relate to the SST Success Model. Depending on the respective details of the SST strategy, there can be further checklist items necessary to fully cover the complete scope. As such, the items provided here should be understood as examples and not as an exhaustive list.

The following section is concerned with success factors related to the *store management and operations* of food retailers. The goal here is to offer retailers with a compilation of checklist items containing internal leverage points of how the store and staff processes in the quick- and self-service restaurants contribute to the successful adoption of an SST strategy. Table 5.3 presents questions aimed at the design and setup of organisational arrangements food retailers need to be aware of when offering self-service solutions to their customers.

Table 5.3: SST Strategy Checklist - quick- and self-service restaurant

Quick- and self-service restaurant	
What is required on an organisational level from the food retailer to enable and support the envisioned SST customer journeys?	
Purpose:	Reviewing and comprehending strategic SST success determinants related to the success dimension of *store management and operations* from the perspective of the food retailer.
Checklist items	**Related success determinants from the SST Success Model**

- *What is the expected level of availability of self-service solutions?* - *Can customers still be served in case of device failures, for example via traditional tills?* - *Does the existing IT infrastructure of the regular tills and warehouse system allow for an integration of SSTs?* - *Is there a kitchen management solution available to receive the orders issued via self-ordering kiosks?* - *Is there a system in place that can provide stock information about products to the SSTs?* - *Is there a business case for adopting technology based on artificial intelligence to support ordering and checkout processes at SSTs?* - *Does existing personnel need to be reallocated to different job roles in the restaurant?* - *Are documentations and training sessions prepared for the staff?* - *Are the operational processes in the restaurant adjusted to include SSTs in the store and staff workflows?* - *Is the process of preparing food in the kitchen area adjusted to the presence of self-ordering kiosks?* - *Is a communication strategy available that explains the introduction of SSTs into the restaurants to the staff?*	Artificial intelligence Change management Integration capability Maintainability Managed services Offline capability Reliability Security processes Staff reallocation Staff training Stock information Store processes

Source: Table by author.

The main focus of this checklist is with the success dimension of *store management and operations*. This dimension as part of the SST Success Model entails retailer-specific criteria, which drive the effective implementation of an SST strategy. The success determinants here are primarily addressing the organisational and processual preparation of food retailers for the introduction of self-service solutions into the restaurants. The researcher therefore included a set of checklist questions, which aim at showing retail practitioners the importance of the strategic success factors in this field. By developing answers to these questions retailers are supposed to gain a better understanding of how SSTs need to be integrated into the overall retail organisation. Adding self-service solutions to the restaurants goes along with the need for a restructuring of staff activities and the food preparation processes. The checklist items

help retail practitioners in setting up the foundation for essential success fields covering matters of technical integration and SST availability topics as well as necessary adjustments in the areas of retail staff and processes in the store itself.

With the complete set of checklist items as presented above the researcher equips retailers with a tool that is easy to use and provides a comprehensive overview of the identified SST success determinants in the area of quick- and self-service restaurants in German food retail from a strategical viewpoint. The SST Strategy Checklist allows retail experts to create a solid groundwork for the implementation of self-service technologies as based on the customer journeys, which are supposed to be enabled by the SSTs. Adhering to this checklist also ensures the success determinants elaborated upon in this study are key elements during the formulation of an SST strategy to be carried out in quick- and self-service restaurants.

6 Conclusions

This chapter serves as a place to reflect on the findings of this study and to draw conclusions on their significance for the research field. Within a synopsis, a summary of the study is provided as to present the overall research approach and outcomes of the research project. In the light of the research questions associated with this study, the researcher outlines the implications of the reviewed findings for theory and for professional business practice. At the end of the chapter, there is an overview of limitations identified within the study and of further research ideas and projects, which can be followed up upon.

6.1 Synopsis

This research programme explores and identifies strategic success determinants of self-service technologies in the German retail food industry of quick- and self-service restaurants. The focus is thereby set on two specific types of SSTs, which are commonly available in this branch of industry – self-ordering kiosks and self-checkouts. The existing literature in the field of SST success predominantly follows a customer-centric approach as to understand the adoption rate of SSTs in various environments. This study takes a unique angle on comprehending strategic SST success factors by applying the viewpoint of a major retail technology manufacturer that is providing SST solutions to food retailers. Senior experts from the manufacturer's organisation are consulted within semi-structured interviews to provide business insights from a strategical perspective on critical SST success factors in the German retail food market of quick- and self-service restaurants.

As a conceptual framework, this study closely reviews the updated IS Success Model by DeLone and McLean and concepts dealing with technology adoption as found in the latest revision of the Technology Acceptance Model (DeLone and McLean, 2003; Venkatesh and Bala, 2008). Core attention is paid to success dimensions covering technology-oriented domains such as *information quality* or *system quality* as opposed to concentrating on customer-related themes of SST acceptance or usage. Following the qualitatively-oriented data analysis technique of thematic analysis, the researcher identifies major SST success determinants, which are discussed in light of the conceptual framework as established in the study. In this vein, four key success dimensions are developed, which hold success factors relevant in this specific field of

the industry – *software quality*, *system quality*, *service quality* and *store management and operations*. The researcher furthermore develops the SST Success Model as an extension of the updated IS Success Model by DeLone and McLean for the concrete use case of the German retail food industry of quick- and self-service restaurants (DeLone and McLean, 2003). This model serves as an entry point to understand and assess SST success determinants in this type of the retail industry from a strategical viewpoint. As a contribution to professional business practice, this study generates an SST Strategy Checklist that can be utilised by retail experts to comprehend and manage SST success factors when dealing with the design and implementation of a strategy focusing on self-service solutions in the German retail food market of quick- and self-service restaurants.

6.1.1 Implications for theory

The focus of this study is set on the specific research field of understanding SST success. Within this research programme, the researcher extends the knowledge of SST success by going beyond concepts of technology and customer adoption, which are mainly the focus areas of existing literature. Moreover, the researcher approaches SST success from a strategical viewpoint by considering the perspective of a major retail technology manufacturer that is providing self-service solutions to food retailers. The research goals involved in this research programme consist of firstly identifying strategic SST success determinants in the German retail food market of quick- and self-service restaurants and secondly of developing an extension of DeLone and McLean's updated IS Success Model as a dedicated SST Success Model for this specific type of industry (DeLone and McLean, 2003).

In the context of SSTs, the results of this study make the need for a specific success dimension apparent, which contains success determinants related to *software quality*. While the conceptual framework is based on the success dimension of *information quality* in this regard as outlined within the updated IS Success Model by DeLone and McLean, the researcher transforms this dimension into *software quality* to better reflect the identified importance of software-related success criteria for the research field investigated (DeLone and McLean, 2003). This domain encapsulates key SST success factors, which are dealing with aspects of *user interface and experience* and *configurability* options. The further success dimensions of *system quality* and *service quality* are based to some extent on the ones laid out by DeLone and McLean, but they

have received necessary adaptations to cater to the research subject of SSTs. These modifications are required as to allow for an accurate coverage of success determinants addressing themes of *hardware quality*, *integration*, *security* and *payment* in the field of *system quality*, and themes of *accessibility* and *availability* in the success dimension of *service quality*. As an additional implication for theory, the researcher draws the reader's attention to the developed success dimension of *store management and operations* that consists of success factors related to *staff acceptance* and *staff management*. Both of which are concerned with understanding the way of how self-service strategies are implemented by food retailers and with examining their impacts on staff and store processes in quick- and self-service restaurants.

6.1.2 Implications for business practice

Considering the rising availability of self-service solutions in food retail, it is vital for retail practitioners in the German industry of quick- and self-service restaurants to design and implement effective customer shopping journeys enabled by SSTs. Food retailers need to understand the field of strategic SST success by adopting a holistic approach that includes both, a customer-centric view of being concerned with achieving a high adoption rate of SSTs as well as a technology-oriented perspective to explore the potential of combining self-service solutions and store processes in a meaningful way. For this purpose, the researcher develops an SST Strategy Checklist that can be used by professionals working in the retail food industry to comprehend SST success factors relevant in the area of quick- and self-service restaurants.

The SST Strategy Checklist outlines three major phases for practitioners as to design effective customer shopping journeys, which are centred around SSTs. To begin with, retailers have to establish a clear vision of the intended use case in the restaurant that is to be enabled by SSTs. The scope of this study thereby accounts for two key types of self-service solutions – self-ordering kiosks for the issuing of food orders and self-checkout systems for an autonomous checkout experience for customers. Secondly, it is important for retailers to assess the strategic SST success characteristics and features relevant to enable the desired use case in the restaurant. The SST Strategy Checklist directs practitioners to the corresponding success determinants as identified within the study in order for them to prepare for the design of the envisioned customer shopping journey. Thirdly, existing organisational procedures of the retailer in terms of store- and

staff-related processes need to be closely reviewed to account for the incorporation of SSTs into the operations of the restaurant. Working with SSTs as a means to enable and drive successful customer journeys surrounding the ordering and delivery of food in quick- and self-service restaurants in Germany is found to mark a huge opportunity for retailers. The results of this study contribute to the professional business practice as they comprehensively outline strategic SST success determinants relevant in this specific field of industry.

6.2 Limitations of the research findings

In light of the goals and methodology defined for this research programme, there are some limitations of the findings of this study, which need to be highlighted. This chapter therefore illustrates which elements have not been part of the research project. The scope of this research project is set to explicitly cover self-service technologies in the German retail food industry of quick- and self-service restaurants. Within a single-case study the researcher works on identifying strategic success determinants of SSTs in this specific field of business. Given the multitude of available SST types in the business practice, this study concentrates on self-ordering kiosks and self-checkout systems as they are most commonly used in the area of quick- and self-service restaurants. The SST Success Model derived from these research findings therefore applies to the deliberately defined scope. As a consequence of this decision on the goals and purpose of the study, the researcher needs to present some factors, which limit the field of scenarios the results of the research programme can be applied to.

The SST success determinants explored upon are discussed for the German market, so success factors in different countries might turn out to vary. The developed SST Success Model likely requires an adaptation, when applied to other types of retail markets, such as fashion, home furnishing business or do-it-yourself home improvement industries. These particular forms of retail sectors would make it necessary for a researcher to adjust the study to the types of SSTs, which are frequently utilised in these markets. As such, a modification of the relevant SST types is needed, since their attributes and configurations considerably depend on the retail use cases and customer shopping journeys they are supposed to enable.

6.3 Ideas for further research

This chapter presents ideas for possible future research endeavours the researcher has come across throughout the course of this study. The SST Success Model, that is generated and discussed in this research project, can be put to the test by applying it to a specific arrangement of SSTs as used in a quick- or self-service restaurant environment in Germany. The results of such a programme would be of key interest as they could demonstrate how effectively the SST Success Model describes strategic success determinants in this type of retail industry. Maybe an application to another form of retail market might be viable as well while adapting some of the model components to the respective use case.

Given the focus of this research project, a similar investigation on strategic SST success factors in a different field of business sounds intriguing and might yield interesting results. Studies in the area of SSTs implemented in fashion for example could lead to the generation of further success determinants, which only emerge in this dedicated domain. Which factors are specific to fashion shopping and which determinants can be reused from the SST Success Model developed in this study? This could also be combined with concentrating on a country other than Germany as to understand, if there are country-dependent differences in the formation and definition of strategic SST success determinants.

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8 Appendix A: form of consent

Research Participation as Interviewee in Doctoral Research Project

What is the doctoral research project about?

The doctoral research project is titled:

Exploring Determinants of Self-Service Technology Success in German Food Retail:
The Case of a Retail Technology Manufacturer

Research goal and scope:
The goal of this research project is to identify success factors of self-service technologies, which are provided to retailers for operation in their food ordering and serving areas. This investigation is performed from the perspective of a major retail technology manufacturer and provider. Typical retailers in this scenario are situated around some form of **self-service restaurant** or **fast food chains**. The doctoral study pays specific attention to these branches of the retail food industry in Germany.

Self-service technologies under investigation:
This study concentrates on the following two types of self-service technologies:

1) Within the food serving environments of retailers, customers can interact with **self-ordering kiosks** for the issuing of orders towards the kitchen area. These orders usually require preparation to be done by kitchen personnel before they are handed out to the customer.
2) Additionally, customers are able to collect food items (not requiring further preparation) and finish the shopping trip themselves via **self-checkout** solutions available in the store.

Intended contribution of the study:
This study aims at exploring SST success determinants in German food retail. The identified characteristics will be aggregated into an overarching SST success model.

Who is carrying out the research?

The doctoral research is conducted by Adrian Engel, who works as a Business Analyst in Retail within the Professional Services D-A-CH region.

The research is carried out as part of a doctoral research programme in conjunction with the Edinburgh Business School of Heriot-Watt University in Scotland and Fachhochschule der Wirtschaft (FHDW) in Paderborn, Germany.

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What level of support is asked for?

As a research methodology, this study relies on conducting interviews with senior experts from the organisation. Key informants have been identified within the company covering critical roles related to the development, marketing, sales and operation of self-service technologies for retail customers. Neither the research participants nor the company itself will be disclosed in the course of the research project as to ensure anonymity and confidentiality of the data.

The interview form is based on a semi-structured guideline with questions touching on various SST-related characteristics. Conducting the interview will require about 45 minutes of the participant's time. The interview session will be audio-recorded as to allow for a subsequent transcription of the responses given. As a means to introduce the research participant to the research topic, a meeting will be scheduled by the researcher upfront to walk the interviewee through the process and address any open questions related to the research project or operational procedures concerning the data collection. This meeting is expected to take about 15 minutes of the participant's time.

The results of the interviews are treated completely anonymously as to remove any possibility of tracing responses based on research participants. The data analysis is solely done based on the level of functional responsibility held within the company. Both, the personal identity itself and the name of the company will be masked and not referred to explicitly in any form. The data collected will be kept strictly confidential.

Statement in support of participation

Before engaging in the research project it is required for the research participant to acknowledge the information and procedures outlined above with regards to the scope, execution and confidentiality of the research project. Acknowledging this form enables the research participant to take part in the project as an interviewee. The research participant will receive a copy of this document for personal records.

Name of person providing consent for participation in the research project:

Signature: **Date:**

_____ _____

Name of researcher:

Adrian Engel

Signature: **Date:**

_____ _____

9 Appendix B: interview guideline

#	Main question	Follow-up question
0	Would you please explain your position and responsibilities within the company?	
1	In your view, why do retailers implement self-ordering kiosks and self-checkout solutions in their store environments?	Why do these types of SSTs support retailers in food ordering and serving businesses, such as self-service restaurants?
2	In your view, which factors drive the success of self-ordering kiosks and self-checkouts for food retailers in Germany?	
3	What kind of self-ordering kiosk and self-checkout-related features are retailers mostly excited about in the course of adding these types of SSTs to their stores?	Which features are they mostly concerned about?
4	What kind of hardware options do food retailers request when implementing self-ordering kiosks and self-checkouts in their store layouts?	Which options are mostly asked for?
5	Which security-related concerns do retailers mention when thinking about the installation of self-ordering kiosks and self-checkout solutions in their food areas and how are they addressed within the design and implementation of these types of SSTs?	
6	Which factors improve integration possibilities of self-ordering kiosks and self-checkouts with the existing store IT environment of food retailers?	

7	How does the introduction of self-ordering kiosks and self-checkouts impact the workforce in the area of ordering and serving food?	Which features of SSTs help store personnel manage the workload as to maintain efficient store operations?
8	How do you ensure a high level of SST availability to food retailers who might be concerned about device failures and reduced turnover as a consequence of malfunctions?	
9	What kind of accessibility features do food retailers ask for that should be supported by self-ordering kiosks and self-checkouts?	
10	Which software-related requirements do retailers have concerning self-ordering kiosks and self-checkouts?	What kind of features are they mostly interested in?
11	What kind of payment options do food retailers ask for that should be supported by the self-ordering kiosks and self-checkouts?	
12	Do you have additional thoughts you would like to express?	

10 Appendix C: developed codes during data analysis

Question 1: benefits of SSTs

Codes	Number of coding references	Number of items coded
Retailer-focused \ Staff management \ Staff management & area productivity	9	8
Retailer-focused \ Staff management \ Saving staff costs	7	6
Retailer-focused \ Staff management \ Staff development and transition	5	5
Customer-focused \ Reducing queues and waiting times	5	4
Retailer-focused \ Upselling and cross-selling	5	4
Customer-focused \ Improved customer and service experience	4	4
Customer-focused \ Granting customers more self-control and self-determination	3	3
Customer-focused \ Different options for customers to pay	1	1
Customer-focused \ Providing innovations to customers	1	1
Retailer-focused \ Better TCO	1	1
Retailer-focused \ Brand presentation	1	1
Retailer-focused \ Operation and maintenance shifted to 3rd party	1	1
Retailer-focused \ Retailers' bias against self-service	1	1
Retailer-focused \ SSTs useful for rather non-extraordinary food	1	1
Retailer-focused \ Staff management \ Just-in-time production	1	1

Question 2: success factors

Codes	Number of coding references	Number of items coded
Customer \ User-friendly and fast handling	5	5
Customer \ Customer acceptance and utilisation	3	3
Customer \ Saving time for customers	3	3
Retailer and positioning in the store \ Visibility, number and location within the store	3	3
Retailer and positioning in the store \ Better TCO	2	2
Retailer and positioning in the store \ Increased turnover	2	2
SST \ System reliability	2	2
Staff \ Re-allocating staff	2	1
Customer \ Easy and simple customer journey	1	1
Customer \ Incentives to use SSTs	1	1
Retailer and positioning in the store \ Operationalisation of the solution	1	1
Retailer and positioning in the store \ SCOs in urban areas	1	1
Retailer and positioning in the store \ Showcasing state-of-the-art technology	1	1
SST \ Cash and cashless payment options	1	1
SST \ Good user interface	1	1
Staff \ Coworker training	1	1
Staff \ Prepare food in a fresh way	1	1
Staff \ Staff acceptance	1	1

Question 3: features

Codes	Number of coding references	Number of items coded
Store operations of retailer \ Potentials for upselling	5	4
UI and configuration possibilities \ Configuration of the UI	4	3
Store operations of retailer \ Fraud prevention	3	3
UI and configuration possibilities \ Feature-rich UI technologies	3	2
Hardware \ Good ergonomics and ease of use	2	2
Hardware \ Scales and scanners	2	2
Store operations of retailer \ Order and pay	2	2
Hardware \ Appealing hardware	1	1
Hardware \ Payment options available	1	1
Hardware \ System availability	1	1
Store operations of retailer \ Age verification	1	1
Store operations of retailer \ Customer engagement	1	1
Store operations of retailer \ Interventions disrupting the customer journey	1	1
Store operations of retailer \ Kitchen management software	1	1
Store operations of retailer \ Queue busting	1	1
Store operations of retailer \ Re-allocation of personnel	1	1
Store operations of retailer \ Relationship with customers	1	1
UI and configuration possibilities \ Support for reflecting stock information	1	1
UI and configuration possibilities \ Time-dependent food menus	1	1

Question 4: hardware

Codes	Number of coding references	Number of items coded
Hardware \ Large touchscreen offering immersive experience	6	6
Peripherals and integrations \ Card payment (EFT)	3	3
Peripherals and integrations \ Cash and cashless	3	3
Peripherals and integrations \ Product scanner	3	2
Peripherals and integrations \ QR code scanner	3	2
Peripherals and integrations \ AI scan technology	2	2
Peripherals and integrations \ Gift and voucher cards	2	2
Retail store operations \ Flexible footprint	2	2
Hardware \ Full-blown SCO systems	1	1
Hardware \ Small express systems	1	1
Peripherals and integrations \ Age verification	1	1
Peripherals and integrations \ Integration with smartphone	1	1
Peripherals and integrations \ Magnetic stripe reader	1	1
Peripherals and integrations \ Online payment	1	1
Peripherals and integrations \ Printer (receipt)	1	1
Retail store operations \ Adaptability and reusability	1	1
Retail store operations \ Break-and-fix capability of hardware	1	1
Retail store operations \ Expensive hardware	1	1
Retail store operations \ Hardware for own coworkers	1	1
Retail store operations \ Kitchen management solution	1	1

Question 5: security

Codes	Number of coding references	Number of items coded
Little to no risk \ Self-ordering kiosks	6	6
Adaptation of staff and store processes \ Mitigation via store personnel	5	4
Mitigation via SST devices \ AI (camera e.g.)	5	5
Adaptation of staff and store processes \ Ratio of supervisor to SSTs	4	3
Adaptation of staff and store processes \ Fraud on purpose or by mistake	2	2
Adaptation of staff and store processes \ Spot-checks	2	2
Mitigation via SST devices \ Control scales	2	2
Mitigation via SST devices \ SST IT security	2	2
Adaptation of staff and store processes \ Consultancy on security topics	1	1
Adaptation of staff and store processes \ Returns and refunds via SSTs	1	1
Adaptation of staff and store processes \ Shrinkage and mis-scans	1	1
Little to no risk \ Integration with kitchen management solution	1	1
Mitigation via SST devices \ Masking of personal information on screens	1	1

Question 6: integration

Codes	Number of coding references	Number of items coded
Technologies \ API and software integration	5	5
Retailer's organisation and processes \ Store space design and operations workflow	3	2
Retailer's organisation and processes \ Single-provider reducing integration efforts and risks	2	2
Retailer's organisation and processes \ Importance of proper integration	1	1
Retailer's organisation and processes \ Support by attendants	1	1
Technologies \ Cloud technologies	1	1
Technologies \ Configurability	1	1
Technologies \ Management of master and transaction data	1	1
Technologies \ Offline capabilities	1	1
Technologies \ Underlying business logic	1	1

Question 7: workforce

Codes	Number of coding references	Number of items coded
Staff reallocation and training \ Freeing up staff from ordering and payment processes	9	7
Staff reallocation and training \ Staff turning more into service-oriented roles	5	3
Change management \ Sensitive change management approach	3	2
Change management \ Staff having the impression of losing their jobs	3	3
Staff reallocation and training \ Staff supporting customers in using SSTs	3	3
Change management \ Retailers need to be careful with staff feeling their job is at risk	2	2
Increased efficiencies \ Better staff efficiency	2	2
Increased efficiencies \ Reduced queues	2	2
Increased efficiencies \ Speeding up time from ordering to food	2	2
Staff reallocation and training \ SST features to alert staff	2	2
Staff reallocation and training \ Staff feeling pressured to keep KPIs in manned stations	2	2
Staff reallocation and training \ Staff preparing fresh food	2	1
Staff reallocation and training \ Staff getting frustrated in cases of device failures	1	1
Increased efficiencies \ Better store efficiency	1	1
Increased efficiencies \ Comparing performance of SSTs with coworkers	1	1
Staff reallocation and training \ Enabling staff to handle	1	1

the order management		
Staff reallocation and training \ Retailer's decision how to allocate staff	1	1
Staff reallocation and training \ SST attendant features for staff	1	1
Staff reallocation and training \ Staff cleaning SSTs	1	1

Question 8: availability

Codes	Number of coding references	Number of items coded
Managed services and SLAs \ Managed services	6	6
Managed services and SLAs \ SLA-based contracts and industry standards	5	5
Managed services and SLAs \ Stable solutions and infrastructure	4	3
Managed services and SLAs \ Preventive maintenance	3	3
Managed services and SLAs \ Incident management including escalation paths	2	2
Managed services and SLAs \ Offline capabilities	2	2
Managed services and SLAs \ Remote access and diagnostics	2	2

Question 9: accessibility

Codes	Number of coding references	Number of items coded
Solutions and approaches \ Changing heights of touchscreens	4	4
Rising importance \ Legal requirements	3	3
Rising importance \ Rising importance as a trend globally	3	3
Solutions and approaches \ Access via keypad	3	3
Rising importance \ Challenge for manufacturers operating multi-nationally	2	1
Rising importance \ No standards	2	1
Rising importance \ Reduced complexity for manufacturers operating in a single country	1	1
Solutions and approaches \ Headphones	1	1
Solutions and approaches \ High contract screen changes	1	1
Solutions and approaches \ Image recognition processes	1	1
Solutions and approaches \ Multi-language support	1	1

Question 10: software

Codes	Number of coding references	Number of items coded
Store operations and processes \ Age verification	6	5
Configuration \ Configurability and flexibility	5	4
User interface and experience \ Simple customer journey	5	5
User interface and experience \ Upselling, promotions and loyalty programmes	5	5
Configuration \ Tableau data with menus and items	4	4
User interface and experience \ Customisation of orders	4	2
Configuration \ Management system for kiosk configuration	3	2
Store operations and processes \ Incorporation of AI technology	3	3
Store operations and processes \ Integration with kitchen management solution	3	2
Store operations and processes \ Avoiding interventions	2	1
Store operations and processes \ Support for fraud detection	2	2
User interface and experience \ Support for pictures and videos	2	2
Configuration \ Reflecting item stock information	1	1
Store operations and processes \ Reuse of existing business logic	1	1
User interface and experience \ Offering a wide choice of available food products	1	1
User interface and experience \ Support for control scales and scanners	1	1

Question 11: payment

Codes	Number of coding references	Number of items coded
Traditional payment \ Card (credit & debit card)	9	8
Traditional payment \ Cash	9	9
Retailer-specific payment \ Card (gift card)	4	4
Rising forms of payment \ Integrated online payments	4	4
Traditional payment \ Cashless	4	4
Retailer-specific payment \ Card (loyalty card)	3	3
Rising forms of payment \ Contactless	2	2
Rising forms of payment \ Digital wallets	1	1