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KNOWLEDGE IN ACTION

Faculty of Business Economics

Master of Management

Master's thesis

Exploring the antecedents of perceived complementarity in service constellations and its roles in shaping customer perceptions of value and risks associated with service constellations

Thi Chinh Hoang

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization International Marketing Strategy

SUPERVISOR :

Prof. dr. Allard VAN RIEL

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ABSTRACT

The rapid evolution of retail environments has introduced service constellations as a strategic approach to meet diverse customer expectations. This thesis explores the antecedents of perceived complementarity within service constellations and its influence on customer perceptions of value and risks. Specifically, it investigates the roles of compatibility, substitutability, and convenience in shaping this perceived complementarity, alongside the broader implications for perceived value and risks in retail service offerings.

The findings reveal that convenience emerges as the most influential factor driving perceived complementarity, followed by substitutability. Interestingly, compatibility shows a limited impact, suggesting further investigation. Perceived complementarity is found to significantly enhance the perceived value of both individual services and the overall service constellation, yet it has minimal impact on perceived risks.

The findings provide valuable insights for retailers seeking to optimize their service bundles, emphasizing the need for strategic alignment of services to maximize customer satisfaction and competitive advantage. This research contributes to the academic understanding of service constellations and offers practical recommendations for designing customer-centric retail experiences. By incorporating these insights, businesses can create compelling value propositions, enhance customer satisfaction, and strengthen their competitive edge in the marketplace.

LIST OF ABBREVIATIONS

Abbreviation	Definition
AVE	Average Variance Extracted
HTMT	Heterotrait-Monotrait Ratio
PC	Perceived Complementarity
PCM	Perceived Compatibility
PCV	Perceived Convenience
PRC	Perceived Risks of the Service Constellation
PS	Perceived Substitutability
PVC	Perceived Value of the Service Constellation
PVI	Perceived Value of Individual Services
PVI_C	Perceived Value of Compatible Individual Services
PVI_S	Perceived Value of Substitute Individual Services
PVI_V	Perceived Value of Convenience Individual Services
UGC	User-Generated Content
VIF	Variance Inflation Factor

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Exploring the antecedents of perceived complementarity in service constellations and its roles in shaping customer perceptions of value and risks associated with service constellations.

CHAPTER 1: INTRODUCTION

Within the dynamic landscape of the retail industry, the creation of a compelling service offer has become a critical determinant of success. The rapid evolution of service systems has raised new challenges for service design (Patricio et al., 2011), wherein businesses face the challenge of constructing complex service offers that cater to a wide range of customer preferences and expectations. These complex service bundles, referred to as "value constellations" (Jüttner & Wehrli, 1994; Normann & Ramirez, 1993; Van Riel et al., 2013), play a pivotal role in attracting and retaining consumers as they are "increasingly buying into constellations of services", i.e., service constellations, rather than considering isolated services (Van Riel et al., 2013).

1.1. Research Motivation

The evolving retail landscape has underscored the pivotal role of service provision in shaping customer experiences and competitive advantage (Berry et al., 2002). As consumer needs and preferences become increasingly discerning and demanding, retailers must adapt their offerings to cater to diverse needs, preferences, and expectations. In response, retailers are transitioning from standalone services to interconnected service constellations, bundling various services to offer comprehensive customer experiences. Additionally, the ability of these individual services to augment each other's value within these constellations offers a pathway to heightened customer satisfaction and enhanced market competitiveness. This is often referred to in academia as the complementarity among products or services. Two service products are complementary if they possess the potential to add value to one another. The effectiveness of the composition of a complex service offer therefore can be optimized when including individual services that possess a significant degree of complementarity (Lee & Kwon, 2011a).

Despite the acknowledged significance of value constellations in the retail domain, the specific dynamics underlying how the individual services interact to amplify each other's value remain a relatively underexplored field academically. While research has been conducted in this area, it has neglected to incorporate a marketing perspective, specifically considering the viewpoint of the consumers. Existing studies have introduced the concept of one-stop shopping (Baye et al., 2018; Caprice & von Schlippenbach, 2013) and value constellation experience (Konuş et al., 2008; Patricio et al., 2011), yet there is a pressing need for further development of a more comprehensive conceptualization of the components, i.e., the individual services, and drivers of value constellations in the retail industry, and frameworks for analyzing the efficacy of these constellations and the extent to which their components mutually affect each other's respective value. As such, this research aims to contribute to academic knowledge by bridging this gap and providing a foundation for future exploration in the fields of marketing and retail.

1.2. Problem Statement

As companies strive to construct effective value constellations, encompassing a multitude of services, they encounter a critical knowledge gap in understanding the intricate dynamics involved in their creation, evaluation, and the interrelationships among the components. In light of this, the primary issue lies in the lack of a comprehensive framework that guides businesses in strategically developing and evaluating value constellations, as well as understanding the synergies between the individual services within these constellations. Addressing this gap is crucial for businesses aiming to optimize their service offerings and to enhance customer satisfaction in the fiercely competitive realm of the retail industry.

The following research question guides the investigation:

How do factors within a service constellation contribute to its perceived complementarity, and how does this complementarity affect customer perceptions of value and risk associated with the constellation?

1.3. Contribution

This research endeavors to advance the academic understanding of service constellations in the field of retail, by investigating how different service components interact to enhance the overall perceived value for customers and mitigate perceived risks. By investigating the factors that influence perceived complementarity within service constellations, this study uncovers the roles of compatibility, substitutability, and convenience as key determinants of complementarity, exploring how these factors dynamically shape value creation and risk reduction within service constellations. Such comprehension can offer retailers practical insights into how to establish synergy within a service constellation and hence optimize their service offerings.

1.4. Approach

To achieve these objectives, the research will adopt a comprehensive approach involving a literature review, a survey, and regression analysis. First, the current paper reviews the relevant value constellation literature and establishes the foundational principles of complementarity within service constellations and the factors that influence it. Second, a model of a retail service constellation will be built, and data will be collected via a survey in order to quantify the mechanisms through which services mutually enhance each other’s value and the value constellation. Findings will then be presented, followed by a discussion analyzing the results' implications for one-stop shop design and marketing strategies. Finally, a conclusion will highlight theoretical and managerial implications, acknowledge study limitations, and propose directions for future research.

CHAPTER 2: LITERATURE REVIEW

This literature review explores the concepts of value constellation and service constellation in current service management and marketing. Drawing from previous studies by several scholars, it emphasizes collaborative relationships between different services and discusses how complementarity influences customer perceptions of value and risk within service constellations.

While previous studies have addressed complementarity in service ecosystems broadly, this review specifically focuses on how complementarity functions in retail service constellations. By examining factors such as compatibility, substitutability, and convenience, it provides a novel framework for understanding customer perceptions in this domain. This framework lays the foundation for further analysis in the following chapters of the current study.

2.1. Value Constellation and Service Constellation

Value constellation has been referred to as the result of the combination of services provided by an interconnected network of organizations, individuals, and other entities (Jüttner & Wehrli, 1994; Normann & Ramirez, 1993; Van Riel et al., 2013). Normann and Ramirez (1993) also argue that the concept of value constellation moves beyond the traditional view of a single company creating a certain value and positioning itself on one point of the value chain. Instead, it emphasizes the importance of collaborative relationships among various actors within an ecosystem (Vargo & Lusch, 2016) to co-create and deliver value to customers.

The concept of value constellation is distinct from the service ecosystem or value net, which focuses on the actors delivering services or value and the relationships between them. Value nets and service ecosystems demonstrate the interdependence of various industry actors, while the value constellation and service constellation approaches highlight the role of the customer and the importance of the consumer perspective. Both service constellation and service ecosystem approaches complement each other and should be incorporated into service innovation management (Van Riel et al., 2013).

Another concept that revolves around the idea of an interconnected network of diverse services within an ecosystem delivering value to customers is service constellation. While value constellations emphasize the collective creation and delivery of overall value, including products, services, experiences, and more, service constellations specifically center on the interlinked network of different services within an ecosystem. Within a service constellation, each entity plays a distinct role and contributes specific capabilities, resources, or expertise to enhance the overall value proposition offered to customers. Different roles of these elementary services include core, facilitating, supporting, and complementary services (Van Riel et al., 2005). While core services are defined as Internet applications that facilitate transactions, tasks, and problem-solving and involve supplementary services to complete higher-level transactions (Borck, 2000), distinguishing between complementary, facilitating, and supporting services is challenging, especially in an online context. Even identifying a clear core service is often difficult (Van Riel et al., 2004). In light of

this, this study adopts a framework that consider all individual services as equal and focus on the complementarity among them in the retail context.

While no single entity possesses all the resources or capabilities required to fulfill the diverse and evolving needs of customers in today's dynamic markets, the presence of multiple services within the constellation amplifies the value customers receive from a single service in the constellation (Van Riel et al., 2013). Because of limited research in this area, further investigation into value constellations is crucial to better understand and leverage the complementary strengths and deliver comprehensive value propositions that exceed what any individual entity could achieve in isolation.

2.2. How Customers Perceive Retail Service Constellations

Understanding how customers perceive value constellations is crucial for the investigation of the complementarity between services within a constellation and for businesses aiming to deliver convincing value propositions in today's dynamic marketplace. The remainder of the literature review will delve into relevant key concepts and propose customer's perceptions of retail service constellations.

The retail domain and one-stop shopping concept

Within the realm of retail, various factors contribute to the shaping of consumer behavior and the dynamics of the market. The retail sector encompasses a wide array of industries, including traditional brick-and-mortar stores, e-commerce platforms, and hybrid models that blend physical and digital channels. In recent years, the retail landscape has witnessed significant transformations driven by technological advancements, shifting consumer preferences, and evolving market dynamics (Burt & Sparks, 2003). Retailing is a crucial part of the economy as it directly interfaces with consumers (Hameli, 2018). The major functions of retailing include providing an assortment, breaking bulk, holding inventory, facilitating ownership transfer, and offering services like credit (Jain et al., 2009; Tang et al., 2021). Retailers aim to provide value through product utility, place utility, time utility and ownership utility (Pradhan & Roy, 2011).

Retailers operate within a complex ecosystem characterized by intense competition, changing consumer trends, and technological innovations. To thrive in this dynamic environment, retailers must adapt their strategies to meet the evolving demands of consumers while maintaining operational efficiency and profitability. Key considerations in the retail domain include location strategy, merchandising techniques, pricing strategies, customer service, and omnichannel integration (Levy & Weitz, 2012).

The retail sector can be broadly classified into store-based retailing (e.g., physical stores) and non-store retailing (e.g., direct selling, e-commerce) (Berman & Evans, 2013). Store-based retailing can be categorized by ownership (independent, chain, franchise, etc.), by merchandise (department stores, supermarkets, specialty stores, etc.), by pricing strategies (discount stores, factory outlets, category killers, etc.), and by location (shopping malls/centers) (Hameli, 2018; Perreault et al., 2013).

The concept of one-stop shopping revolves around the idea of providing consumers with a comprehensive range of products and services within a single retail destination, and hence is a specific type of service constellation. This approach aims to simplify the shopping experience for customers by offering convenience, variety, and accessibility in one location (Hernández & Rosas, 2012). One-stop shopping destinations encompass diverse product categories, including groceries, apparel, electronics, household goods, and personal care items, as well as ancillary services such as banking, dining, and entertainment (Burt & Sparks, 2003).

One-stop shopping destinations serve as convenient hubs where consumers can fulfill multiple needs and preferences in a single visit, minimizing the need for multiple trips to different stores. This convenience factor is particularly appealing to time-pressed consumers seeking efficient and streamlined shopping experiences (Reimers & Clulow, 2004). Moreover, by offering a diverse array of products and services under one roof, retailers can cater to the varied preferences of consumers while maximizing sales opportunities and enhancing customer loyalty (Arnold & Reynolds, 2003).

However, despite the advancements in retail service offerings and the pivotal role in driving economic growth and employment opportunities, the understanding of customer perceptions and behaviors within the retail service constellations remains a subject of ongoing research, necessitating further exploration into the dynamics of value creation, customer value, and customer experience in this domain.

Value constellation experience

Research primarily addresses customer experience in general while the specific concept of value constellation experience has received less explicit attention. Customer experience is perceived by customers through interactions with a business and encompasses various elements such as emotions, perceptions, and evaluations (Meyer & Schwager, 2007; Verhoef et al., 2009; Lemon & Verhoef, 2016). In academic literature, this is viewed as a holistic construct that involves understanding customer needs and creating consistent, satisfying experiences to foster loyalty and advocacy. However, this concept of customer experience has mostly referred to the interaction between customers and a singular firm.

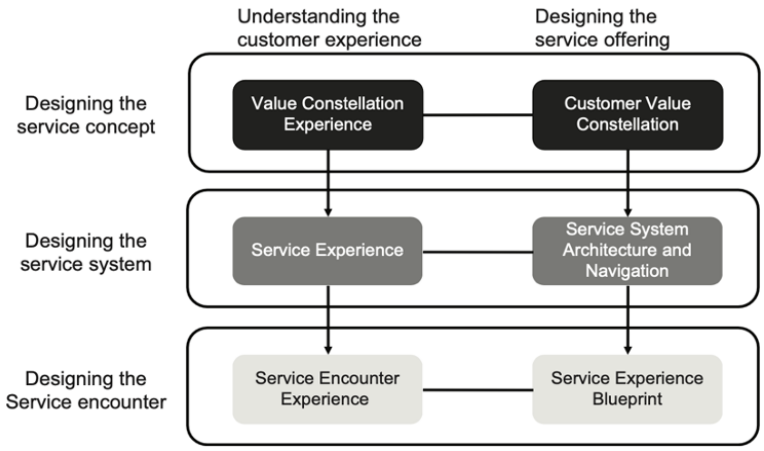


Figure 1. General model of multilevel service design (Patricio et al., 2011)

Patricio et al. (2011) introduced a multilevel service design framework, positing that customer experience consists of three distinct levels: value constellation experience, service experience, and service encounter experience. The value constellation experience involves the interactions between customers and service organizations facilitating specific activities, highlighting the co-creation of value within the constellation. Decomposing the activities involved in a value constellation experience and analyzing existing services that respond to those needs can guide the design of the service constellation and service ecosystem. This perspective acknowledges that evaluating value constellations can contribute to the assessment and composition of service constellations and create new opportunities for service innovation and advancement.

Customer value

The concept of customer value is crucial in marketing and service research as it is a key source of competitive advantage and is emphasized in business strategy (Woodruff, 1997; Leroi-Werelds, 2019). Customer value is widely considered as the perceived benefits or worth a customer believes they receive compared to the cost or sacrifices of obtaining a product or service. Definitions from various sources highlight the multidimensional and dynamic nature of this concept, which considers functional, emotional, social, and symbolic elements and can vary among customers and situations. Customers mainly differentiate offerings based on the combination of available products or services (Patrício et al., 2011; Van Riel et al., 2013), referred to as value constellations in literature (Normann & Ramirez, 1993). This indicates that customers evaluate a value constellation as a whole rather than evaluating each elementary service or product individually.

2.3. Complementarity within Service Constellations

Complementarity within service constellations refers to the synergistic relationships between different services that enhance their collective value when integrated, i.e., a value constellation (Van Riel et al., 2004). The concept of complementarity plays a pivotal role in understanding how various services interact within such constellations.

Previous studies have indicated that the value derived from a service constellation no longer solely relies on an individual core service. Instead, a significant portion of this value emanates from complementary, supportive, and facilitating services (Van Riel et al., 2004). Mobile service users, for example, have diverse needs and use their devices to access a wide range of benefits derived from several services such as software distribution platforms (iTunes, AppStore), mobile applications, operating systems (OSX, iOS), and internet-enabled portable devices (iPhone, iPod, iMac, iPad, MacBook) to fulfill their needs rather than relying solely on a single service. The value of these services is greater when viewed as a whole and can be impacted by each other (Van Riel et al., 2013). Complementarity is essential for achieving a seamless service experience, where each service component contributes to fulfilling customer needs and preferences in a coherent manner (Lee & Kwon, 2011b). Complementarity is also crucial for service innovation and differentiation within constellations, resulting in improved customer experiences and a competitive edge in dynamic markets (Wieland et al., 2016). Additionally, Kowalkowski et al. (2013) emphasize the importance of complementarity in promoting customer engagement and loyalty in

service ecosystems. They suggest that service providers must carefully orchestrate complementary offerings to create a holistic and integrated service experience that resonates with customer expectations and preferences.

The concept of complementarity thus appears highly relevant in the context of understanding the dynamics of service constellations. By examining how different services interact and complement each other, service providers can design more effective strategies for value constellation creation in today's competitive service landscape. However, it remains underinvestigated how consumers experience and value the complementarity of services within an e-commerce value constellation. As such, it is the focus of the scope of this study.

Complementarity in retail and beyond

The concept of complementarity has significant implications in retail contexts, where the integration of services often defines the customer experience. Studies in the retail domain emphasize how complementary offerings, such as product recommendations, loyalty programs, flexible payment options, and post-purchase services (e.g., easy returns and refunds), create a unified customer journey. Reimers and Clulow (2004) explore how retail constellations, such as shopping malls or e-commerce platforms, leverage complementary services to maximize convenience and enhance customer satisfaction. A practical example is one-stop shopping destinations, where the availability of groceries, apparel, dining, and ancillary services such as banking and childcare collectively enrich the customer experience. The complementarity of these services enables retailers to cater to diverse consumer needs while maximizing engagement and loyalty.

In domains beyond retail, complementarity has also been studied in areas such as healthcare, hospitality, and digital platforms. For instance, in healthcare ecosystems, complementary services such as diagnostic imaging, specialist consultations, and telemedicine create integrated patient care pathways. In the hospitality industry, complementary offerings such as booking platforms, in-house dining, concierge services, and travel arrangements enhance the overall guest experience (Kim & So, 2022). Similarly, digital platforms like Amazon and Airbnb thrive on the complementarity of services within their ecosystems to deliver convenience, personalization, and seamless access to diverse offerings. These studies underscore the importance of complementarity in shaping customer perceptions across industries.

Factors influencing complementarity within service constellations

The degree of complementarity within service constellations is shaped by various factors that influence how individual services interact and enhance one another. As each individual service plays a distinct role in a constellation, it is crucial to take into consideration different relationships between these services when examining the complementarity between them. Brand extension literature have discussed the fit between the product and service classes, emphasizing the importance of ensuring coherence and relevance to facilitate consumer acceptance when introducing brand extension (Aaker and Keller, 1990; Van Riel et. al, 2001). This concept of "fit" is

crucial in the context of service constellations where various services coexist. Transposing this concept into the service constellation context, where various services coexist to create a comprehensive offering, the current paper aims to explore how different individual services interact and complement each other based on similar fit dimensions.

Service combinations can be viewed as fitting together in a variety of ways. This paper adapts one fit dimension introduced by Aaker and Keller (1990) – substitutability, and propose two new dimensions – compatibility and convenience, based on how customer evaluate a service constellation. *Compatibility* refers to the extent to which two or more services, products, or technologies can be used together without modification, while *substitutability* is the degree to which the consumer perceives one service as a viable replacement for another (Van Riel et al., 2001). *Convenience* refers to the ease and effortlessness with which a customer can access, use, and derive benefits from a service or a combination of services within a constellation. It encompasses the reduction of time, complexity, and physical or cognitive effort required to achieve a desired outcome (Berry et al., 2002). These three key dimensions provide a framework for understanding how services interact and integrate within a constellation to deliver enhanced value to consumers.

2.4. Theoretical Framework and Conceptual Model

This paper aims to investigate further the intricate dynamics of complementarity within service constellations in the retail industry by building on past studies that highlight the importance of complementarity in enhancing customer experiences and promoting value creation in service ecosystems (Van Riel et al., 2013). In particular, this study seeks to identify and explore the factors that drive complementarity, focusing on the roles of compatibility, substitutability, and convenience. By examining how these factors influence the way elementary services work together within a constellation, the study contributes to a deeper understanding of how complementarity shapes both the perceived value of individual services and the overall constellation, as well as its impact on mitigating perceived risks. Through exploring how elementary services complement each other within the same constellation and contribute to the broader value constellation, the study aims to advance our understanding of the complex interplay between services in shaping customer experiences and perceptions in the retail domain. To accomplish the objectives mentioned above, the author aims to address the following research question:

How do factors within a service constellation contribute to its perceived complementarity, and how does this complementarity affect customer perceptions of value and risk associated with the constellation?

Having established the core concepts of compatibility, substitutability, and convenience, it is crucial to examine how these dimensions influence the perceived complementarity of services within a constellation. The significance of complementary services within a service constellation has long been acknowledged in literature (Van Riel et. al, 2005). Compatible services, by their nature, are designed to enhance each other's functionalities, leading to a more holistic and satisfying consumer experience. This idea aligns with research in service ecosystems, where

service compatibility has been shown to improve customer satisfaction and value co-creation by reducing the effort needed to integrate different service components (Gawer & Cusumano, 2002). While substitute services may appear to compete with each other, studies have shown that under certain conditions, they can complement each other significantly (Van Riel et. al, 2001). Understanding the mechanisms behind the complementarity within compatible services and substitute services is essential for service providers to optimize their offerings and capitalize on market opportunities. Therefore, the following hypotheses has been formulated:

H1: *Higher perceived* ***compatibility*** *between two services in a service constellation leads to higher perceived complementarity within the constellation.*

H2: *Higher perceived* ***substitutability*** *between two services in a service constellation leads to higher perceived complementarity within the constellation.*

As highlighted above, convenience plays a crucial role in the value placed upon service constellations by customers. Customers oftentimes are willing to pay a higher price when purchasing from a service constellation, for example, as an exchange of a higher degree of convenience. High convenience typically enhances customer satisfaction by minimizing the friction involved in service interactions (Berry et al., 2002; Patricio et al., 2011). Based on these findings, a direct positive relationship between the degree to which a service increases the perceived convenience of a service constellation and the perceived complementarity within the constellation was proposed:

H3: *Higher degree to which a service increases the perceived* ***convenience*** *of a service constellation leads to higher perceived complementarity within the constellation.*

Research has shown that the strategic alignment of services can lead to synergistic effects, resulting in a more compelling value proposition for consumers (Normann and Ramírez, 1993). When services are perceived as complementary, customers are more likely to derive additional benefits from each individual service, as its value is augmented by the supporting services in the constellation. For instance, in a retail setting, a delivery service may increase the perceived value of a product offering, as it allows customers to enjoy a more seamless shopping experience. Research in value co-creation suggests that when services complement each other effectively, the perceived value of each individual service within the constellation is amplified (Vargo & Lusch, 2008). Thus, the following hypothesis was proposed, which posit a direct positive relationship between the perceived complementarity and the perceived value of individual services in the constellation:

H4: *Higher perceived complementarity of services in a constellation leads to higher perceived value of individual services in the constellation.*

Building on the premise that perceived complementarity enhances the perceived value of individual services, it could be useful to consider the nature of these services within the constellation. Different types of individual services - such as those that align strategically with others (compatible services), serve as substitutes for existing options (substitute services), or enhance

the ease of the overall constellation (convenience services) - may be uniquely influenced by the complementarity effect. Based on these considerations, the following sub-hypotheses are proposed:

H4a: *Higher perceived complementarity of services in a constellation leads to higher perceived value of compatible services.*

H4b: *Higher perceived complementarity of services in a constellation leads to higher perceived value of substitute services.*

H4c: *Higher perceived complementarity of services in a constellation leads to higher perceived value of convenience services.*

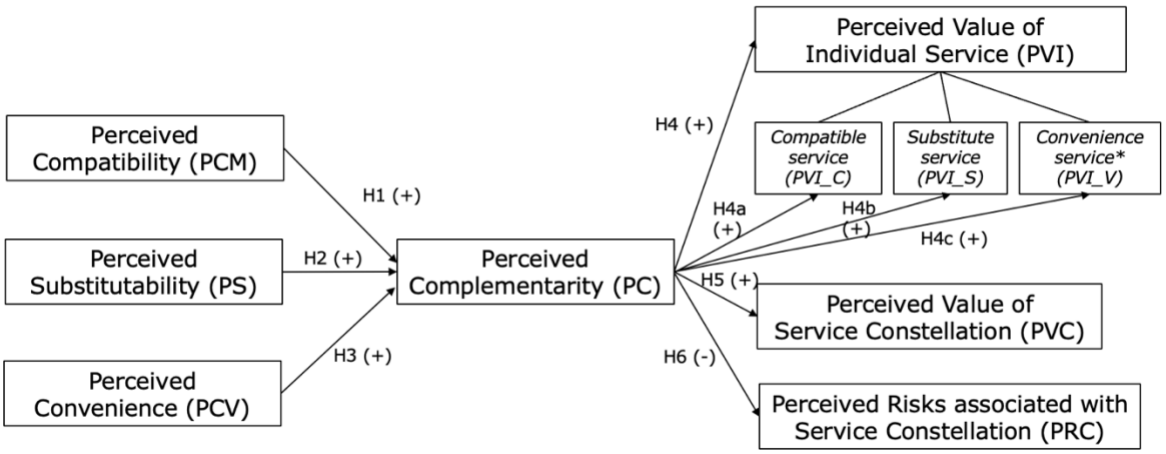
The overall perceived value of a service constellation is determined by how well the individual services interact and enhance one another (Normann & Ramirez, 1993). When services are complementary, the entire constellation is seen as more valuable because it provides a more comprehensive and efficient solution to the customer's needs. In retail, this can be observed when services such as personalized recommendations, loyalty programs, and convenient checkout options work together to create a holistic and satisfying shopping experience. Studies show that when services are well-aligned and complementary, customers view the entire constellation as providing greater value than the sum of its parts (Normann & Ramirez, 1993; Van Riel et al., 2013).

H5: *Higher perceived complementarity of services in a constellation leads to higher perceived value obtained from using the service constellation (perceived value of service constellation).*

Perceived complementarity in a service constellation can also reduce customers' perceived risks associated with using the service constellation. When services within a constellation are complementary, they work together synergistically to enhance the overall value proposition for customers including the reduction of uncertainties, especially ones associated with financial transactions. For example, in a retail service constellation like a mall, if customers encounter complementary services such as customer service and post-purchase service with transparent refund policy, or when have the opportunity to compare prices between stores, they may perceive lower financial risk associated with their purchases. This assumption led to the proposition of the following hypothesis:

H6: *Higher perceived complementarity of services in a constellation leads to lower perceived risks associated with using the service constellation.*

The following conceptual model is proposed based on the literature study, stated research questions, and hypotheses.



**Service that increases the perceived convenience of the service constellation*

Figure 2. Conceptual model

CHAPTER 3: RESEARCH DESIGN

This chapter presents the framework for the empirical investigation of the research hypotheses, focusing on the relationships between perceived compatibility, perceived substitutability, perceived convenience, perceived complementarity, perceived value and risks within service constellations. The chapter is structured into three main sections. The first section outlines how the research was constructed, detailing the methods and measurements chosen to test the stated hypotheses and meet the objectives. The second section discusses the data collection process and the sample characteristics. Finally, the third section describes the data analysis methods employed to test the hypotheses. This preparation lays the foundation for the empirical results presented in Chapter 4.

3.1. Research Methodology

To answer the research questions, a quantitative research design will be employed to examine the causal relationships between perceived compatibility, perceived substitutability, perceived convenience as independent variables, and complementarity as a mediating variable affecting perceived value (both of individual services and the overall service constellation) and perceived risk associated with the service constellation. A multi-regression model is used to assess the magnitude and correlations among these variables using a linear regression equation.

The general regression equation is as follows:

$$Y = \alpha + \beta 1 * X1 + \beta 2 * X2 + \cdots + \beta n * Xn + \varepsilon$$

Y = dependent variable

α = intercept

Xi = independent variable

βi = coefficient parameter

n = number of variables

ε = error term

The study will utilize six separate regression models to evaluate the relationships defined in the conceptual model and address the hypotheses. These models are summarized in Table 1 below:

Table 1. Regression models

Model	Dependent Variable (Y)	Independent Variables (X)	Equation	Hypothesis
1	Perceived Complementarity (PC)	Perceived Compatibility (PCM), Substitutability (PS), Convenience (PCV)	PC= α+β1∗PCM+β2∗PS+β3 ∗PCV+ ε	H1, H2, H3
2	Perceived Value of Individual Services (PVI_C)	Perceived Complementarity (PC)	PVI_C= α+β1∗PC+ ε	H4a
3	Perceived Value of Individual Services (PVI_S)	Perceived Complementarity (PC)	PVI_S= α+β1∗PC+ ε	H4b
4	Perceived Value of Individual Services (PVI_V)	Perceived Complementarity (PC)	PVI_V= α+β1∗PC+ ε	H4c
5	Perceived Value of the Service Constellation (PVC)	Perceived Complementarity (PC)	PVC= α+β1∗PC+ ε	H5
6	Perceived Risks of the Service Constellation (PRC)	Perceived Complementarity (PC)	PRC= α+β1∗PC+ ε	H6

The first model examines how perceived compatibility, perceived substitutability, and perceived convenience affect perceived complementarity of services in a constellation (testing H1, H2, and H3). The next 4 models investigate the impact of perceived complementarity on the perceived value of individual services (H4a, H4b, H4c) and of the overall service constellation (H5). The last model examines whether complementarity reduces perceived risks associated with the service constellation (H6).

3.2. Data Collection

Data collection for this study took place over a period of 10 weeks, from late May 2024 to early August 2024, using an online survey administered via Qualtrics. The survey was disseminated

through various channels, including social media platforms like Facebook, LinkedIn, WhatsApp, and Instagram, as well as survey exchange platforms such as PollPool.com and SurveySwap.io. These platforms were chosen to ensure a diverse and broad pool of respondents, enabling the research to capture a wide range of perspectives. By utilizing both social media outreach and dedicated survey-swapping platforms, the study aimed to balance respondent quality and quantity, reaching participants with relevant shopping experiences in retail service constellations. This approach helped gather the necessary sample size within the designated timeframe.

3.2.1. Sampling Method

This study adopts convenience sampling method due to its practicality and suitability in efficiently reaching a wide population. Participants are recruited from various demographics to ensure diversity in terms of age, gender, and socioeconomic status, all of whom must have had experience shopping in one-stop retail environments, i.e. shopping malls. These participants will have encountered multiple services (e.g., payment, customer service, product variety, and additional amenities such as loyalty programs or delivery services) within a single shopping trip, making them well-qualified to assess the complementarity of these services.

3.2.2. Sample Size

In determining an appropriate sample size for this study, various guidelines from statistical literature are considered. A frequently recommended rule is to have at least ten participants per variable in regression analysis to ensure sufficient power for hypothesis testing (Hair et al., 2010). For this study, with seven key variables being examined, this would suggest a baseline sample size of 70 respondents. However, modern approaches recommend considering factors like model complexity and desired statistical power. To ensure sufficient power and accurate estimates, a sample size of 150 to 200 participants is commonly recommended for studies involving multiple variables and Likert-scale measurements (Cohen, 1988; Wolf et al., 2013). This will provide robust data for hypothesis testing and ensure reliable results.

Given the nature of this research, aiming for a sample size of around 150 to 200 participants will provide the necessary statistical power and ensure reliable results across the model's complexity. This number is sufficient to capture meaningful relationships between variables while maintaining the rigor needed for generalization in the retail context.

3.2.3. Questionnaire Design

The questionnaire used in this research is composed of two distinct sections. The first section focuses on gathering insights into participants' experiences with different services in a one-stop shopping mall scenario, concentrating on variables such as perceived compatibility, substitutability, convenience, complementarity, as well as the perceived value and risks associated with the overall shopping experience. These key constructs are evaluated using a seven-point Likert scale, where 1 indicates "strongly disagree" and 7 indicates "strongly agree." The second

section is dedicated to collecting demographic data such as gender, age, marital status, and annual income, through multiple-choice questions.

The questionnaire begins with an introduction explaining the purpose and ensuring GDPR compliance. Participants are asked to imagine a typical shopping experience in a shopping mall setting with various stores, including shoe shops, a sports equipment store, and a café, reflecting the one-stop shopping concept.

Key constructs such as perceived value and substitutability are adapted from existing literature, with questions designed to assess customer perceptions of these aspacts of the service constellation. The items "I enjoy shopping at _" and "_ offers value for money" draw on Sweeney and Soutar's (2001) conceptualization of perceived value as an enjoyable and cost-benefit evaluation. Items measuring substitudability were generated based on Aaker and Keller's (1990) definition and measurement items of substitute, which highlight the ability of one service to replace another in satisfying the same need.

The rest of the items was self-derived based on the definitions of the concepts. Perceived convenience is measured by the degree to which the café enhances the overall shopping experience, while perceived risks focus on concerns like payment security and overcharging.

The final questionnaire included total seven variables, two open-ended questions, 36 Likert-scaled questions for the main research constructs, and four demographic questions (See Appendix 1). To ensure clarity and effectiveness, the survey underwent a pilot test with six participants who had experience in similar settings. This process allowed for minor adjustments and ensured that the questionnaire was well-suited for the main data collection phase.

3.3. Data Analysis

In this section, the results collected from the survey will be presented including data cleaning, sample description, and factor analysis. Reliability testing will be utilized to ensure the consistency of the measurement constructs, followed by correlation analysis to examine the relationships between variables. Finally, regression analysis will be conducted to test the hypotheses and provide insights to the key findings of the study.

3.3.1. Data Preparation

Data was collected over a period of ten weeks, from 20th May 2024 to 5th August 2024, using a convenience sampling method through an online survey hosted on Qualtrics. A total of 268 responses were gathered including incomplete responses from 114 participants who did not finish the questionnaire. Therefore, these incomplete responses were excluded from the dataset, leaving a final qualified sample of 154 completed responses.

The data refinement process involved several steps to ensure the quality and reliability of the responses for regression analysis. Firstly, responses were filtered to exclude incomplete surveys. Only those who completed all sections of the survey were retained for analysis. Secondly,

responses were reviewed to detect any potential straight-lining behavior, where participants might have consistently selected the same answer for all items, or used repetitive sequences such as "23452345" across questions. Any such cases were flagged and removed from the analysis to maintain the integrity of the data. Lastly, outlier detection was performed using statistical methods to identify and exclude any responses that could skew the results. Specifically, the Mahalanobis distance test was applied to detect multivariate outliers, followed by the Chi-square distribution test to confirm statistical significance. Four distinct models were assessed individually, each incorporating unique combinations of dependent and independent variables to thoroughly test the dataset's structure and relationships. Responses with a probability value of <0.001 (16 outliers) were excluded from the final dataset to ensure the reliability of the sample.

After completing this three-step data cleaning process, the final sample of 138 valid responses was used for regression analysis (See Table 2).

Table 2. Data preparation summary

Index	Value
# of participants	268
# of complete responses	154
# of observations	154
# of outliers	16
# of qualified observations	138

3.3.2. Demographics

Table 3 provides an overview of the demographic characteristics of the research sample. The gender distribution shows a higher representation of females, making up 70.3% of respondents, while 27.5% are male. A small minority identified as "Others" (2 participants) or chose not to disclose their gender (1 participant). This imbalance suggests that the sample is heavily skewed towards female participants, which could impact the generalizability of the study's findings if gender differences are relevant to the research outcomes.

The age distribution shows that over half of the respondents (54.4%) are aged 21–30, followed by 28.9% (40 participants) aged 31–40, while younger participants (20 or below) and older participants (41 or above) make up 4.4% and 8.7% respectively.

In terms of marital status, 66.7% identified as single, while 29.7% reported being married or cohabiting. The remaining categories – *Divorced* and *Other* - were minimally represented. The income distribution reveals that most participants earn between 20,000 and 40,000 euros annually (53.6%), followed by 26.8% earning less than 20,000 euros, and smaller groups reporting higher incomes.

Overall, this sample characterized by a youthful and predominantly female demographic, with most respondents earning moderate incomes and being single. These traits align with the target

population of the study but may limit the generalizability of findings due to the gender skew and relatively young age profile.

Table 3. Demographics of the research sample

Measure	Item	Count	Percentage (%)
Gender	Female	97	70.3
	Male	38	27.5
	Others	2	1.5
	Prefer not to say	1	0.7
Age (years old)	20 or bellow	6	4.4
	21-30	75	54.4
	31-40	40	28.9
	41 or above	12	8.7
	Missing	5	3.6
Status	Single	92	66.7
	Cohabitant/Married	41	29.7
	Divorced	1	0.7
	Other	4	2.9
Annual net income	Less than 20,000 EUR	37	26.8
	20,000 - 40,000 EUR	74	53.6
	40,000 – 60,000 EUR	18	13.0
	Above 60,000 EUR	9	6.6

3.3.3. Descriptive Statistics and Distribution of the Data

Overall, the distributions of variables in the dataset exhibit varying levels of symmetry and deviation from normality, with most skewed toward higher agreement on the 7-point Likert scale (see descriptive statistics in Table 4 below). While most constructs reflect moderate to strong consensus, specific variations and tendencies provide deeper insight into participant perceptions.

Perceived Compatibility (PCM) ranges from 1 to 7, with a mean score of 5.02, indicating participants generally perceive certain services as compatible within the constellation. A slightly negative skew (-0.86) suggests that responses lean toward higher scores, while a kurtosis of 1.25 suggests a relatively narrow spread of responses, with responses clustering near the mean.

In contrast, Perceived Substitutability (PS) shows a higher mean of 5.11 and a milder negative skew (-0.635), while reflecting a similar range of 2 to 7. The kurtosis value of 0.27 suggests a relatively normal distribution, indicating a moderate range of opinions about the substitutability of the two selected services in the constellation.

Perceived Convenience (PCV) stands out with a relatively high mean of 5.30, pointing to strong perceptions of convenience. Its negative skew (-0.859) confirms a bias toward agreement, though the kurtosis (0.303) indicates that responses remain evenly distributed without extreme concentration.

Table 4. Descriptive Statistics and Data Distribution

	Minimum	Maximum	Mean	Skewness	Kurtosis
PCM	1	7	5.0242	-.860	1.251
PS	2	7	5.1063	-.635	.270
PCV	1	7	5.2995	-.859	.303
PC	3	7	5.1530	-.314	-.205
PVI_S	2	7	5.2077	-.672	.646
PVI_C	1	7	5.0676	-.818	.958
PVI_V	1	7	5.1981	-.933	.910
PVC	1	7	5.3816	-1.281	3.587
PRC	1	7	3.5676	.262	-.732

Participants perceive the complementarity of the service constellation (PC) within the range of 3 to 7, with a mean of 5.15, reflecting moderately high agreement. The near-zero skewedness (-0.314) and low kurtosis (-0.205) suggest a relatively flat and balanced spread of responses, indicating a normal distribution with no significant clustering or deviation.

Among the subdimensions of Perceived Value of Individual Service (PVI), each demonstrates unique characteristics. PVI_S (Substitute Service) shows a mean of 5.21, with a negative skewedness (-0.672) and moderate kurtosis (0.646), suggesting that responses lean toward agreement while remaining moderately focused. PVI_C (Compatible Service) has a mean of 5.07, with a stronger skew (-0.818), indicating greater clustering toward higher scores. Its kurtosis (0.958) points to slightly concentrated opinions. PVI_V (Convenience Service) emerges as the highest among these dimensions, with a mean of 5.19 and a noticeable skew (-0.933). The kurtosis of 0.910 highlights a high degree of consistency in responses. While PVI_C and PVI_V both range from 1 to 7, the range of PVI_S is slightly narrower, spanning from 2 to 7.

Perceived Value of Service Constellation (PVC) has the highest mean in the dataset (5.38), and ranges from 1 to 7, reflecting a strong agreement on the overall value derived from the service constellation. Its distribution exhibits a pronounced negative skew (-1.281), with a leptokurtic pattern (3.587), [1] suggesting that responses are tightly concentrated around the higher end of the scale.

Finally, Perceived Risk Associated with the Service Constellation (PRC) contrasts with the other variables, as it has the lowest mean (3.57) in the dataset, falling below the midpoint of the scale. Its slight positive skew (0.262) indicates a tendency toward lower scores, and the kurtosis (-0.732) reflects a relatively flat and broad spread of responses.

3.3.4. Correlation Analysis

[1] The value deviates from the normal distribution, potentially requiring a transformation. However, given the robustness of SmartPLS and SPSS, and only one variable is affected, no transformation was applied.

Table 5 presents the correlation matrix for the main constructs based on the bivariate Pearson Correlation, providing insights into the strength and direction of their linear relationships. According to Dancey and Reidy (2007), correlations below 0.3 are considered negligible, while coefficients between 0.5 and 0.7 indicate moderate relationships, and values above 0.7 reflect strong correlations.

Table 5. Correlation Matrix

	PCM	PS	PCV	PC	PVI_S	PVI_C	PVI_V	PVC	PRC
PCM	1								
PS	.438**	1							
PCV	.212*	.237**	1						
PC	.348**	.390**	.632**	1					
PVI_S	.346**	.298**	166	.251**	1				
PVI_C	.361**	.328**	.167*	.358**	.552**	1			
PVI_V	.426**	.171*	.513**	.439**	.373**	.401**	1		
PVC	.314**	.329**	.455**	.471**	.400**	.400**	.404**	1	
PRC	.044	.117	-.078	.015	.162	.050	.029	-.139	1

***Correlation is significant at the 0.01 level*
**Correlation is significant at the 0.05 level*

Most correlations in the matrix are statistically significant, as indicated by their corresponding significance levels ($p < 0.01$ or $p < 0.05$) (see Appendix 2). Some correlations exhibit moderate associations ($0.5 < r < 0.7$). Notably, PC and PCV have a comparatively strong correlation ($r = 0.632$, $p < 0.01$), suggesting that a higher sense of complementarity strongly enhances perceptions of convenience in the service constellation. No correlations exceed the threshold of 0.7, implying that the constructs maintain sufficient distinctiveness, avoiding issues of multicollinearity or redundancy.

PCM and PS exhibit a moderate positive correlation ($r = 0.438$, $p < 0.01$), indicating that perceptions of compatibility and substitutability within service constellations tend to align. This relationship suggests that services perceived as compatible are also moderately viewed as substitutable, reflecting potential overlaps in their conceptual foundations. PCM also shows a weaker but statistically significant positive correlation with PVC ($r = 0.314$, $p < 0.01$), highlighting its role in enhancing the perceived overall value of the constellation.

PC demonstrates a strong positive correlation with PVC ($r = 0.471$, $p < 0.01$), suggesting that when services complement one another effectively, customers derive greater perceived value from the constellation as a whole. Similarly, PC correlates moderately with PCM ($r = 0.348$, $p < 0.01$) and PS ($r = 0.390$, $p < 0.01$), emphasizing its interconnectedness with the compatibility and substitutability constructs.

Among the subdimensions of Perceived Value of Individual Service (PVI), PVI_S, PVI_C, and PVI_V, strong internal correlations are evident. For instance, PVI_C and PVI_S share a significant

positive correlation ($r = 0.552$, $p < 0.01$), indicating a notable overlap in how substitute and compatible services contribute to perceived value. Additionally, PVI_V correlates strongly with both PVC ($r = 0.404$, $p < 0.01$) and PC ($r = 0.439$, $p < 0.01$), underscoring the importance of convenience services in driving both complementarity and value perceptions.

PRC, however, exhibits non-significant correlations with all other constructs. For example, PRC shows no significant relationship with PCM ($r = 0.044$, $p = 0.612$) and also a non-significant correlation with PVC ($r = 0.103$, $p = 0.173$) (See Appendix 2). This suggests that perceived risk operates independently from perceived value of individual services as well as the whole constellation, and complementarity perceptions within the service constellation.

Overall, the correlation analysis confirms moderately strong relationships between the constructs of compatibility, complementarity, substitutability, and value, providing evidence for the interconnectedness of these perceptions while ensuring the theoretical distinctiveness of the measured constructs. However, the limited role of perceived risk highlights its distinctiveness, suggesting further exploration in the context of service constellations.

3.3.5. Measurement Model Assessment

Following the two-step procedure outlined by Hair et al. (2022) and Hair et al. (2020), the evaluation of the measurement model was conducted as a prerequisite for structural model analysis. First, the reliability and validity of the constructs were evaluated through internal consistency, convergent validity, and discriminant validity assessments. Once the measurement model is validated, the analysis progresses to the structural model, where the hypothesized relationships among constructs are tested.

As detailed by Hair et al. (2022), reflective measurement models are assessed through several criteria: indicator loadings, Cronbach's Alpha, Composite Reliability, Average Variance Extracted, and the Heterotrait-Monotrait Ratio (HTMT). Addressing multicollinearity using the Variance Inflation Factor (VIF) is also important to confirm that the indicators are not excessively correlated, thereby preserving the model's integrity.

According to Hair et al. (2013) and Fornell and Larcker (1981), Cronbach's alpha and rho_c values above 0.7 indicate reliability, while AVE values above 0.5 demonstrate adequate convergent validity. Outer loadings should typically exceed 0.7 to demonstrate that the item contributes strongly to the construct it measures (Hair et al., 2011). Items with loadings between 0.4 and 0.7 can be retained if removing them does not improve the composite reliability or Average Variance Extracted (AVE). Loadings below 0.4 are generally problematic and should be considered for removal.

Table 6. Construct reliability and validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
PC	0.862	0.872	0.891	0.480
PCM	0.807	0.836	0.883	0.716
PCV	0.888	0.899	0.931	0.818
PRC	0.805	-2.315	0.793	0.576
PS	0.621	0.696	0.790	0.561
PVC	0.845	0.846	0.906	0.763
PVI_C	0.886	0.902	0.929	0.814
PVI_S	0.760	0.825	0.813	0.438
PVI_V	0.872	0.874	0.921	0.796

Perceived Compatibility (PCM)

PCM demonstrates strong reliability and validity, with a Cronbach's alpha of 0.807, rho_a of 0.836, and rho_c of 0.883 (See Table 6). The AVE of 0.716 exceeds the threshold of 0.5, confirming adequate convergent validity. All three indicators of PCM (PCM_1, PCM_2, PCM_3) have high loadings (0.813–0.878) (See Table 7), indicating strong contributions to the PCM construct. These results validate PCM as a reliable construct measured by its indicators.

Perceived Convenience (PCV)

PCV achieved robust reliability, with Cronbach's alpha of 0.888, rho_a of 0.899, and rho_c of 0.931. Its AVE is 0.818, indicating excellent convergent validity. Loadings of indicators PCV_1 to PCV_3 all exceed 0.7 (ranging from 0.849 to 0.933), indicating a strong measurement model for the PCV construct.

Perceived Substitutability (PS)

PS showed weak reliability, with a Cronbach's alpha of 0.621, rho_a of 0.696, and rho_c of 0.790. The AVE of 0.561 meets the threshold for convergent validity, but the low Cronbach's alpha highlights internal consistency concerns. Revisions to the construct or its indicators may be necessary. According to Table 6 – Outer Loadings Matrix, two indicators (PS_1 = 0.852, PS_2 = 0.772) load strongly, while PS_3 had a weaker loading (0.601) and was subsequently removed. This removal improved the construct's reliability and validity, increasing composite reliability (rho_c) to 0.832 and AVE to 0.714, ensuring better alignment with recommended thresholds.

Perceived Complementarity (PC)

The reliability of PC is acceptable, with a Cronbach's alpha of 0.862, rho_a of 0.872, and rho_c of 0.891. However, the AVE is 0.480, which is below the threshold of 0.5, indicating potential issues with convergent validity. This suggests that while the construct is internally consistent, some items may not adequately capture the construct's variance. Upon reviewing the factor loadings, PC_5 was removed due to its weak contribution to the construct. This adjustment improved the AVE to 0.511, exceeding the threshold, and the revised construct is retained for further analysis.

Perceived Value of Individual Service (PVI)

PVI consists of three subdimensions: PVI_S, PVI_C, and PVI_V, which are assessed separately.

PVI_S (Substitute Service): While its Cronbach's alpha is acceptable at 0.760, the rho_a (0.825) and rho_c (0.813) indicate moderate reliability. However, the AVE is 0.438, below the threshold for convergent validity, suggesting that the indicators for this subdimension require further refinement. A closer examination of the indicator loadings revealed that PVI_1 to PVI_3 had weak loadings, failing to meet the threshold for reliability, whereas indicators such as PVI_4 (0.743), PVI_5 (0.838), and PVI_6 (0.838) showed stronger relationships with the construct. To address these concerns, PVI_1, PVI_2, and PVI_3 were removed. This adjustment significantly improved the construct's reliability and validity metrics, as reflected in the updated values: Cronbach's alpha increased to 0.839, rho_a to 0.915, rho_c to 0.901, and AVE to 0.753.

PVI_C (Compatible Service): Strong reliability and validity were observed, with a Cronbach's alpha of 0.886, rho_a of 0.902, rho_c of 0.929, and AVE of 0.814. All indicators exhibited very high loadings (PVI_7 = 0.909, PVI_8 = 0.933, PVI_9 = 0.864), confirming strong reliability for this subdimension.

PVI_V (Convenience Service): This subdimension performed similarly well, with a Cronbach's alpha of 0.872, rho_a of 0.874, rho_c of 0.921, and AVE of 0.796, ensuring reliability and validity. All three indicators had loadings exceeding 0.7 (PVI_10 = 0.870, PVI_11 = 0.908, PVI_12 = 0.899), additionally supporting the validity of this subdimension.

Perceived Value of Service Constellation (PVC)

PVC also performed well in terms of reliability and validity. It has a Cronbach's alpha of 0.845, rho_a of 0.846, and rho_c of 0.906, with an AVE of 0.763, indicating excellent convergent validity. The loadings of PVC_1 (0.867), PVC_2 (0.881), and PVC_3 (0.873) also indicate a well-measured construct.

Perceived Risk associated with Service Constellation (PRC)

The Perceived Risk associated with Service Constellation (PRC) showed mixed reliability results. While Cronbach's alpha was acceptable at 0.805, rho_a was negative and unexpectedly low (-2.315). Rho_a, by its mathematical definition, cannot be negative as it is derived from squared correlations and other non-negative components. This anomaly points to a significant problem, likely a computational error arising from either irregularities in the data (such as near-zero variances) or, more probably, a misspecification of the measurement model. The varying indicator loadings, with PRC_2 performing strongly (0.997) while PRC_1 (0.644) and PRC_3 (0.565) showed weaker contributions, further support the possibility of model misspecification. Despite this issue with rho_a, the Average Variance Extracted (AVE) exceeded the 0.5 threshold (0.576), suggesting adequate convergent validity. Given the acceptable Cronbach's alpha and AVE, PRC was retained, but the problematic rho_a highlights the need for careful interpretation and potential model refinement in future research.

Table 7. Outer Loadings Matrix

	PC	PCM	PCV	PRC	PS	PVC	PVI_C	PVI_S	PVI_V
PCM_1		0.813							
PCM_2		0.878							
PCM_3		0.847							
PCV_1			0.928						
PCV_2			0.933						
PCV_3			0.849						
PC_1	0.590								
PC_2	0.768								
PC_3	0.773								
PC_4	0.630								
PC_5	0.515								
PC_6	0.678								
PC_7	0.747								
PC_8	0.734								
PC_9	0.751								
PRC_1				0.644					
PRC_2				0.997					
PRC_3				0.565					
PS_1					0.852				
PS_2					0.772				
PS_3					0.601				
PVC_1						0.867			
PVC_2						0.881			
PVC_3						0.873			
PVI_1								0.460	
PVI_2								0.438	
PVI_3								0.518	
PVI_4								0.743	
PVI_5								0.838	
PVI_6								0.838	
PVI_7							0.909		
PVI_8							0.933		
PVI_9							0.864		
PVI_10									0.870
PVI_11									0.908
PVI_12									0.899

The HTMT matrix in Table 8 confirms discriminant validity, with all values below the threshold of 0.9, indicating clear distinctions between constructs. For example, PCM and PC exhibit a low HTMT value of 0.412, while PRC and PVC show 0.169, supporting the uniqueness of these constructs. These results validate the measurement model, ensuring it is suitable for subsequent structural model analysis.

Table 8. Discriminant validity - Heterotrait-Monotrait Ratio (HTMT) Matrix

	PC	PCM	PCV	PRC	PS	PVC	PVI_C	PVI_S	PVI_V
PC									
PCM	0.412								
PCV	0.749	0.249							
PRC	0.088	0.063	0.112						
PS	0.526	0.617	0.275	0.205					
PVC	0.564	0.375	0.532	0.169	0.319				
PVI_C	0.394	0.416	0.191	0.076	0.457	0.467			
PVI_S	0.307	0.475	0.303	0.076	0.473	0.347	0.502		
PVI_V	0.509	0.502	0.584	0.097	0.252	0.469	0.460	0.485	

To ensure that multicollinearity does not affect the accuracy of the measurement model, the variance inflation factor (VIF) was calculated for all indicators. VIF values below 5 are generally considered acceptable, indicating that indicators do not exhibit significant multicollinearity (Hair et al., 2022). As shown in Table 9, all indicators exhibit VIF values well below the threshold, with the highest observed VIF being 3.512 for PCV_2. This confirms that multicollinearity is not a concern in the measurement model, supporting the validity of the indicators.

Table 9. Collinearity statistics (VIF)

	VIF		VIF
PCM_1	2.051	**PRC_3**	1.667
PCM_2	2.256	**PS_1**	1.245
PCM_3	1.481	**PS_2**	1.245
PCV_1	3.400	**PVC_1**	1.974
PCV_2	3.512	**PVC_2**	2.058
PCV_3	1.990	**PVC_3**	2.048
PC_1	1.498	**PVI_10**	2.025
PC_2	2.402	**PVI_11**	2.818
PC_3	2.265	**PVI_12**	2.491
PC_4	1.691	**PVI_4**	1.603
PC_6	1.752	**PVI_5**	2.491
PC_7	3.286	**PVI_6**	2.530
PC_8	3.473	**PVI_7**	2.994
PC_9	2.289	**PVI_8**	3.197
PRC_1	1.697	**PVI_9**	2.072
PRC_2	2.042	**PVI_9**	2.072

3.3.6. Regression Analysis

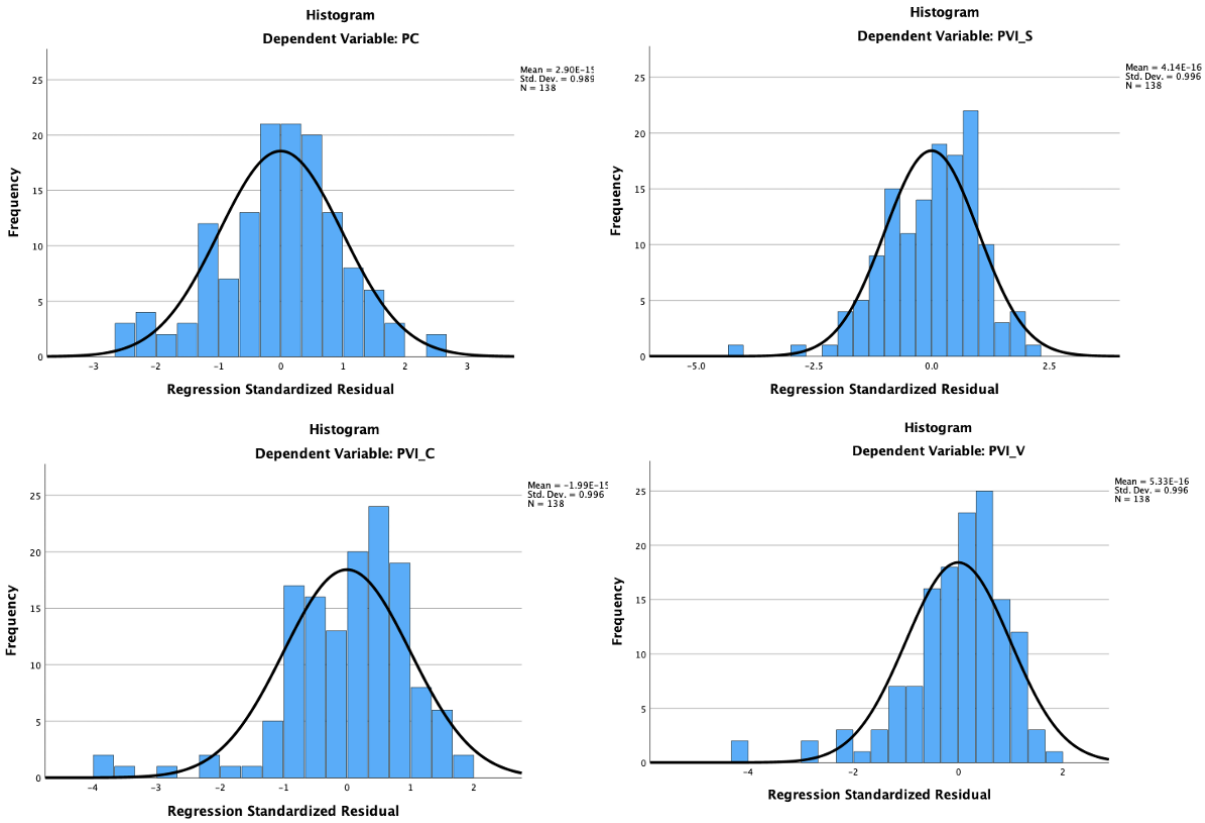
In the previous steps, the validity and reliability of the constructs were rigorously evaluated, ensuring the robustness of the measurement model. In this section, the structural model is assessed to test the hypotheses outlined in earlier chapters. A multiple linear regression analysis was conducted to explore the relationships between the dependent and independent variables and

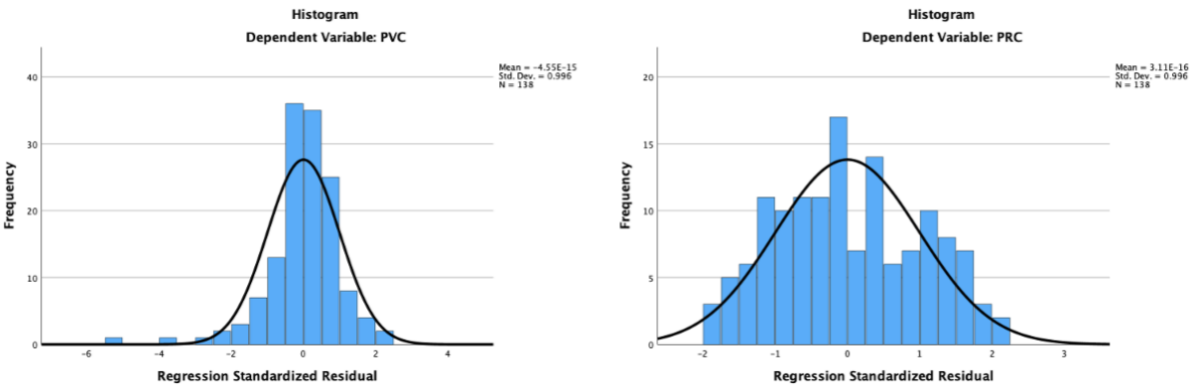
to evaluate the extent of their interaction. Six regression models were developed, each featuring a unique dependent variable.

Before conducting the regression, key assumptions were assessed to ensure the reliability of the results. These assumptions included normality, multicollinearity, linearity, homoscedasticity, and the independence of residuals. Outliers had been identified and eliminated during the data preparation stage, while normality was partially assessed in the previous section using descriptive statistics. The remaining checks are completed in this section.

Histograms of regression standardized residuals for all dependent variables (See Figure 3) exhibit approximately bell-shaped distributions, indicating adherence to the assumption of normality. The histogram for PC, for example, demonstrates a near-symmetrical distribution centered around zero, and similar trends are observed for PVI_S, PVI_C, PVI_V, PVC, and PRC. Mean residual values across all models are close to zero, further supporting the assumption of normality (Field, 2000). The normal P-P plots of regression standardized residuals (See Appendix 5) reveal that data points align closely with the diagonal line, indicating a linear relationship between predicted and observed values. This alignment suggests that the regression equations are appropriate for modeling the relationships between variables. Scatterplots of residuals versus predicted values (See Appendix 6) show a random and balanced distribution of residuals around the zero line, without clustering or funnel-shaped patterns, confirming homoscedasticity. Homoscedasticity ensures the reliability of standard error estimates and statistical tests. These diagnostic results validate the assumptions of normality, linearity, and homoscedasticity, ensuring the appropriateness of the regression models and the reliability of subsequent analyses.

Figure 3. Histograms of regression standardized residuals of the six models





In regression analysis, the coefficient of determination (R^2/ R-square) is an important measure that shows how much of the variation in the dependent variable is explained by the independent variables. R-square values range from 0 to 1, where 0 means the independent variables do not explain any variance in the dependent variable, and 1 indicates that they explain all the variance (Sekaran & Bougie, 2016). A higher R-square value reflects stronger explanatory power of the model, suggesting better performance. The Adjusted R-square provides a more accurate measure by accounting for the number of predictors in the model, making it useful when comparing models with different numbers of variables.

The R-square values in Table 10 reveal that the model performs well for PC (0.533), indicating that 53.3% of its variance is explained by the predictors, followed by PVC (0.233) and PVI_V (0.204), reflecting moderate explanatory power. However, PVI_C (0.116) and PVI_S (0.077) show limited explanatory strength, while PRC (0.001) indicates that the predictor fails to explain its variance, suggesting the need for refinement. The low R-square for PRC suggests potential issues with the measurement or theoretical alignment, which will be further addressed in the discussion and limitations sections.

Table 10. R-square

	R^2	R^2 adjusted
PC	0.533	0.523
PRC	0.001	-0.006
PVC	0.233	0.227
PVI_C	0.116	0.109
PVI_S	0.077	0.071
PVI_V	0.204	0.198

To determine the significance and magnitude of the relationships between variables, bootstrapping is performed with 5,000 resamples. This technique provides estimates of the path coefficients and their statistical significance. The hypotheses are tested through path coefficients, p-values, and t-values, which collectively determine the strength and reliability of each proposed relationship. The findings from this analysis will form the basis for hypothesis confirmation or rejection, as presented in Chapter 4.

CHAPTER 4: RESULTS

This chapter presents the findings derived from the structural model evaluation and hypothesis testing conducted using SmartPLS. These findings address the research questions by testing the hypothesized relationships within the conceptual framework. The results are summarized in Table 11, with key statistical metrics such as path coefficients, p-values, t-values, and f-square values used to evaluate the strength and significance of the relationships between constructs. For a more visual representation of these results, see Appendix 3 (Structural Model - Path Coefficients) and Appendix 4 (Structural Model - p-values).

Out of the eight hypotheses tested, six are supported by the data, demonstrating significant relationships among the constructs in the proposed model. PCV emerged as the strongest predictor of PC, with a path coefficient of 0.605 ($p < 0.001$, $t = 9.076$), underscoring the critical role of perceived convenience in enhancing perceived complementarity. The f-square values provide additional insights into the effect sizes of the predictors within the model. According to Cohen (1988), f-square values are classified as small (0.02), medium (0.15), or large (0.35). As showed in Table 6, PCV demonstrates a large effect on PC (0.734), indicating that perceived convenience explains a substantial portion of the variance in perceived complementarity, highlighting its dominant role in shaping user perceptions within the service constellation. Similarly, PS significantly influences PC ($\beta = 0.212$, $p = 0.001$), indicating that substitutability contributes positively to complementarity within the service constellation however with a relatively modest impact (f-square = 0.076). PCM on the other hand does not show a significant relationship with PC ($\beta = 0.119$, $p = 0.095$, f-square = 0.024), suggesting that compatibility between services does not play a major role in shaping complementarity. As such, H1 is rejected, while H2 and H3 are supported.

The results show that PC significantly enhances the perceived value of individual services. For instance, the relationship between PC and PVI_C is significant ($\beta = 0.340$, $p = 0.001$, f-square = 0.131), supporting H4a and confirming that complementarity increases the perceived value of compatible services. Similarly, PC positively influences PVI_S ($\beta = 0.278$, $p = 0.008$, f-square = 0.084) and PVI_V ($\beta = 0.452$, $p < 0.001$, f-square = 0.256), supporting H4b and H4c, respectively. Among these, PVI_V demonstrates the strongest relationship with PC, suggesting that complementarity particularly enhances the value of convenience services within a constellation. Since all three sub-hypotheses (H4a, H4b, H4c) are supported, the overarching hypothesis H4 is also considered supported. These findings emphasize the central role of perceived complementarity in driving the value of individual services.

The results further confirm that PC significantly impacts PVC ($\beta = 0.483$, $p < 0.001$, f-square = 0.304), supporting H5 and emphasizing the relevance of complementarity in determining the overall perceived value of the service constellation. However, the relationship between PC and PRC is not significant ($\beta = -0.036$, $p = 0.792$, f-square = 0.001), leading to the rejection of H6. This suggests that perceived complementarity does not play a notable role in reducing perceived risks associated with service constellations. This outcome aligns with the earlier correlation analysis,

where no major correlations were observed between PRC and other constructs, further reinforcing the lack of evidence for this relationship.

Table 11. Hypotheses Testing Results (Main Effects)

Hypothesis	Path	Path coefficients(β)	p-values	t-values	f-square	Hypothesis Confirmation
H1	**PCM -> PC**	0.119	0.095	1.670	0.024	Rejected
H2	**PS -> PC**	0.212	0.001	3.215	0.076	Supported
H3	**PCV -> PC**	0.605	0.000	9.076	0.734	Supported
H4a	**PC -> PVI_C**	0.340	0.001	3.406	0.131	Supported
H4b	**PC -> PVI_S**	0.278	0.008	2.670	0.084	Supported
H4c	**PC -> PVI_V**	0.452	0.000	4.610	0.256	Supported
H5	**PC -> PVC**	0.483	0.000	6.221	0.304	Supported
H6	**PC -> PRC**	-0.036	0.792	0.264	0.001	Rejected

In summary, the findings confirm the importance of complementarity in service constellations, with strong support for most hypothesized relationships. Perceived convenience (PCV) is the dominant predictor of complementarity, followed by substitutability (PS), and compatibility (PCM) on the other hand shows limited influence. While complementarity significantly enhances the perceived value of both the constellation and individual services, it does not appear to meaningfully reduce perceived risks. These results align with the theoretical framework and provide a foundation for discussing their implications in the following chapter.

In addition to the direct relationships, the analysis of indirect effects provides valuable insights into how constructs interact within the service constellation framework. The results of the indirect effects, summarized in Table 12, highlight the mediating role of perceived complementarity in shaping the perceived value and risk associated with the constellation.

Table 12. Indirect effects

Path	β	Sample mean (M)	STDEV	t-values	p-values
PCM -> PRC	-0.004	-0.001	0.019	0.220	0.826
PCM -> PVC	0.057	0.061	0.037	1.551	0.121
PCM -> PVI_C	0.040	0.046	0.031	1.296	0.195
PCM -> PVI_S	0.033	0.038	0.027	1.205	0.228
PCM -> PVI_V	0.054	0.060	0.039	1.381	0.167
PCV -> PRC	-0.022	-0.011	0.083	0.262	0.793
PCV -> PVC	0.292	0.298	0.057	5.129	0.000
PCV -> PVI_C	0.206	0.208	0.057	3.622	0.000
PCV -> PVI_S	0.168	0.177	0.064	2.619	0.009
PCV -> PVI_V	0.273	0.279	0.066	4.159	0.000
PS -> PRC	-0.008	-0.004	0.031	0.248	0.804
PS -> PVC	0.102	0.106	0.037	2.787	0.005
PS -> PVI_C	0.072	0.076	0.035	2.083	0.037
PS -> PVI_S	0.059	0.063	0.030	1.933	0.053
PS -> PVI_V	0.096	0.098	0.034	2.779	0.005

The results indicate that PCV significantly influences both the overall perceived value of the constellation ($\beta = 0.292$, $p < 0.001$) and the value of individual services, including compatible ($\beta =$

0.206, p < 0.001), substitute (β = 0.168, p = 0.009), and convenience services (β = 0.273, p < 0.001) through PC. These results underline the critical role of perceived convenience in influencing perceptions of both individual and collective value of services within constellations. PS also demonstrates significant indirect effects through PC, enhancing PVC (β = 0.102, p = 0.005), PVI_C (β = 0.072, p = 0.037), and PVI_V (β = 0.096, p = 0.005). These results highlight perceived substitutability's dual contribution, directly fostering complementarity while indirectly shaping value perceptions across multiple service types.

In contrast, PCM exhibits negligible indirect effects, with no significant influence observed on either PVC (β = 0.057, p = 0.121) or PVI dimensions (e.g., PVI_C, β = 0.040, p = 0.195). This supports earlier findings, further suggesting PCM's limited role in driving complementarity and related outcomes. Finally, none of the predictors (PCV, PS, PCM) exhibit significant indirect effects on perceived risks (PRC). This aligns with the findings from the direct effects analysis.

CHAPTER 5: DISCUSSION & CONCLUSION

This chapter provides an in-depth discussion of the study's findings, focusing on the relationships tested in the conceptual model and their implications, contextualized through comparisons with prior research. It discusses the antecedents of service complementarity and their impact on value creation and risk mitigation within service constellations, offering suggestions for future research and practical recommendations for improving service design and integration in evolving ecosystems.

5.1. Discussion of Results

5.1.1. Antecedents of Perceived Complementarity

Perceived compatibility as a driver of perceived complementarity (H1)

Hypothesis H1 posits that higher perceived compatibility between two services in a service constellation leads to higher perceived complementarity. However, this relationship was not supported, as indicated by a non-significant path coefficient and p-value. The weak influence of compatibility challenges earlier frameworks, such as the Service-Dominant Logic proposed by Vargo and Lusch (2008), which emphasize compatibility as a foundation for value co-creation. However, in today's increasingly digital service ecosystems, users appear to prioritize practical outcomes such as speed, ease of use, and seamless integration over strict theoretical alignment between services. For example, a user might seamlessly use a ride-sharing app integrated with a payment platform, even if the underlying business models of these two services are not entirely compatible. This suggests that in such contexts, compatibility may be a necessary but not sufficient condition for perceived complementarity. While some level of basic compatibility is required for integration, other factors like convenience and substitutability may play a more dominant role in shaping user perceptions.

Furthermore, the perceived compatibility might differ from the actual compatibility. While actual compatibility refers to the technical alignment between services, perceived compatibility is shaped by user experience factors such as physical or interface design, branding, and marketing. A well-designed user interface that enables seamless data exchange can create a strong sense of perceived compatibility, even if the underlying technical architectures of the services are quite different. This "perceived compatibility" might be more influential than the actual technical compatibility in driving perceived complementarity. In addition, exploring the user journey and employing user journey mapping could reveal how perceptions of compatibility evolve throughout different stages of interaction with the service constellation. For instance, initial perceptions might be based on superficial features, while deeper engagement might reveal underlying incompatibilities.

The lack of significant indirect effects for PCM additionally suggests that mere compatibility does not translate into perceived value enhancement or risk mitigation unless coupled with convenience or substitutability. This implies that users may not consciously consider compatibility when assessing the benefits or risks of a service constellation, focusing instead on more tangible aspects like ease of use and flexibility.

The self-derived scenario used in the questionnaire may have also contributed to this result. The scenario may have oversimplified the concept of compatibility, failing to capture its multifaceted nature. For instance, it might have focused primarily on functional compatibility (whether the services work together) and neglected other dimensions like strategic compatibility (whether the services align in terms of their overall goals and target markets). Future research could investigate how different types of compatibility, such as functional, strategic, temporal (whether services are available when needed) and value-based compatibility, independently and collectively influence perceived complementarity.

Perceived substitutability as a driver of perceived complementarity (H2)

Hypothesis H2, which proposes that higher perceived substitutability between two services leads to higher complementarity, was supported. The significant and positive relationship suggests that users perceive service constellations as more cohesive when they offer alternative options for certain products or services. This finding aligns with Guiltinan (1987), who identified substitutability as a strategic factor in enhancing usability and user satisfaction. In practice, substitutability allows users to adapt the constellation to their specific needs and hence improves their perceptions towards the value constellation.

This finding is also consistent with Aaker and Keller's (1990) research, which demonstrated that substitutability enhances the transfer of quality perceptions between a brand and its extensions. Similarly, in service constellations, substitutable services provide flexibility, ensuring that users can achieve their goals even if one component is unavailable or less suitable. This strengthens the perception of integration and mutual support among components, fostering complementarity. It's also important to differentiate between types of substitutes and their varying effects on complementarity. For instance, "complementary substitutes," like a ride-sharing app and a public

transport app, offer different benefits for different situations while still contributing to the overall goal of getting from point A to point B. On the other hand, "perfect substitutes," like two different ride-sharing apps with identical features and pricing, might contribute less to perceived complementarity as they don't offer unique value within the ecosystem.

While substitutability and complementarity are often seen as opposing dimensions (Aaker & Keller, 1990; Van Riel et al., 2001; Nagy et al., 2019), this study's findings reveal that substitutability can actually foster complementarity by providing flexibility and adaptability within the service constellation. For example, in a shopping mall, several clothing stores offering similar types of apparel (substitutes) can enhance the overall shopping experience (complementarity) by providing customers with more choices and options. This flexibility allows users to adapt the constellation to their specific needs and preferences, strengthening the perception of integration and mutual support among components. This is especially true for imperfect substitutes where the products or services are similar but not identical, offering slightly different features or benefits.

This finding further suggests that the relationship between these dimensions is more interconnected and dynamic than previously thought. However, despite the statistical significance, the f-square value for this relationship (0.076) indicates a relatively small effect size. This suggests that while substitutability does contribute to complementarity, its influence is less pronounced than that of convenience.

Perceived Convenience as a driver of perceived complementarity (H3)

The results strongly support Hypothesis H3, which confirms that services that increase perceived convenience enhance complementarity within the constellation. Perceived convenience emerged as the strongest driver of complementarity, with a large effect size and significant path coefficient. This aligns with existing literature emphasizing convenience as a core driver of user satisfaction and system integration (Berry et al., 2002; Reimers & Clulow, 2009, Benoit et al., 2017).

Time scarcity is a growing issue, with consumers increasingly valuing time-saving shopping options. Research by Sari et al. (2022) on multi-service platforms highlights that convenience remains a top priority for users seeking efficient, time-saving solutions. This supports the idea that service constellations designed with convenience-driven features, such as unified interfaces and streamlined processes, are more likely to be perceived as cohesive and complementary. For example, platforms that integrate diverse services into a single system, similar to the one-stop shopping model in retail, enhance complementarity by minimizing friction and promoting synergy across services. Reimers and Clulow (2009) further emphasize the importance of convenience attributes such as extended trading hours, an enclosed environment, location, and especially time convenience as potential solutions to this issue. Their study shows that time convenience is the most significant factor in determining retail center patronage, regardless of age, income, gender, or center preference. They also pointed out that mallgoers prioritize time convenience more than those who prefer shopping strips, highlighting the role of time convenience within service constellations.

These findings are also consistent with the broader literature that underscores the pivotal role of convenience in shaping user perceptions and behavior in the service ecosystems context. Lai and Liew (2021) and Park et al. (2019) emphasize that convenience not only directly enhances user satisfaction but also mediates other important factors, such as perceived security and overall attitude toward a service ecosystem. This suggests that convenience is becoming a dominant factor in service adoption and integration, particularly in digital contexts where users expect seamless and effortless experiences. However, it's worth considering the potential for "convenience overload." While convenience is generally positive, an excessive number of integrated services or overly streamlined processes could lead to complexity or cognitive overload for some users. Future research could explore the optimal level of convenience in service constellations, identifying potential thresholds where convenience begins to detract from user experience.

5.1.2. The Role of Complementarity in Service Constellations

The findings of this study reveal that complementarity significantly influences the perceived value of both individual services and the overall constellation, while its effect on risk reduction is limited. These results contribute to a better understanding of complementarity's role in creating effective service constellations.

Complementarity and the value of individual services in a constellation (H4a, H4b, H4c)

Hypotheses H4a, H4b, and H4c posit that higher perceived complementarity leads to higher perceived value of compatible services, substitute services, and convenience services within the constellation. The findings confirm these hypotheses, with complementarity positively influencing all three types of individual services. This further supports Jacobides et al.'s (2018) definition of complementarity as the *"increased marginal value of a variable due to the presence of another"*, underscoring its role in value enhancement within ecosystems.

Among the three types of services examined, complementarity has the strongest impact on services that improve the perceived convenience of the constellation, followed by compatible and substitute services. The relatively stronger relationship between complementarity and convenience services mirrors findings by Lai and Liew (2021), who argue that convenience-oriented features are particularly valued in multi-service platforms. This may explain why complementarity's influence is most pronounced for services designed to save time or minimize user effort.

Complementarity and the perceived value of the constellation (H5)

Hypothesis H5, which posits that higher perceived complementarity enhances the overall perceived value of the service constellation, is strongly supported. Complementarity fosters a sense of cohesion and synergy within the constellation, which translates into higher perceived value at the aggregate level.

These results align with existing literature emphasizing the importance of complementarity in enhancing perceived value and customer experiences of service constellations. Normann and

Ramírez (1993) highlight that strategic reconfiguration of roles and relationships among various actors to create synergy can lead to enhanced overall value that exceeds the sum of individual components. Vargo and Lusch (2008) argue that value co-creation depends on the integration of resources, indicating that complementarity functions as a key enabler. Further, Ceccagnoli et al. (2012) highlight that co-creation in platform ecosystems, facilitated by complementarity, leads to increased innovation and value generation. Similarly, research by Reimers and Clulow (2009) on retail ecosystems highlights that the cohesive integration of services drives higher user satisfaction and perceived value. This study builds on these insights by demonstrating that complementarity not only enhances user perceptions of individual services but also elevates the overall value of the constellation as a single, unified offering.

Complementarity and perceived risks associated with the constellation (H6)

Hypothesis H6, which states that higher perceived complementarity reduces perceived risks associated with the constellation, was not supported. The findings reveal a non-significant relationship between complementarity and perceived risks, suggesting that internal synergies within the constellation do not directly mitigate external uncertainties, such as data security concerns or service reliability.

This result contrasts with prior research, such as Bauer et al. (2004), which suggests that integration fosters trust and reduces uncertainty in consumer interactions. One possible explanation for this discrepancy is that risk perceptions in modern ecosystems are shaped more by external factors, such as brand reputation and privacy safeguards, than by internal synergies. Users' concerns about risks in digital platforms, for example, often center on data protection and transparency, rather than the functionality of interconnected services (Shaw & Sergueeva, 2016). Even if services within a constellation are highly complementary, users may still be concerned about the overall security and privacy practices of the ecosystem. For example, a user might appreciate the seamless integration of various travel services in a booking platform, but still be worried about the platform's data security measures. These external factors can overshadow any risk reduction effects that might arise from internal synergies created by complementarity. Furthermore, the interconnected nature of service constellations can introduce "systemic risk," where a failure in one service can cascade and affect others. While individual services might have robust security measures, the interconnectedness creates new vulnerabilities that users might perceive. In addition to external safeguards, the concept of "trust brokers" could play a significant role in mitigating perceived risks within service constellations. These could be third-party entities or platforms that verify the security and reliability of individual services, providing an additional layer of assurance to users.

The relationship between complementarity and perceived risk is complex. While cohesive service integration can reduce uncertainty, other factors like data security and service reliability play significant roles. In evolving service ecosystems, trust and mutual benefits are crucial in risk management (Olsson & Franke, 2019), indicating that complementarity alone may not suffice to

mitigate perceived risks. Another suggestion to reduce customer perceived risk is through service guarantees (Kandampully and Butler, 2001).

Another explanation may lie in the measurement of perceived risk. The reflective measurement approach used in this study, which focused on a limited set of risk dimensions, may not have fully captured the complexity of user risk perceptions. A formative measurement approach, which would consider diverse dimensions such as service reliability, brand trust, and privacy concerns, might provide a more comprehensive assessment of perceived risk. Furthermore, the questionnaire items, such as concerns about credit card payments, may have been too narrow in scope. Future research should consider a more holistic approach to measuring perceived risk, including a wider range of potential risks and using a formative measurement approach.

5.2. Theoretical Implications

This study contributes to the growing body of literature on service ecosystems by offering a more in-depth understanding of the antecedents of perceived complementarity and its role in shaping user perceptions of individual services in a constellation and the service constellation as a whole. Prior frameworks, such as the Service-Dominant Logic by Vargo and Lusch (2008), emphasize resource integration and collaboration as the foundation of value co-creation. However, this study challenges some assumptions, particularly regarding compatibility, suggesting that its significance may diminish in highly digitalized and convenience-driven contexts. Users appear to prioritize efficiency and usability (convenience and substitutability) over theoretical alignment between services (compatibility), signaling a shift in the dynamics of value co-creation. This also suggests a need to expand existing theoretical frameworks to incorporate a broader range of factors that contribute to complementarity within service constellations.

Furthermore, the findings on substitutability reveal a novel interplay between traditionally opposing dimensions. While substitutability has often been framed as an alternative to complementarity (Aaker & Keller, 1990), this study demonstrates that substitutability can enhance complementarity by providing flexibility and adaptability. This insight broadens the theoretical understanding of these constructs, suggesting they may function as interrelated rather than mutually exclusive dimensions within service constellations.

The study also builds on ecosystem literature by validating the role of complementarity in driving perceived value of individual services in the constellation and of the whole service constellation. Complementarity enhances the value of interconnected services by emphasizing their interdependence, reflecting the principles outlined in ecosystem theories. By demonstrating complementarity's varying impact on different service types, particularly its pronounced influence on convenience services, this study additionally refines theoretical models of complementarity and highlights its context-dependent nature.

The absence of convergence across demographic groups (age, gender, income, marital status, etc.) suggests that these factors do not significantly influence the observed results. This indicates that the core findings of this study are consistent across different demographic segments within

the sample. This lack of demographic differentiation is logical considering the specific context of the research, which focused on the general experience of shopping within a mall environment. Consequently, despite a respondent pool consisting of approximately 70% female participants, separate group comparisons based on demographics were deemed unnecessary.

However, the non-significant relationship between complementarity and perceived risks underscores the need for more granular theoretical exploration. Previous research emphasizes that integration fosters trust, yet this study suggests that risk perceptions may be more influenced by external assurances, such as data privacy and brand reputation. These findings invite further theoretical inquiry into the boundaries of complementarity's role in mitigating risks.

5.3. Managerial Implications

From a managerial perspective, the findings provide actionable insights into designing effective service constellations. First, the study emphasizes the importance of prioritizing convenience-driven features. Managers should focus on integrating services that minimize user effort and time, as this type of service appears to have the strongest positive impact on complementarity, which eventually enhance customer perceptions of value in the service constellation. To effectively implement these strategies, managers should leverage data analytics to gain deep insights into user behavior and preferences within the service constellation. By tracking user interactions and identifying patterns, managers can determine which services are truly complementary from the user's perspective and tailor the ecosystem accordingly. In digital context, for example, managers can analyze user journey maps, track click-through rates, and conduct A/B testing to identify pain points and areas where convenience can be improved. This data-driven approach allows for a more nuanced understanding of user needs and preferences than relying solely on assumptions.

The findings on substitutability suggest that flexibility is a critical component of service design. By offering users alternative options for achieving their goals, managers can enhance the perceived cohesion of the service constellation. Physical ecosystems such as tourist destinations with restaurant streets or shopping streets serve as excellent examples of how substitutability can create cohesive environments. In restaurant streets, for instance, customers benefit from a variety of cuisines, where the ability to switch between options enhances their overall experience. Similarly, in shopping streets, substitutable options for similar products or services allow customers to find alternatives that meet their preferences while encouraging them to remain within the ecosystem. Urban planners and shopping mall developers can intentionally design spaces that foster substitutability. This could involve clustering similar businesses together, creating diverse retail mixes, and ensuring convenient navigation and wayfinding to encourage exploration and comparison shopping within the constellation.

In addition to benefiting customers, these constellations provide mutual advantages to the businesses within them. For example, restaurants or shops in such constellations often benefit from shared marketing efforts and increased visibility due to their proximity to other providers. This collective marketing dynamic attracts more foot traffic, creating a "halo effect" where businesses draw customers to one another. Managers of digital and physical ecosystems can

replicate this by fostering partnerships among service providers and implementing shared promotional campaigns to enhance the appeal of the entire constellation. Managers should continuously evaluate the service mix within the constellation and identify opportunities to introduce new services that enhance substitutability and cater to evolving customer needs. This could involve conducting market research, analyzing competitor offerings, and monitoring emerging trends to proactively expand the constellation's value proposition. However, it's important to carefully manage the balance between substitutability and potential cannibalization of individual services.

The limited role of compatibility, however, calls for a re-evaluation of traditional approaches to service integration. Managers should consider whether strict compatibility is necessary or whether broader interoperability and functional alignment suffice in creating cohesive ecosystems. In addition to focusing on internal integration, managers should embrace "open innovation" by actively collaborating with external partners to expand the range of services offered within the constellation. This can involve forming strategic alliances, integrating third-party APIs, or even creating platforms that encourage independent developers to build and offer complementary services.

Finally, addressing risk perceptions requires a multi-faceted approach. While complementarity enhances value perceptions, it does not necessarily mitigate perceived risks. Managers should consider implementing robust external safeguards, such as clear data privacy policies, third-party certifications, transparent communication, and offering service guarantees to enhance user trust and confidence in the ecosystem. It's also important to recognize that service constellation design is not a static process. Managers need to adopt a "dynamic" approach, continuously monitoring user feedback, tracking emerging trends, and making iterative adjustments to the ecosystem. This includes regularly evaluating the performance of individual services, identifying areas for improvement in integration, and adapting to the evolving needs and expectations of users.

5.4. Limitations and Future Research

This study offers valuable insights into the dynamics of service constellations, yet several limitations open avenues for future research. These limitations, along with unexpected findings, provide a roadmap for a more comprehensive understanding of service ecosystems.

Methodological Considerations

Firstly, the reliance on self-reported survey data, while providing valuable insights into user perceptions, may have introduced biases. Respondents might have provided socially desirable answers or struggled to accurately recall and articulate their experiences. Future research could employ mixed-methods approaches, combining self-reported data with behavioral observation, tracking data from digital platforms, or experimental designs to gain a more objective and comprehensive understanding of user behavior within service constellations.

Secondly, the convenience sampling method, while practical, might limit the generalizability of the findings. Although no significant demographic differences emerged within our sample, the results may not fully represent populations with diverse cultural backgrounds or varying levels of digital literacy. Future studies should aim for more representative samples and explore the influence of cultural values, digital literacy, and other demographic factors on perceptions of service constellations.

Thirdly, the measurement of certain constructs presented challenges. The reflective measurement approach used for perceived risk associated with the service constellation may not have fully captured the construct's complexity, potentially contributing to its weak explanatory power and the negative AVE. Future research should adopt a formative measurement approach for PRC, incorporating dimensions such as service reliability, brand trust, and privacy concerns. Revising the scale items to better reflect these dimensions would enhance the construct's validity. Future studies should also rigorously test and validate the scales in general, potentially through pilot studies, pre-tests, and more advanced statistical techniques, to ensure higher reliability and validity of the measures.

Scenario and Scope

The study's reliance on a self-derived scenario in the questionnaire may have further influenced participants' responses. The specific scenario might not have fully resonated with all participants' lived experiences, potentially leading to variability in the interpretation of constructs like perceived compatibility and perceived risks. Future research should develop more detailed and validated scenarios that reflect a broader range of real-world service interactions, ensuring greater alignment with users' past experiences and expectations.

Furthermore, the focus on a specific type of service constellation limits the generalizability of the findings. While the study provides valuable knowledge about retail ecosystems and digital platforms, the dynamics of complementarity, substitutability, and convenience could differ in other contexts. Future research should expand the scope to explore diverse service ecosystems, including but not limited to healthcare hubs, educational platforms, entertainment ecosystems, and tourism destinations. Investigating how the core constructs operate within these different domains would significantly broaden our understanding of service constellations. For example, future research could examine the application of these constructs in destination management, analyzing how various services within a tourist destination (e.g., accommodation, transportation, attractions, dining) contribute to the overall visitor experience through complementarity and substitutability.

Theoretical Refinements

Certain findings diverged from initial expectations, highlighting areas for further theoretical exploration. The investigation into the interplay of compatibility, substitutability, and convenience as antecedents of perceived complementarity revealed mixed results. While convenience emerged as a dominant factor, confirming existing literature, the influence of compatibility appeared limited,

challenging traditional assumptions of Service-Dominant Logic. This suggests that users may prioritize practical outcomes and seamless integration over strict technical alignment between services in today's digital landscape. Future research should delve deeper into the evolving role of compatibility in the digital age, particularly exploring the interplay between "perceived" and "actual" compatibility and investigating how factors like user interface design and branding influence these perceptions. Moreover, future research can look into how compatibility can be intentionally fostered within service constellations. This involves investigating strategies and design principles that service providers can employ to create and communicate compatibility between services, thereby enhancing perceived complementarity and overall user value.

Additionally, the anticipated reduction in perceived risks through complementarity was not supported by the data. While complementarity enhanced the perceived value of both individual services and the overall constellation, its role in mitigating risks remains inconclusive. This suggests that risk perceptions are likely shaped by factors external to the constellation's internal synergies, such as data privacy concerns, service reliability, and brand reputation. Future studies could employ longitudinal designs to examine how user perceptions of risk evolve over time with continued use of a service constellation. Furthermore, they should investigate the mechanisms through which trust-building initiatives, such as robust privacy policies, service guarantees, and third-party certifications, interact with complementarity to influence perceived risks. For instance, does a strong reputation of a few key services within a constellation mitigate risks associated with less-known services through a "halo effect"?

Future Research Directions

Beyond addressing the limitations, several promising avenues for future research emerge:

The Role of Substitutability: The finding that substitutability can enhance complementarity warrants further investigation. Future research should explore this dynamic in different ecosystem types, particularly those emphasizing substitutability, such as online travel platforms. For instance, how does the availability of multiple airlines and hotel choices on a single platform contribute to the overall perceived value of the travel booking ecosystem? Does the presence of these alternatives mitigate the negative impact of a service failure (e.g., a flight cancellation) by allowing users to quickly find and book a replacement option within the same platform?

Mutual Benefits in Service Constellations: Exploring how businesses within a service constellation can achieve mutual benefits offers another fruitful research direction. How can digital platforms foster collaboration among service providers? What are the most effective shared promotional strategies for creating a "halo effect" where the success of one service elevates the entire ecosystem?

Longitudinal Studies: Future research should adopt longitudinal approaches to track how user perceptions of complementarity, substitutability, and convenience evolve with continued use of a service constellation. Does user learning and adaptation lead to a deeper appreciation for complementarity, or does it highlight the need for greater flexibility and customization?

Sustainability Considerations: Future research should investigate how sustainability influences customer perceptions of service constellations. This includes exploring whether customers actively seek out and favor constellations that prioritize sustainability through initiatives like carbon offsetting or waste reduction. Does a constellation's perceived commitment to environmental responsibility affect customer trust, loyalty, and willingness to pay? How does communicating these sustainability initiatives impact customer engagement?

User-Generated Content: Examine the role of user-generated content (UGC) in shaping perceptions of service constellations. How do user reviews, ratings, and recommendations influence the value of individual services and the ecosystem as a whole? Can service providers effectively leverage UGC to enhance trust and promote the adoption of service constellations?

Strategically Expanding Service Constellations: Understanding how to effectively expand service constellations is crucial for their long-term success and value creation. Studies could explore frameworks or models that guide decision-making in expanding service constellations, focusing on how new services can be evaluated for their potential to contribute positively to the constellations. For example, how can managers assess the potential of a new service to enhance the user experience, contribute to the constellation's value proposition, and avoid redundancies or conflicts with existing services? Furthermore, research could investigate the optimal timing and sequencing of service additions, considering the evolving needs of users and the dynamic nature of service ecosystems.

By addressing these limitations and pursuing these research directions, we can significantly advance our understanding of service constellations, providing both theoretical contributions and actionable insights for managers seeking to design and optimize these increasingly important ecosystems.

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APPENDIX

Appendix 1. Measurement Items – Questionnaire

A. Open-ended questions related to scenario

Scenario:	Imagine that you are in a shopping mall (the shopping mall that you visit most, for example), and you are looking for a pair of sports shoes. You haven't decided about the brand or the type of shoes, so you are browsing. In this shopping mall, a number of stores are co-located, including 2 shoe shops, a sports equipment store, and a café.
Question 1	Please indicate the name of the shoe shop 1 (think about your favorite shoe shop, a Nike outlet, for example):
Question 2	Please indicate the name of the shoe shop 1 (think about another shoe shop that you often visit, an Adidas outlet, for example):

B. Main constructs - Likert scale questions

Construct	Item	Question
Perceived Value of Individual Service – Substitute service (PVI_S)	PVI_1	I am satisfied with the value I receive from the shoe shop 1
	PVI_2	The shopping experience at the shoe shop 1 offers value for money
	PVI_3	I enjoy shopping at shoe shop 1
	PVI_4	I am satisfied with the value I receive from the shoe shop 2
	PVI_5	The shopping experience at the shoe shop 2 offers value for money
	PVI_6	I enjoy shopping at shoe shop 2
Perceived Value of Individual Service – Compatible service (PVI_C)	PVI_7	I am satisfied with the value I receive from the sports equipment store
	PVI_8	The shopping experience at the sports equipment store offers value for money.
	PVI_9	I enjoy shopping at the sports equipment store
Perceived Value of Individual Service – Convenience service (PVI_V)	PVI_10	I am satisfied with the value I receive from the café
	PVI_11	The shopping experience at the café offers value for money
	PVI_12	I enjoy shopping at the café
Perceived Compatibility (PCM)	PCM_1	Products from the sports equipment store and the shoe shops can be used in similar contexts.
	PCM_2	The sports equipment store and the shoe shops sell products that align with each other in terms of usage situations.
	PCM_3	I often use products from the sports equipment store together with products from the shoe shops.
Perceived Substitutibility (PS)	PS_1	The 2 shoe shops replace each other in fulfilling a certain need.
	PS_2	Products from the 2 shoe shops are substitutes for each other.
	PS_3	The core functionalities and features of the products from the 2 shoe shops are very similar.
Perceived Convenience (PCV)	PCV_1	The café increases the convenience of the shopping mall as a whole.
	PCV_2	The café enhances the overall convenience of going to the shopping mall.

	PCV_3	The café makes it easier for you when shopping in the mall.
Perceived Value of the Constellation (PVC)	PVC_1	I am satisfied with the overall value I receive from the shopping mall as a whole.
	PVC_2	The overall shopping experience at the mall offers value for money.
	PVC_3	I enjoy shopping at this mall.
Perceived Risks associated with the Constellation (PRC)	PRC_1	I think shopping in this mall involves a certain level of risk
	PRC_2	I don't feel safe making payments with my credit card while shopping in this mall
	PRC_3	I might be overcharged
Perceived Complementarity (PC)	PC_1	The shoe shop and the sports equipment store possess the potential to add value to each other.
	PC_2	The sports equipment store enhances the benefits of shopping at the shoe shops.
	PC_3	The combination of the shoe shop and the sports equipment store enhances the overall value of my shopping experience.
	PC_4	The 2 shoe shops possess the potential to add value to each other.
	PC_5	Shoe shop 1 enhances the benefits of shopping at shoe shop 2.
	PC_6	The combination of the 2 shoe shops enhances the overall value of my shopping experience.
	PC_7	The café possesses the potential to add value to shopping at the mall.
	PC_8	The café enhances the benefits of shopping at the mall.
	PC_9	The combination of the shoe shop and the café enhances the overall value of my shopping experience.

B. Demographics - Multiple choice and open-ended questions

Question	Answer option
What is your gender?	Male
	Female
	Prefer not to say
	Other
What is your age in years?	Open-ended
What is your marital status?	Single
	Cohabitat/Married
	Divorced
	Other
What is your annual net income?	Less than 20,000 EUR
	20,000 - 40,000 EUR
	40,000 - 60,000 EUR
	Above 60,000 EUR

Appendix 2: Correlations Matrix

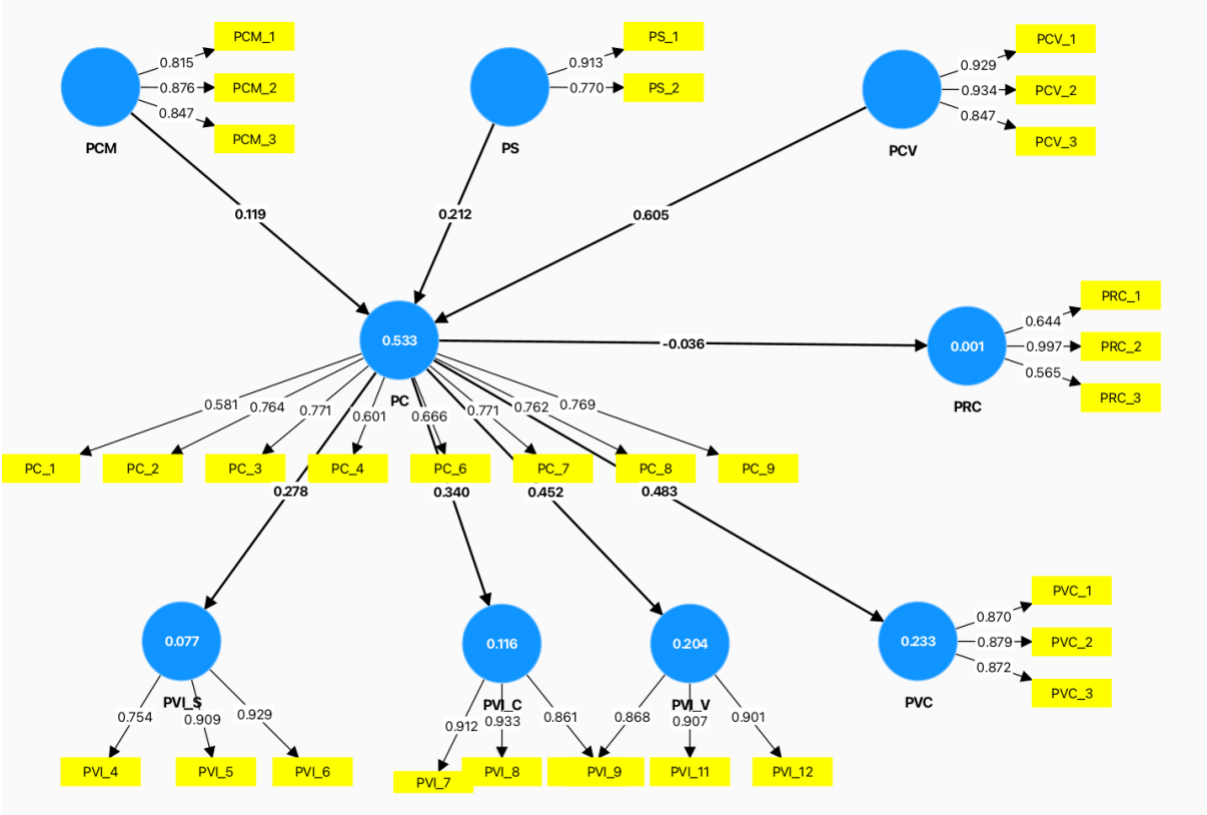
Correlations

		PCM	PS	PCV	PC	PVI_S	PVI_C	PVI_V	PVC	PRC
PCM	Pearson Correlation	1	.438**	.212*	.348**	.346**	.361**	.426**	.314**	.044
	Sig. (2-tailed)		<.001	.012	<.001	<.001	<.001	<.001	<.001	.612
	N	138	138	138	138	138	138	138	138	138
PS	Pearson Correlation	.438**	1	.237**	.390**	.298**	.328**	.171*	.329**	.117
	Sig. (2-tailed)	<.001		.005	<.001	<.001	<.001	.045	<.001	.173
	N	138	138	138	138	138	138	138	138	138
PCV	Pearson Correlation	.212*	.237**	1	.632**	.166	.167*	.513**	.455**	-.078
	Sig. (2-tailed)	.012	.005		<.001	.052	.050	<.001	<.001	.361
	N	138	138	138	138	138	138	138	138	138
PC	Pearson Correlation	.348**	.390**	.632**	1	.251**	.358**	.439**	.471**	.015
	Sig. (2-tailed)	<.001	<.001	<.001		.003	<.001	<.001	<.001	.860
	N	138	138	138	138	138	138	138	138	138
PVI_S	Pearson Correlation	.346**	.298**	.166	.251**	1	.552**	.373**	.400**	.162
	Sig. (2-tailed)	<.001	<.001	.052	.003		<.001	<.001	<.001	.057
	N	138	138	138	138	138	138	138	138	138
PVI_C	Pearson Correlation	.361**	.328**	.167*	.358**	.552**	1	.401**	.400**	.050
	Sig. (2-tailed)	<.001	<.001	.050	<.001	<.001		<.001	<.001	.564
	N	138	138	138	138	138	138	138	138	138
PVI_V	Pearson Correlation	.426**	.171*	.513**	.439**	.373**	.401**	1	.404**	.029
	Sig. (2-tailed)	<.001	.045	<.001	<.001	<.001	<.001		<.001	.733
	N	138	138	138	138	138	138	138	138	138
PVC	Pearson Correlation	.314**	.329**	.455**	.471**	.400**	.400**	.404**	1	-.139
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001		.103
	N	138	138	138	138	138	138	138	138	138
PRC	Pearson Correlation	.044	.117	-.078	.015	.162	.050	.029	-.139	1
	Sig. (2-tailed)	.612	.173	.361	.860	.057	.564	.733	.103	
	N	138	138	138	138	138	138	138	138	138

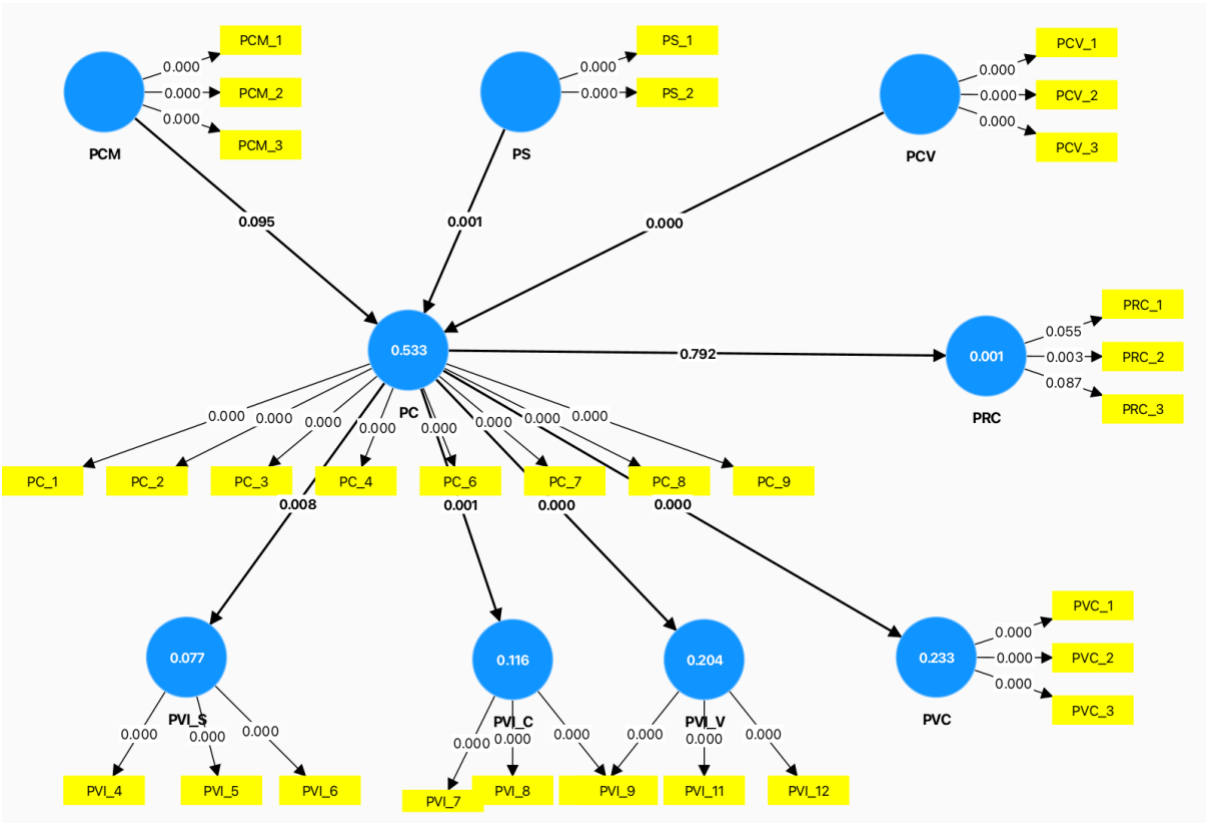
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

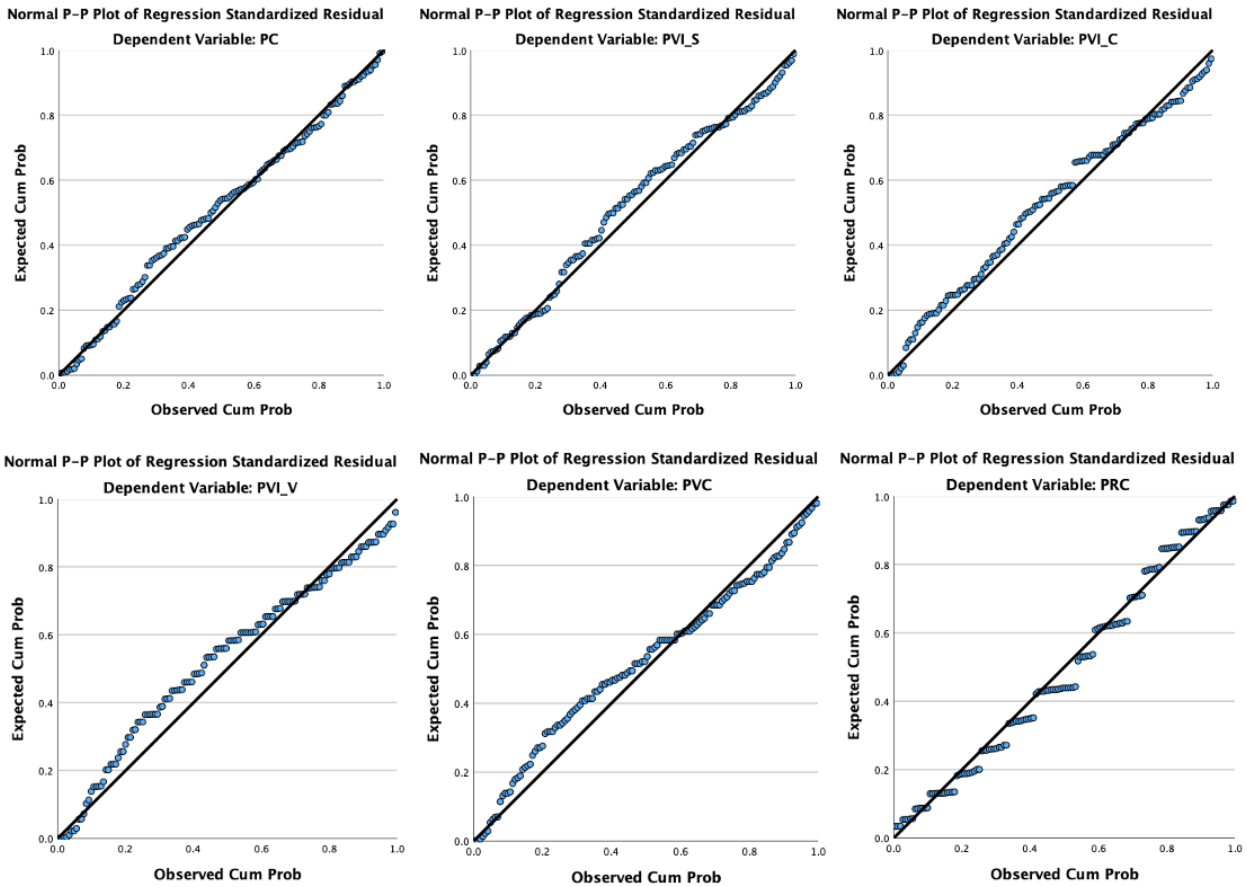
Appendix 3: Structural Model – Path Coefficients



Appendix 4: Structural Model – p-values (Bootstrap results)



Appendix 5: Normal P-P Plot of regression standardized residuals of the six models



Appendix 6: Scatterplots of the six models