NEW APPROACHES TO SME

INNOVATING DIGITALLY

SERVICE INNOVATION EDUCATION

Digital Innovation Audit

Mapping of a Digital Innovation Process for Services based on Scientific Literature and Expert Interviews

Co-funded by the Erasmus+ Programme of the European Union

"It is very hard to transform your culture and your workforce to be a relevant company in the digital world if all of your processes are stuck in the traditional world."
-Julie Sweet

In the face of challenges around service innovation in the digital world, universities play an important role by combining theory with practice and setting standards of future work practices. Therefore, lecturers need up-to-date, reliable information to develop modern course curricula. Thus, the objective of the project is to gain a better understanding of how small service companies currently undertake new product development so that the project can improve how digital innovation for services is taught.

Therefore, this DIGITAL INNOVATION AUDIT shall form a foundation for following intellectual outputs within the course of this project. By investigating scientific literature on innovation processes with specific attention to digital innovation and service innovation, a theoretical basis is set. This is followed by 26 expert interviews with higher education lecturers in the field of innovation management to construct an up-to-date digital innovation process for services. Lastly, an innovation tools platform is built to map digital tools along the innovation process.

Partnership

This Digital Innovation Audit as a part of the Erasmus+ Strategic Alliances Project "Digital Innovation for Service Sectors" was conceptualized and produced by Judith Helmer, Thien-Minh-Thuong Huynh, Dr. Sue Rossano-Rivero (in alphabetical order), The Fachhochschule Münster – University of Applied Sciences, Science-to-Business Marketing Research Centre, in collaboration with the Digital Innovation Project Partnership.

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This project has been funded with support from the European Commission within the Erasmus+ programme. This publication [communication] reflects the views only of the authors, and neither the Commission nor the Erasmus+ programme National Agency cannot be held responsible for any use, which may be made of the information contained therein.

List of Abbreviations

HE .....Higher Education

IoT .....Internet of Things

SMEs ..... Small and medium entreprises

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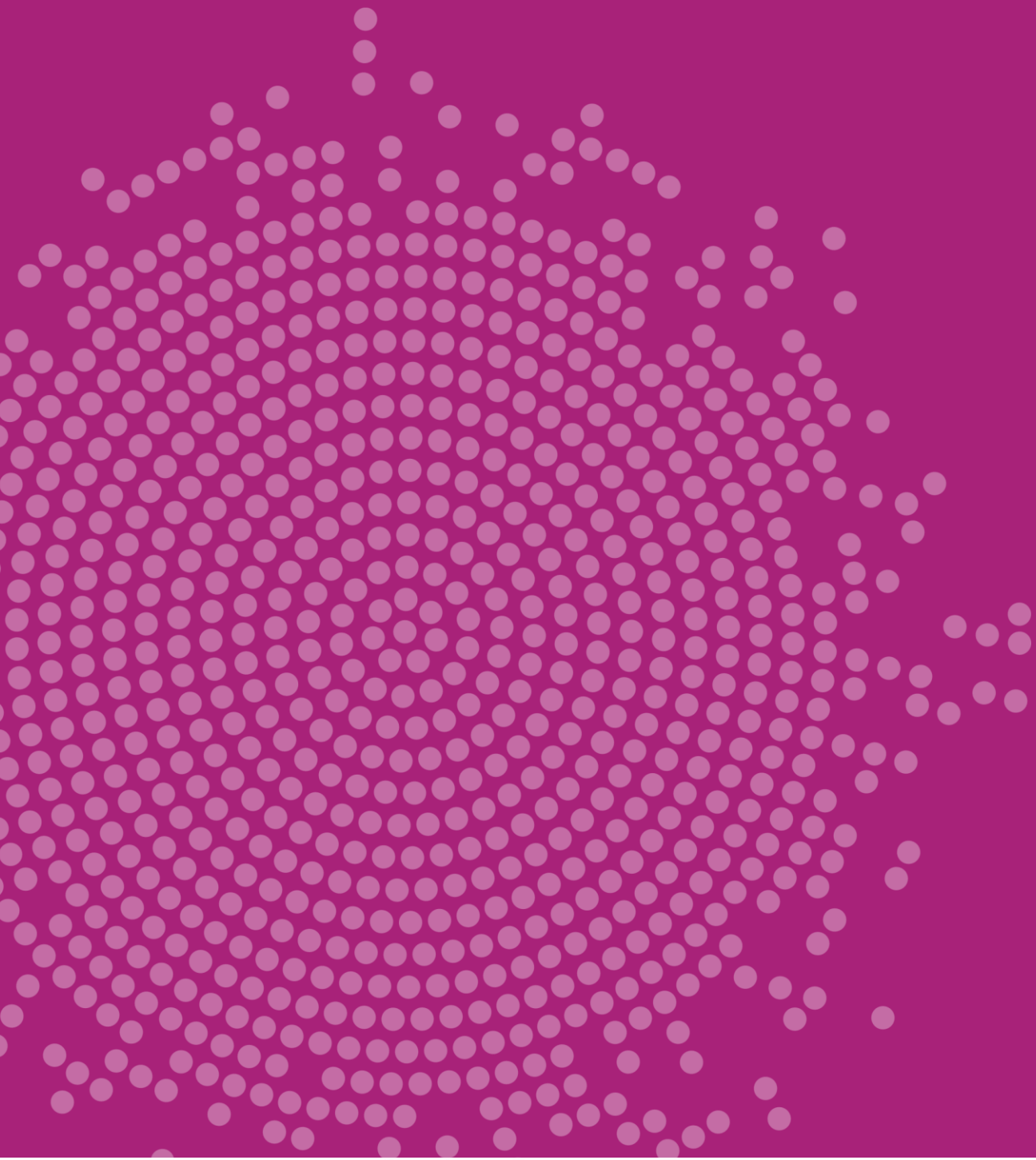
Section 1

Introduction



1. Introduction

In the light of new trends such as digitalization and servitization, staying competitive proves to be a difficult task for many companies. Due to the challenges arising from changes in technology and customer behavior, companies are asked to constantly innovate. Challenges include higher customer expectations, for example, and further evolving technological possibilities such as the Internet of Things (IoT) or Big Data and advanced analytics (D'Emidio, Dorton, & Duncan, 2015). In this regard, servitization or service innovation has appeared as a successful way for many companies to overcome the dead-end road of competition (Bouwman & Fielt, Service Innovation and Business Models, 2008). In fact, it is believed that service innovation has become an essential factor in achieving a competitive advantage – something recognized not only in traditional service sectors but also in manufacturing companies and entire industries (Dörner, Gassmann, & Gebauer, 2011). As companies focus more and more on developing services, service innovation has started to gain increasing attention also in research causing the traditional product innovation view to shift towards a multidimensional service innovation view (see e.g., Carlborg, Kindström, & Kowalkowski, 2014; Biemans, Griffin, & Moenaert, 2015). However, the development and designing of new services is still little researched and not a lot is known about the process (Bouwman, De Vos, & Haaker, 2008). The knowledge and understanding about how digital technologies are being strategically used during the process of service innovation is even more limited (Akaka & Vargo, 2014).

Digital technologies offer multiple valuable benefits especially for small and medium enterprises (SMEs). SMEs usually take up the majority of business enterprises, contribute largely to employment and turnover in developed countries (European Commission, 2020), and are often considered to be the driving force of economic development (Hanclova, Rozehnal, Ministr., & Tvrdikova, 2015; Ntwoku, Negash, & Meso, 2017). Potential benefits that could be reaped from digital innovation through digital technologies include, among others, better access to skills and talent or better communication and collaboration (OECD, 2017). Overall, digital technologies can provide SMEs with a competitive advantage against larger companies (IDC, 2016). However, in reality, SMEs do not frequently participate in digital innovation (Ramdani, Raja, & Kayumova, 2021) and often lag behind large companies with regard to digital technology adoption (Ntwoku, Negash, & Meso, 2017). According to a PricewaterhouseCoopers (PwC) report, over 70% of monitoring and evaluation experts claim that they lack the knowledge to choose appropriate digital tools such as data collection tools or data analysis tools (PwC, 2019). Nevertheless, it is of common agreement that technology, i.e., digital tools, play an important role in the process of value creation in service systems (Maglio & Spohrer, 2008; Nambisan, Lyytinen, Majchrzak, & Song, 2017). It is believed that technology and service innovation are interconnected (Lusch & Nambisan, 2015) as service innovation is increasingly dependent on information technology and digitization of information processes (Bouwman, De Vos, & Haaker, 2008). Therefore, this discrepancy regarding digital innovation and service innovation emphasizes the need for further knowledge, especially for SMES, in this regard.

Furthermore, the process of service innovation has become more complex over time, increasing the difficulty of developing and reinventing new services. This complexity is partially due to the rise in collaborations between companies and organizations across various domains and supply chains and rapidly changing consumer demands and needs (Bouwman, De Vos, & Haaker, 2008). Not only have customers become co-creators of services by expressing their demands, thus, adding to the complexity of service innovation, but increasing competition has largely driven service innovation. The difficulty concerning competitive strategies, however, is the fact that services such as information are easily imitable but have the largest impact on value creation when successful. In order for service innovations to not be copied, they have to be based on technical features that are unique themselves but also require unique capabilities and resources available to the companies. A lack of knowledge, skills and competence in this regard

or the lack of knowledge about the requirement of these resources can be detrimental to successful service innovation to happen (Bouwman & Fielt, 2008).

The goal of this literature review is, therefore, to shine light on the service innovation process as well as how and which digital tools can facilitate the innovation process. Moreover, the focus of this literature review will remain on SMEs and their new development process providing insights for SMEs on when and how to incorporate digital tools within their innovation processes. By reviewing current and well-established theories and approaches on innovation processes and mapping the identified innovation processes against each other, a new digital innovation process for services can be created. In this context, the term 'digital innovation for services' does not refer specifically to the development of a digital service such as an online-platform for customers or an app-based solution. Rather, the consulted literature will focus on the digitalization of the service innovation process itself meaning which digital tools available on the market can facilitate the process of innovating to deliver service offerings as an output.

The literature review is structured as follows: firstly, the contextual framework of the review is given, and the methodological protocol is introduced. The actual literature review is initiated by an overview of relevant definitions and terms, followed by a comparison of various theories and insights on innovation processes. Then, the process of mapping these theories is explained and shown and lastly, a preliminary digital innovation process model for services is presented which will be based on the analyzed scientific literature.

Following the literature review, a second major part will be concerned with qualitative research. Therefore, qualitative interviews and surveys with Higher Education (HE) educators and lecturers will be conducted in order to enrich and complete the literature-based digital innovation process for services. Conducting these expert interviews will validate the literature-based preliminary innovation model by offering a practical view and understanding on the topic. In this context, firstly, the main focus of the interviews is already introduced in the contextual framework. More detailed aspects are stated later on in the methodological approach. This is followed by the key findings of these interviews This is followed by the key findings of these interviews subdivided into a short introduction and the insights on innovation processes, digital innovation, service innovation, and teaching practices and challenges. Lastly, this is rounded off by the final digital innovation process model for services.

Section 2

Contextual Framework

2. Contextual Framework

Before going into the literature review, a general conceptual framework shall be set with regard to the aim and focus of the literature review and expert interviews. This is followed by the foundational frameworks considered regarding service and digital innovation from an outcome perspective to derive insights as a prerequisite for the process perspective.

Aim and focus of the literature review

The aim of the literature review is to review existing academic and industry theories on innovation management and innovation processes and develop a new understanding and a new model of service innovation processes. The output of this review on new digital innovation processes for services will provide an analysis of the range of available literature on innovation processes – more specifically in the field of digitalization and servitization – and result in a mapping of an up-to-date digital innovation process for services. The Digital Innovation Audit is therefore based on the recent and well-grounded theories of innovation process.

The focus of the literature review is, consequently, how the process of service innovation is portrayed in renowned and current theories and how this service innovation process is taught in HE, while leaving out the business perspective to be analyzed in a later stage of this project. Furthermore, the digital focus of this study is on the supporting role of digital tools within a service innovation process to contribute to a digitally enabled service solution. The goal is to establish a way for service innovation process management to evaluate and map currently available and future digital tools on the market and use them in the right phases of the service innovation process.

The target group for this review are first and foremost HE lecturers and educators teaching innovation management courses, HE organizations and policy makers. Nevertheless, it shall also serve as a source of information for businesses and other interested stakeholders. A specific business perspective – in particular, an SME-specific view – will be deferred to a later stage of the project.

As such, the main aim and result of the literature review is a preliminary digital innovation process for services based on recent scientific literature. This outcome shall be followed by conducted expert interviews to validate and finalize the output.

Aim and focus of expert interviews

HE lecturers and educators will be asked to share their experiences on their understanding of innovation processes and which digital tools can support during the process in order to enrich the literature review and complete a new model of a digital innovation process for services. Therefore, the aim of the expert interviews is the inclusion of the network of HE organizations to enrich the theories and findings of the literature review. By directly involving educators in the research phase of the Audit, authenticity of the results is ensured as well as invaluable insights gained. Put simply, the interviews aim to address the following three fundamental questions:

1) How do educators teach innovation processes in higher education institutions?
2) How do servitization and digitalization influence innovation processes?
3) Which challenges are currently faced in teaching innovation processes and how should these challenges be met?

The first question focuses on the optimal innovation process as well as current teaching practices of educators in HE institutions. In the interviews, participants will be asked to provide information and insight on their current innovation process teaching practices as well as the theories and methods on which they are built. The second question deals

with the specific influence of the trends servitization and digitalization on innovation processes. In the first step, participants are asked to report how service innovation or a service-centered approach influences the innovation process and which capabilities are specifically needed to account for this. After that, the interviewer asks about the influence of digitalization on innovation processes, which tools facilitate the innovation process and how, and which capabilities are specifically needed to be able to integrate digitalization in the innovation process. Lastly, the third question shall approach the current needs for improvement within innovation processes teaching referring to needs as educators as well as those of internal and external stakeholders. A specific focus shall be placed on servitization and digitalization, again. To answer these questions a minimum number of 24 interviews shall be conducted. To make the research strategy more flexible considering the limitations due to the pandemic situation, these practical insights can be generated via a structured qualitative survey in the form of an online survey, via a structured qualitative one-on-one interview or via a local focus group. As a result, the preliminary digital innovation process for services shall be enriched and developed into the final digital innovation process for services.

Digital innovation - as an outcome

The rise of various digital technologies, their increasing importance for business successes and even their impact on restructuring of entire industries have led managers to pay special attention to dealing with digital innovations. The potential benefits of digital technologies to product and service innovation have complexified the requirements with regard to managing a company's product and service portfolio which is why the need for a holistic managerial framework has arisen (Nylén & Holmström, 2015). Consequently, before one can focus on managing innovation on a process level, it is important to understand the contextual framework which influences the innovation as an outcome, namely which requirements the final output (products, services, processes, etc.) is required to fulfil, how the changing digital environment influences the innovation process and the innovation outcome and how innovation management needs to act in order to cope with these different influences. Therefore, a managerial framework for digital innovation (see Table 1) for a product or service outcome is introduced.

Table 1: Framework for Digital Innovation

Dimension	Area	Element
Product	User Experience	Usability
		Aesthetics
		Engagement
	Value Proposition	Segmentation
		Bundling
		Commissions
Environment	Digital evolution scanning	Devices
		Channels
		Behaviors
Organization	Skills	Learning
		Roles
		Teams
	Improvisation	Space
		Time
		Coordination

Table 1: Managerial framework for digital innovation strategy (Adaptation from Nylén & Holmström, 2015).

This managerial framework was particularly chosen as it emphasizes different aspects unique to digital innovation. It emphasizes how companies need to deal with their products and services, their digital environment, and their way of organizing their innovation work (Nylén & Holmström, 2015) and thus, based on the framework, delivers valuable insights concerning digital innovation and service innovation as an outcome which will act as the basis for the process-level analysis. These insights have been derived based on the framework and shall be discussed next to give context to the scope in which the digital innovation model for services will be developed.

Insight 1: Service innovation is concerned with customer-centricity, while dealing with issues of complexity.

Current developments in service innovation as an outcome focus not only on service which are efficient to use and easy to learn but which should also provide a rich user experience during usage as well. The user experience should be measurable which can be done on three different levels: by offering high levels of usability, providing carefully designed aesthetic properties which elicit an emotional response from the users and evoke engagement in customers by making the user experience meaningful (Nylén & Holmström, 2015). A mirrored complexity and customer-centricity can be found in other perspectives of servitization – referring back to service-dominant logic (Vargo & Lusch, 2004) – stressing the importance of value that is created during the interaction between provider and consumer (Gebauer, Paiola, Saccani, & Rapaccini, 2020; Jang, Bae, & Kim, 2020; Oliva & Kallenberg, 2003). Thus, the qualitative expert interviews will further look into the characteristics of service innovation and, especially, shed light on the practical perspective on complexification and customer-centricity in service innovation.

Insight 2: Digital innovation includes an outcomes and landscapes which can enable customer-centricity but also complexification.

The framework introduced provides a holistic view on digital innovation, namely the digital innovation outcomes as in digital products and services and the digital innovation landscape which continues to develop into a dynamic and fast-paced environment (Nylén & Holmström, 2015). Both, the digital products and services as well as landscape perspective shall be used to draw insights for the process perspective. Again, it is referred to the aspect of customer-centricity by the involvement of co-creation. This concept finds wide application in the context of new forms of services highlighting the role of the customer in the process of innovation (Perks, Gruber, & Edvardsson, 2012). Next to this, the dynamic and fast-paced digital landscape adds to the characteristics of digital innovation to be more and more complexified. The use of digital tools in the process of service innovation is regarded as highly important (Akaka & Vargo, 2014) and will be further researched in this project.

Insight 3: Digital innovation in combination with service innovation offers a wide range of new possibilities but also leads to a complexification.

As digital innovation can have a vast impact on different areas within a company, e.g., even a firm's business model, it can lead to a range of complex benefits. Therefore, it requires an articulated value proposition in order to communicate the value properly (Nylén & Holmström, 2015). Considering the wide range of application, the interviews will be concerned with the general understanding of digital and service innovation by experts to construct the perception of this new perspective. In this context, it will also be asked for good practices as well as challenges in teaching to identify common foci – or value propositions – and uncover critical points connected to the transition to a digital and service focus.

Insight 4: Therefore, companies are required to scan their environment to identify useful digital tools to apply for service innovation.

The digital environment is constantly changing due to the nature of digital technology which is constantly evolving. In order to harness the full potential of digital innovation, firms need to keep up to date with evolving digital technologies by gathering information on new digital devices, channels, and associated user behaviors (Nylén & Holmström, 2015).

As such, this project aims at uncovering best practices of digital tools usage in service innovation which shall be mapped along the innovation process and made available to stakeholders on an online platform. Therefore, the interview results will be used to identify these best practices.

Insight 5: A new set of skills and capabilities is required to reap the benefits of digital (service) innovation.

As digital technologies keep evolving, current forms of organizing innovation work need to transform with the rapid pace in order to tackle the resulting challenges. In this context, the framework draws attention on new skills or capabilities which are needed to meet the new requirements (Nylén & Holmström, 2015). In this context, it is possible to build on, for example, existing frameworks and skill concepts in the sphere of digital transformation (Ferrari, 2012), entrepreneurship (Bacigalupo, Kampylis, Punie, & Van den Brande, 2016), and innovation (Tether, Mina, Consoli, & Gagliardi, 2005). Therefore, the interviews will help identifying necessary capabilities for digital innovation and service innovation from a practical perspective.

Insight 6: Improvisation is required within individual as well as organizational behavior – asking for a process that is flexible in space, time, and coordination.

In contrast to analog innovation processes, digital innovation calls for a higher level of improvisation and acts of reconfiguration as the innovation process unfolds. Therefore, digital innovation requires an organizational culture that allows for flexibility, iteration and risk-taking in different dimensions such as a creative workspace, generous working hours, and coordination with existing projects (Nylén & Holmström, 2015). Building a connection to the process perspective, the role of flexibility and iteration shall be specifically analyzed in the literature review as well as interview results.

Service innovation - from outcome to process

With regard to service innovation, attention shall be drawn to the service innovation framework by Lusch and Nambisan (2015). While the focus of this literature review is on the service innovation process itself, it is, nevertheless, still crucial to understand the framework and dimensions surrounding service innovation. Therefore, this framework provides important insights into the context in which the identified innovation processes should be analyzed.

Insight 7: Service innovation can be viewed from two perspectives – outcome and process.

Firstly, the framework for service innovation is described to be based on a service-dominant logic and co-creation (Lusch & Nambisan, 2015; Perks, Gruber & Edvardsson, 2012). The relationship between the two is grounded on the key assumptions of the service-dominant logic. The service-dominant logic focuses on a process rather than an output.

Insight 8: The service ecosystem, the service platform, and value co-creation are the three main elements of the service innovation framework.

Therefore, regarding the process, there is a need to involve customers and other actors in the co-creation of value (Perks, Gruber & Edvardsson, 2012). The framework grounded in service-dominant logic puts forward three inter-related key elements: the service ecosystem, the service platform and value co-creation (Lusch & Nambisan, 2015) (see Figure 1).

Insight 9: Furthermore, the network aspect is highlighted. Especially for SMEs, collaborations with partners are important to compensate lacking internal resources.

It highlights the necessary network aspect of innovation and stresses the required interaction between actors of this network and the resources, i.e., tangible and intangible components, in order to create value (Lusch & Nambisan, 2015). Especially with SMEs, it is observed that service innovation results from inter-firm collaborations as external resources are required to compensate the lack of internal resources compared to larger firms (Teece, 1986; Toedtling

& Kaufmann, 2001). Those collaborations usually take place in the form of networks through their network relationships including ecosystem actors such as suppliers, competitors and even customers (Mohannak, 1997).

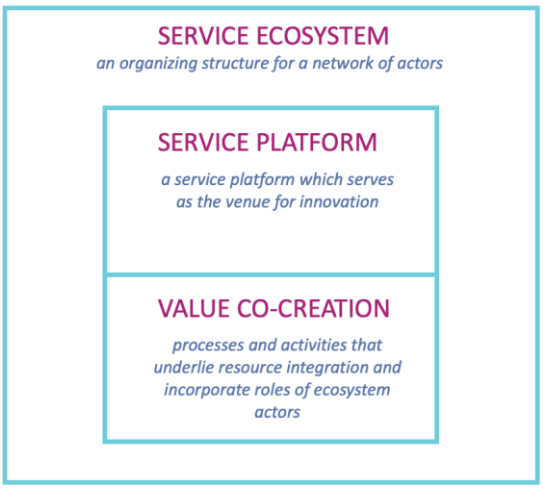


Figure 1: Service innovation framework (Adaptation of Figure 1 from Lusch & Nambisan (2015, p.162) by Häikiö & Koivumäki (2016)).

As a prerequisite to look into the process perspective, it can be summarized:

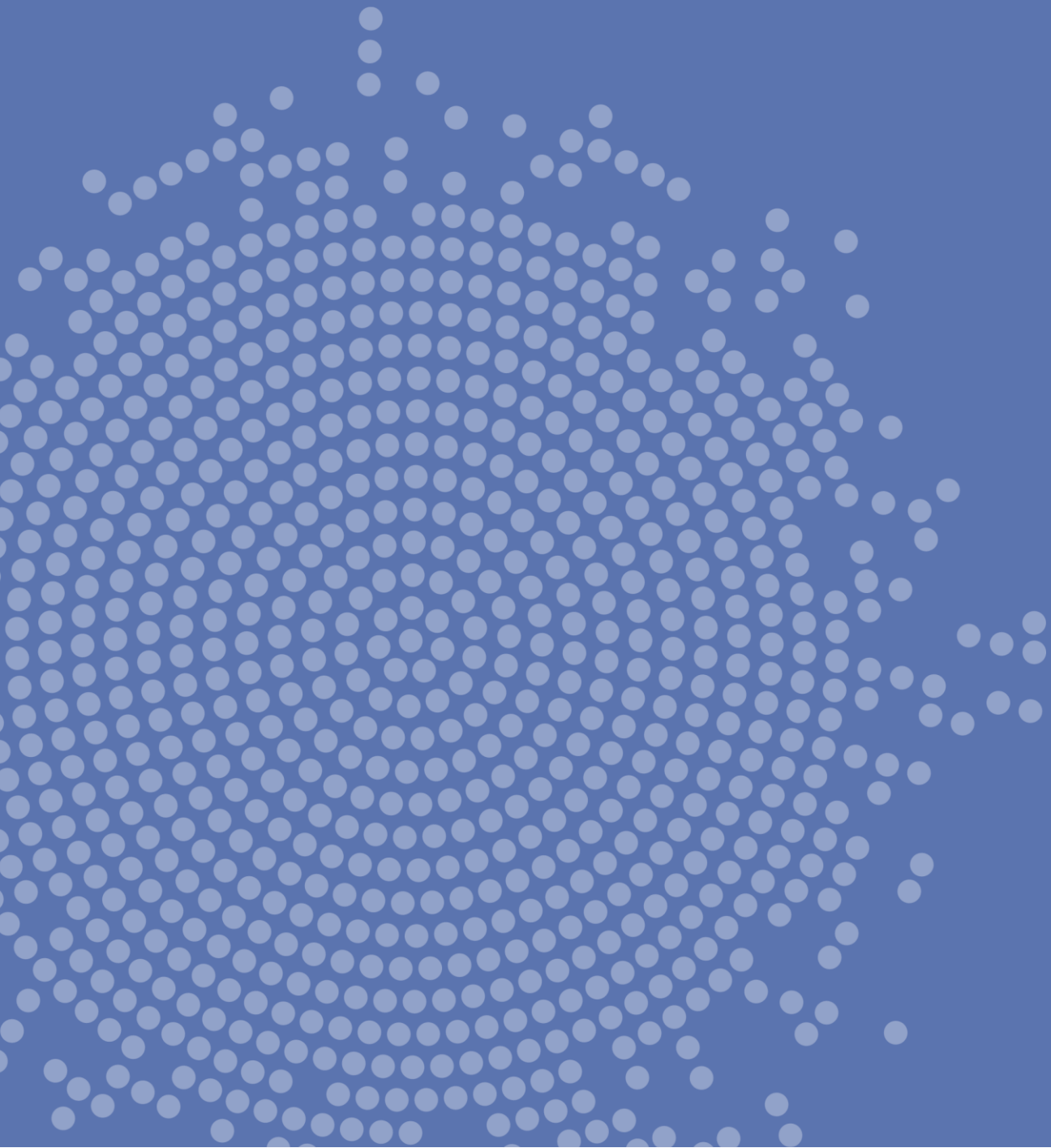
- New forms of service innovation are concerned with customer-centricity and complexification issues.
- Digital innovation appears as a driver for customer-centricity but also for further complexification.
- The combination of digital and service innovation opens up new opportunities which further complexify the picture. Thus, best practices and current challenges need to be uncovered to lead to a more targeted development.
- For service innovation, co-creation through the network is an important factor. Therefore, innovation needs to take place on a service platform to invite the service ecosystem (= network) to co-create.
- The identification of useful digital tools is key to digitalizing service innovation.
- The combination of digital and service innovation requires a new set of capabilities which need to be defined.
- Flexibility and iteration might play a significant role in digital and service innovation which needs to be further analyzed.

Digital innovation for services - as a process

Not only can digital innovation be analyzed as an outcome by contributing to the expansion of a company's product and service portfolio but digital innovation for service as a process with its unique properties has to be understood as well (Yoo, Lyytinen, Boland, & Berente, 2010). The above insights illustrate the relation of the outcome and process perspective and highlight specific elements of importance. Due to the nature of digital technologies themselves, they enable new types of innovation processes, namely digital innovation processes, that are "distinctively different from the analogue innovation processes of the Industrial Era" (Nylen & Holmström, 2015, p. 58). These digital innovation processes are characterized as highly complex owing to their rapid pace which make them especially difficult to control and predict (Yoo, Lyytinen, Boland, & Berente, 2010). Consequently, the analysis of different innovation processes will be the main focus in the following chapters – accounting for digital- and service-specific elements.

Section 3

Methodology of Literature Review



3. Methodology of Literature Review

Planning and preparing the literature review

Prior to the literature research, a set of criteria was decided on regarding the selection and inclusion of papers. Based on the contextual framework established earlier, only papers were included which specifically focused on innovation models describing the sequences of activities and innovation phases to remain within the scope of a process view. Additionally, relevant terms to be defined were identified and added as criteria to select papers which delivered relevant definitions. Furthermore, the contribution of the papers towards the theoretical background behind service innovation was another criterion of inclusion.

Conducting the literature review

In order to provide a Digital Innovation Audit in the form of a state-of-the-art review on new digital innovation processes for services, the literature review needs to draw on an extensive database and will specifically focus on service and digital innovation literature. Therefore, a database on the relevant literature was created as a first step. As such, we consider scientific literature which was published since the emergence of the service focus in innovation literature as first mentioned in Barras (1986), starting to theorize innovation in services. Thus, papers from 1986 until 2021 were considered including well-established as well as current theories and approaches. The sources for the literature review consisted largely of the literature databases from all project partners ranging from internal publications to previous research works. Additionally, extensive literature search was conducted on databases such as Science Direct and Google Scholar. Furthermore, a general and structured search in the Web of Science was conducted including the time period as well as specific search terms.

The search terms used during the creation of the literature database consisted of different combinations of the following terms:

1. Innovation, innovation management, innovation process
2. Digital innovation, digitalization, digital tools
3. Servitization, service innovation, services, service sector

Based on the set criteria, the yielded results were scanned through based on their relevancy in terms of definitions and approaches or theories on innovation processes. The main focus, however, remained on innovation process theories, only literature providing definitions relevant to the literature research were selected. The relevancy of needed definitions was decided on beforehand. Therefore, the most important papers were collected separately to create a database for the literature review.

The literature search yielded 242 results according to the databases used. After a first round of screening, only 80 articles were perceived to be specifically relevant for the literature review. After a more detailed analysis of these articles, 55 articles remained which provided the theoretical base and contributed to development of the new service development model for this literature review. Specifically, 25 of these scientific articles were found to include innovation process theories and approach which were used for the mapping of innovation processes.

Analyzing the literature

The literature selected was analyzed in form of a mapping process. The theories on innovation processes were mapped against each other in order to create a preliminary digital innovation process for services that can be universally applied. The conceptual model of the literature review can be seen in Figure 2 which showcases the different steps

involved in the analysis of identified theories. The result of the literature review will be summarized in the preliminary digital innovation process for services outlined in chapter 5.

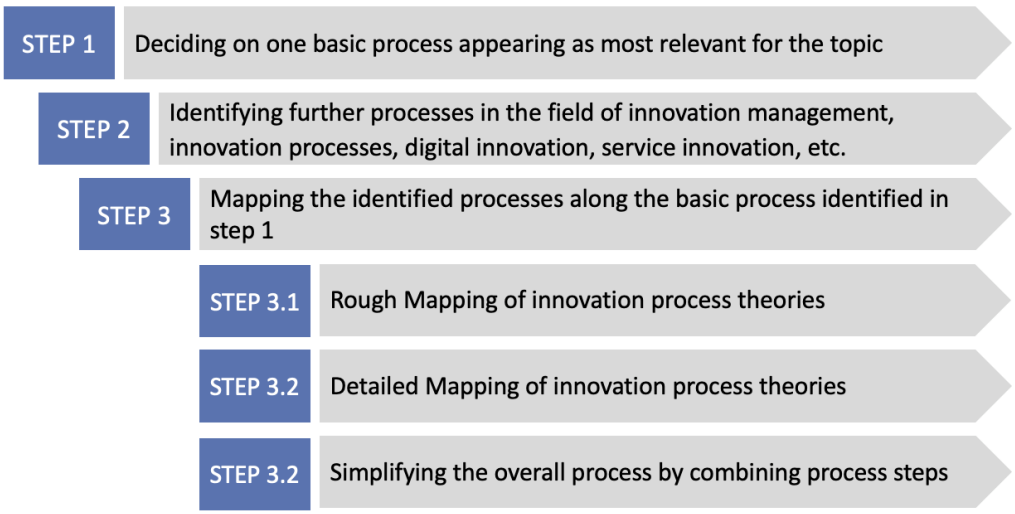


Figure 2: Conceptual model of literature review (own depiction).

Section 4

Literature Review of Digital Innovation Processes for Services

4. Literature Review of Digital Innovation Process for Services

4.1 Definitions of Relevant Terms

A common agreement on the definition of relevant terms used during this project is necessary in order to create an aligned understanding when mapping innovation process theories against each other. The chosen definitions are based on various selected definitions found throughout academic literature fitting to the context of this project and will act as the basis for the mapping process and conducted interviews. The relevancy of the terms was derived from breaking down the term 'Digital Innovation Process for Services' into its basic core terms. A selection of definitions of these relevant terms is presented in Table 2.

Table 2: A selective overview of definitions of relevant terms

Term to be defined	Overview of selective definitions	Authors
Innovation	"unique ideas that are **implemented**" (p.39)	Van de Ven (2017)
	"**production or adoption, assimilation, and exploitation of value-added novelty** in economic and social spheres; renewal and enlargement of **products, services and markets**; development of new methods of production; and establishment of new management system. **It is both a process and an outcome**" (p.1155)	Crossan & Apaydin (2010)
	"[Innovation]…is often employed as a substitute for creativity, knowledge or change" (p.1155)	Crossan & Apaydin (2010)
	First definition coined by Schumpeter in the late 1920s: "innovation is reflected in **novel outputs**: a **new good** or a new quality of a good; a **new method of production;** a **new market**; a new source of supply; or a new organizational structure, which can be summarized as 'doing things differently'" (p.1155)	Crossan & Apaydin (2010) based on Hansen & Wakonen (1997)
	"the **creation and adoption of an idea, a product, a technology**, or a program that is new to the adopting unit" (p.6)	Yoo, Lyytinen, Boland, & Berente (2010)
Innovation process	"**nonlinear cycle of divergent and convergent activities that may repeat in unpredictable ways over time**" (p. 40)	Van de Ven (2017)
	"Actual innovation process is **highly iterative**, organizations may **enter the process at different stages** and **back-track to earlier points**, but engaging in innovation follows **a broadly agreed life cycle**" (p.187)	Tate, Bongiovanni, Kowalkiewicz & Twonson (2018) based on Gassmann & Enkel (2004) and Kyffin & Gardien (2009)
Digitization	"the **transformation from analog to digital data**. The increased availability of data enabled by advances in creating, transferring, storing, and analyzing digital data" (p.181)	Ritter & Pedersen (2020)
	"…a mere technical **process of encoding** diverse types of **analog information in digital format**" (p.6)	Yoo, Lyytinen, Boland, & Berente (2010)

Continued on next page

Table 2: A selective overview of definitions of relevant terms

Term to be defined	Overview of selective definitions	Authors
Digitalization	"We define the term 'digitalization' as the **application of digital technologies** (…), i.e., digitalization is the impact of digitization **on society**" (pp.181)	Ritter & Pedersen (2020)
	"the **transformation of socio-technical structures** that were previously **mediated by non-digital artifacts** or relationships **into ones that are mediated by digitized artifacts** and relationships (…) and involves **organizing** new socio-technical structures with **digitized artifacts** as well as the **changes in artifacts** themselves" (p.6)	Yoo, Lyytinen, Boland, & Berente (2010)
Servitization	"**The transformational process of shifting from a product-centric business model and logic to a service-centric approach**" (p.7)	Kowalkowski et al. (2017)
Service Innovation	"the **rebundling of diverse resources** that create novel resources that are beneficial (i.e., value experiencing) to some actors in a given context" (p.161)	Lusch & Nambisan (2015)
	"a change in the **roles and the composition of the actor network** involved in the **value creation processes**" (p.98)	Häikiö & Koivumäki (2016)
Digital Innovation	"Digital innovation is the **use of digital technology during the process of innovating**. Digital innovation can also be used to describe, fully or partly, the **outcome of innovation**. Digital innovation has radically **changed the nature and structure** of new products and services, spawned novel value creation and value appropriation pathways, enabled innovation collectives that involve dynamic sets of actors with diverse goals and capabilities produced a **new breed of innovation processes**, and more broadly, transformed entire industries in its wake" (p.233)	Nambisan, Lyytinen, Majchrzak, & Song (2017)
	"…**innovation enabled by digital technologies** that leads to the creation of new forms of digitalization" (p.6)	Yoo, Lyytinen, Boland, & Berente (2010)
	"…the unique properties of digital technology **enable new types of innovation processes** that are distinctively different from the analog processes of the Industrial Era" (p.58)	Nylén & Holmström (2015)

Table 2: A selective overview of definitions of relevant terms

Firstly, when looking at different definitions of '*innovation*', the term was often described in the context of novelty. This included not only the creation of "novel outputs" (Crossan & Apaydin, 2010, p.1155) but also the "production or adoption, assimilation, and exploitation" (Crossan & Apaydin, 2010, p.1155) of them. The outputs were interpreted broadly, ranging from an idea to products and technology to services as well as markets (Yoo et al. 2010; Crossan & Apaydin, 2010). Innovation is considered to be the implementation of distinctive ideas (Van de Ven, 2017) and entails not only an outcome but also a process (Crossan & Apaydin, 2010). Combining all these insights found in literature, innovation shall be defined as the following: *Innovation is the production or adoption, assimilation, and exploitation of value-added novelty in outputs – such as products, services, and markets – which are implemented. It is both a*

process and an outcome.

Secondly, specific focus is put on the '*innovation process*' itself. Without going into details about any stages or phases, the innovation process is described to follow "a broadly agreed life-cycle" (Tate, Bongiovanni, Kowalkiewicz, & Townson, 2018, p. 187) across literature which in its nature consists of irregular divergent and convergent cycles of activities. These cycles of activities are considered to be iterative and can be repeated unlimited times (Van de Ven, 2017; Tate et al., 2018). Therefore, the following definition based on Van de Ven (2017) and Tate et al. (2018) will be used in this project: *Innovation process is a nonlinear cycle of divergent and convergent activities that may repeat in unpredictable ways over time. It is highly iterative and organizations may enter the process at different stages and backtrack to earlier points but engaging in innovation follows a broadly agreed life cycle.*

To elaborate on how the term '*digital*' influences the research on service innovation, firstly, the terms 'digitization' and 'digitalization' are defined. While digitization is considered to be the technical process of transforming analog data into a digital format, the meaning of digitalization is expanded towards the impact of such digitization including the application of digital technologies. The impact in this context is referred to be on society (Ritter & Pedersen, 2020; Yoo et al., 2010). Regarding the effect that digitalization has on innovation, the definition of '*digital innovation*' is explored additionally within this literature research. In the context of this project, digital innovation is not considered as the creation of digital technology but rather the "use of technology during the process of innovating" (Nambisan, Lyytinen, Majchrzak, & Song, 2017, p. 233). Therefore, the focus is on the application of tools and technology in order to enhance the innovation outcome or process.

Lastly, further highlight is put on the term 'service innovation' as well as the term 'servitization'. In order to fully comprehend the main goal of this research, it is necessary to understand what is meant with service innovation. Firstly, servitization is the logic and the concept to a service-centered approach, understood as the "transformational process of shifting from a product-centric business model and logic to a service-centric approach" (Kowalkowski, Gebauer, Kamp, & Parry, 2017, p.7). Based on this concept, service innovation refers to the process itself, a "rebundling of diverse resources" (Lusch & Nambisan, 2015, p. 161) including the change effect on the actor network that is involved during the innovation process, explicitly the roles and composition within the actor network (Häikiö & Koivumäki, 2016, p. 98). Therefore, service innovation shall be defined as *the rebundling of diverse resources, change of roles, and composition of the actor network involved in the value creation processes*. Table 3 gives an overview of the final definitions used within this project.

Table 3: Final definitions based on literature

Term to be defined	Final definitions
Innovation	Innovation is the production or adoption, assimilation, and exploitation of value-added novelty in outputs – such as products, services, and markets – which are implemented. It is both a process and an outcome.
Innovation process	Innovation process is a nonlinear cycle of divergent and convergent activities that may repeat in unpredictable ways over time. It is highly iterative and organizations may enter the process at different stages and backtrack to earlier points but engaging in innovation follows a broadly agreed life cycle.
Digitization & Digitalization	Digitization is the transformation from analog to digital data while digitalization is the application of digital technologies to society.
Digital Innovation	Digital innovation is the use of digital technology during the process of innovating.

Servitization	Servitization is the transformational process of shifting from a product-centric business model and logic to a service-centric approach.
Service Innovation	Service innovation is the rebundling of diverse resources and change of roles and composition of the actor network involved in the value creation processes.

Table 3: Final definitions based on literature

Based on these definitions and within the framework of this research, it shall be explored (1) how innovation processes are specifically shaped in different theories, (2) which specific characteristics need to be added, changed, or removed to construct a service innovation process, and (3) how digital technologies and tools can contribute to and be used during the innovation.

4.2 Basis of Studies

Overview of approaches collected

Based on academic literature, 25 approaches on innovation processes were identified. The focus during the research was on specific theories about the different stages and phases of an innovation process in order to identify a general digital innovation process for services applicable to the creation of service offerings by making use of digital tools. In the following Table 4, a short overview on the identified innovation processes is given. Moreover, additional insights on digital and service innovation were gathered in order to highlight the specifics and most important factors on how to successfully execute service innovation with the help of digital tools.

Table 4: An overview on the identified innovation processes

Studies and approaches on innovation processes	1. Digital Service Innovation Process (Häikiö & Koivumäki, 2016) 2. Process Theory of Innovation (Crossan & Apaydin, 2010) 3. Disruptive Innovation Process (Petzold, Landinez, & Baaken, 2019) 4. New Service Development Process (Zomerdijk & Voss, 2011) 5. Reverse Product Cycle (Barras, 1986) 6. Stage-Gate-Model (Cooper, 1990) 7. Product Development Funnel (Wheelwright & Clark, 1992) 8. Service Innovation Process (Thomke, 2003) 9. Design Thinking (Beckman & Barry, 2007) 10. Design Thinking-Based Innovation (Osorio, 2009) 11. Innovation Journey (Van de Ven, 2017) 12. Service Logic Value Generation Process (Grönroos & Gummerus, 2014) 13. Innovation Management Process (Alexandersdottir, 2015) 14. Iterative Stage-Gate-Model (Cooper, 2014) 15. The Fuzzy Front End of Innovation (Herstatt & Verworn, 2001) 16. The Fuzzy Front End (Dornberger & Suvelza, 2012) 17. D4 Roadmap (Silverstein, Samuel, & DeCarlo, 2009) 18. Outcome-Driven Innovation (JTBD theory) (Ulwick & Osterwalder, 2016) 19. Innovation Life-Cycle (Tate, Bongiovanni, Kowalkiewicz & Twonson, 2018) 20. Digital Service Innovation Sprints (Tate et al., 2018) 21. Innovation Process for Services (Dörner, Gassmann & Gebauer, 2011) 22. Revised Theoretical Model for Service Innovation (Srivastava & Shainesh, 2015) 23. Public sector innovation process (Cinar, Trott, & Simms, 2019) 24. Overlapping Stage-Model (Jolly, 1997) 25. Search Model (Tidd & Bessant, 2020)

Table 4: An overview on the identified innovation processes

Specific insights derived from innovation process studies

The 25 identified innovation processes revealed that many innovation process phases are considered to be similar, and some stages were found repeatedly in various theories, i.e., some sort of 'ideation' steps and different variations of 'development' steps. Often, the theories differed in terms of their specific focus on different phases. Innovation theories such as Design Thinking (Beckman & Barry, 2007) or The Fuzzy Front-End theories (Herstatt & Verworn, 2001; Dornberger & Suvelza, 2012), among others, put more emphasis on the early stages of an innovation process while other theories disclosed more insights on how service innovation can develop from existing solutions (e.g., Barras, 1986), focusing more on the later stages. Most of the identified theories on innovation processes took a general approach or a product approach whereas only a few specialized on service innovation. Some approaches showcasing innovation were very detailed and included specific tasks in each step (e.g., Zomerdijk & Voss, 2011), while some theories merely described the general directions in which the innovation process could move (e.g., Van de Ven, 2017).

Further differences were found with regard to the sequence of innovation steps. Many theories mentioned an iterative approach and a non-linear life cycle (e.g., Zomerdijk & Voss, 2011; Beckman & Barry, 2007; Cooper, 2014; Van de Ven, 2017) contrasting linear innovation processes (e.g., Cooper, 1986). Moreover, focusing specifically on service innovation, it was stated that service innovation occurred differently from firm to firm – some followed a rather strict structure of innovation steps while other companies innovated more flexibly and unstructured (Zomerdijk & Voss, 2011). Especially Van de Ven (2017) claimed that innovations cannot be reduced to a fixed sequence of steps and stages which is why a usual stage gate model (e.g., Cooper, 1986) cannot truly depict the innovation life cycle which rather consists of a "nonlinear cycle of divergent and convergent activities that may repeat in unpredictable ways over time" (Van de Ven, 2017, p.40). In this context, according to a case study on 17 companies (Zomerdijk & Voss, 2011), a rough summary of innovation activities revealed that - despite the structural differences in the innovation steps - all companies put explicit focus on the front end of the process, 'gathering customer insights' being the most important key activity. This insight is kept in mind during mapping the innovation processes. In the following Table 5, a short overview is given on the various identified innovation processes and their specific theory focus.

Table 5: An overview on identified innovation processes and their specific focus

Authors	Identified innovation process	Iteration	Product focus	Service focus	Digital focus
Häikiö & Koivumäki (2016)	Digital Service Innovation Process ○ Ideation ○ Concepting/Design ○ Development ○ Deployment ○ Pilot Service			x	x
Crossan & Apaydin (2010)	Process Theory of Innovation ○ Initiation and Decision Making ○ Portfolio Management ○ Development and Implementation ○ Project Management ○ Marketing and Commercialization		x	x	
Petzold, Landinez & Baaken (2018)	Disruptive Innovation Process ○ Initiation Phase ○ Niche Market Phase ○ Mainstream Market Phase		x	x	

Continued on next page

Table 5: An overview on identified innovation processes and their specific focus

Authors	Identified innovation process	Iteration	Product focus	Service focus	Digital focus
Zomerdijk & Voss (2011)	New Service Development Process ○ Gathering customer insights ○ Ideation and Implications ○ Testing Concepts and Creating Design	x		x	
Barras (1986)	Reverse Product Cycle ○ Improving efficiency of products ○ Improving quality of products ○ Creating new services			x	
Cooper (1990)	Stage-Gate-Model ○ Idea ○ Preliminary Assessment ○ Definition ○ Development ○ Testing & Validation ○ Commercialization		x		
Wheelwright & Clark (1992)	Product Development Funnel ○ Phase 1: Generation of product/process idea, Concept Development ○ Phase 2: Detailing project proposal boundaries and required knowledge ○ Phase 3: Development of different types of projects		x		
Thomke (2003)	Service Innovation Process ○ Evaluate ideas ○ Plan and Design ○ Implement ○ Test ○ Recommend			x	
Beckman & Barry (2007)	Design Thinking ○ Observations ○ Frameworks ○ Imperatives ○ Solutions	x	x	x	
Osorio (2007)	Design Thinking-Based Innovation ○ Learning and Discovery ○ Alternative Generation ○ Pre-Launch Development ○ Launch and Exploitation	x	x	x	
Van de Ven (2017)	Innovation Journey ○ Divergent Behavior ○ Convergent Behavior	x	x	x	

Continued on next page

Table 5: An overview on identified innovation processes and their specific focus

Authors	Identified innovation process	Iteration	Product focus	Service focus	Digital focus
Grönroos & Gummerus (2014)	Service Logic Value Generation Process ○ Design ○ Development ○ Manufacturing ○ Delivery	x		x	
Alexandersdóttir (2015)	Innovation Management Process ○ Fundamental Research ○ Technology Development ○ Pre-Development Activities ○ Product and Process Development ○ Product and Market introduction		x		
Cooper (2014)	Iterative Stage-Gate-Model ○ Discovery: Idea Generation ○ Idea Scoping ○ Build Business Case ○ Development ○ Testing and Validation ○ Launch	x	x		
Herstatt & Verworn (2001)	The Fuzzy Front End of Innovation ○ Idea Generation and Assessment ○ Concept Development and Product Planning ○ Development ○ Prototypes and Pilot Tests ○ Production, Market Introduction and Penetration		x		
Dornberger & Suvelza (2012)	The Fuzzy Front End ○ Opportunity identification ○ Idea Management ○ Concept Development ○ Product Development ○ Commercialization		x		
Silverstein, Samuel & DeCarlo (2009)	D4 Roadmap ○ Define ○ Discover ○ Develop ○ Demonstrate		x	x	
Tate, Bongiovanni, Kowalkiewicz, & Townson (2018)	Innovation Lifecycle ○ Scoping and Idea generation ○ Ideas evaluation ○ Early prototypes for iteration ○ Business modelling and marketing ○ Testing ○ Evaluation	x			

Continued on next page

Table 5: An overview on identified innovation processes and their specific focus

Authors	Identified innovation process	Iteration	Product focus	Service focus	Digital focus
Ulwick & Osterwalder (2018)	Outcome-Driven Innovation (Jobs-to-be-done (JTBD) theory) ○ Define customer's JTBD ○ Uncover customer's needs ○ Quantify underserved outcome ○ Discover hidden segments of opportunity ○ Align existing products with market opportunities Conceptualize new products		x		
Tate, Bongiovanni, Kowalkiewicz, & Townson (2018)	Digital Service Innovation Sprints ○ Incubate ○ Research ○ Design ○ Ideate ○ Validate ○ Implementation ○ Integrate	x		x	x
Dörner, Gassmann & Gebauer (2011)	Innovation Process for Services ○ Definition ○ Development ○ Market Launch			x	
Srivastava & Shainesh (2015)	Revised Theoretical Model for Service Innovation ○ Idea and Launch Stage ○ Infancy and Early Growth Stage ○ Late Growth and Expansion Stage			x	
Cinar, Trott & Simms (2019)	Public sector innovation process ○ Idea generation and selection ○ Development and design ○ Implementation ○ Sustainment	x	x	x	
Jolly (1997)	Overlapping Stage-Model ○ Imagining ○ Incubating ○ Demonstrating ○ Promoting ○ Sustaining	x	x		x
Tidd & Bessant (2020)	Search model/Simplified innovation process ○ Search ○ Select ○ Implement ○ Capture		x	x	

Table 5: An overview on identified innovation processes and their specific focus

4.3 Process Mapping based on Literature

Procedure of mapping innovation processes

The goal of mapping various innovation processes against each other is to create a universally applicable digital innovation process for services that can be taught in HE. Therefore, the process mapping is broken down into six different steps. Firstly, one basic innovation process, which appeared as most relevant for the topic, is decided on. Secondly, further processes in the field of innovation management, innovation processes, digital innovation, service innovation and similar fields are identified. Within the frame of this literature review, 25 innovation processes were identified. Thirdly, the processes are mapped along the basic process identified in step 1. Fourthly, each individual process is reviewed in detail and similarities are determined. Fifthly, the overall innovation process is simplified by combining the process steps resulting in a three-level process construct.

Visualisation of Basic Digital Innovation Process for Services

The innovation process model by Häikiö & Koivumäki (2016) in particular was taken as a baseline. In this case, this model was chosen due to its explicit focus on a digital service innovation process rather than a general product innovation process focus. The focus on digital innovation as well as on service innovation acts as the groundwork to which the other identified models are mapped. In the following Figure 3, the process model is visualized and key elements of each process step are summarized. This way, the identified process steps and their key activities are taken as a blueprint in order to assign similar process steps of other innovation process theories to the same phase of innovation.

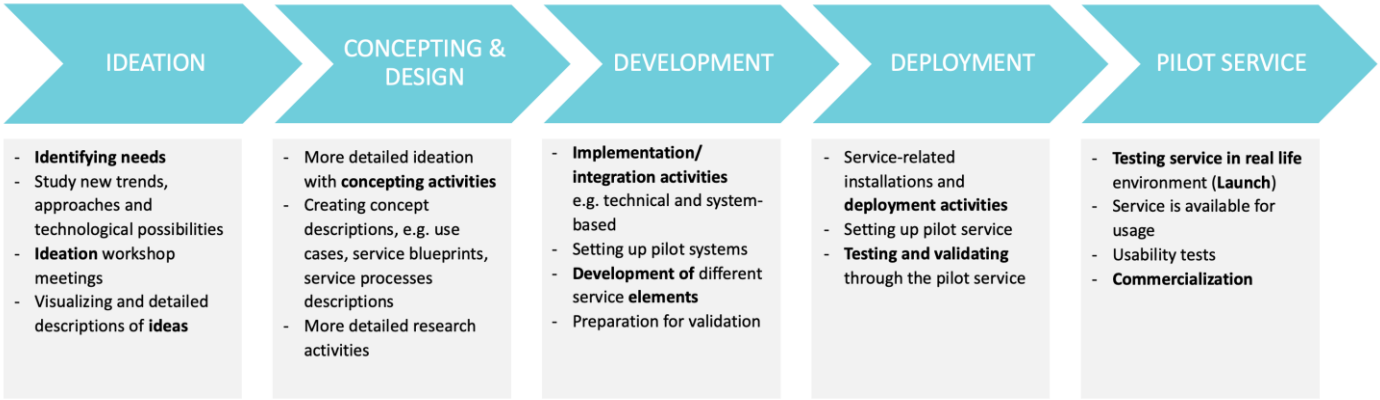


Figure 3: Basic Digital Innovation Process for Services (Häikiö & Koivumäki, 2016).

Rough mapping of different innovation theories

In the first round of process mapping, the different innovation process theories were simply broken down into their process steps or phases that described the innovation process. In order to map them to the basic innovation process by Häikiö & Koivumaki (2016), the key elements and activities within the innovation phases are identified. If an identified innovation process step entails similar key elements to a certain step of the basic innovation process such as ‘ideation’, ‘idea generation’ or ‘idea description’, it is mapped according to that innovation phase (in this example: ideation). Therefore, the mapped process phases do not have to be named exactly the same term but match the same key features (see Figure 4).

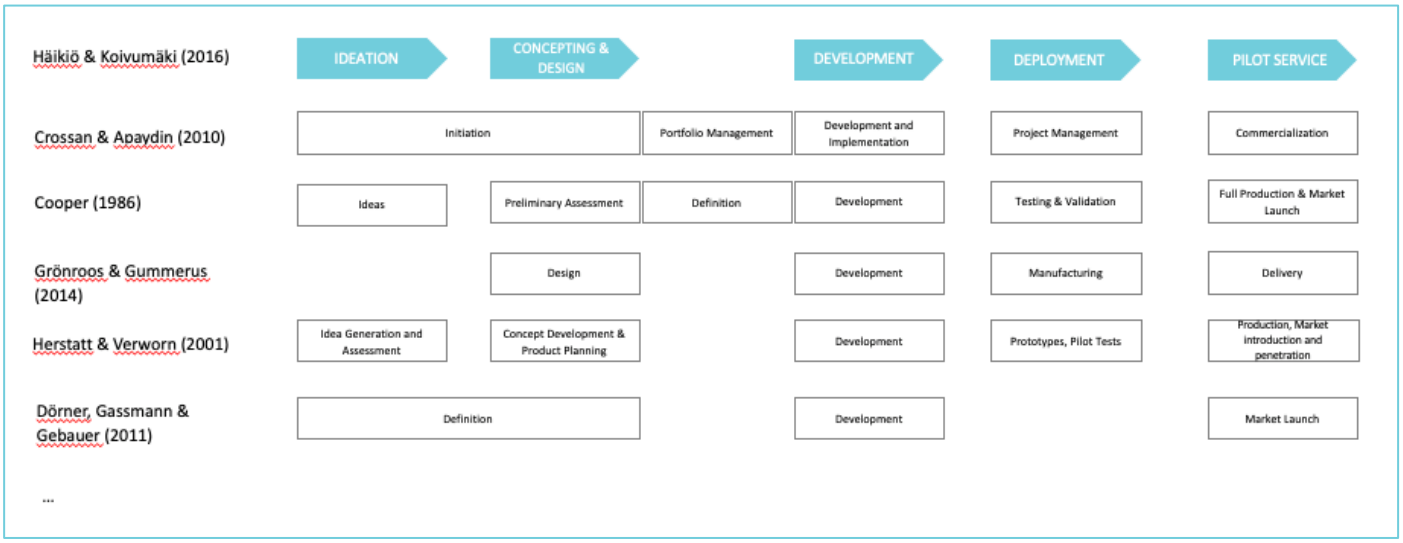


Figure 4: Extract of the simplified rough mapping of innovation process steps (own depiction).

However, some innovation theories (e.g., Crossan & Apaydin, 2010; Cooper, 1986; etc.) include additional process phases which do not confer to the basic process steps. Those are acknowledged regardless and positioned in their specific order within the innovation process. As this continued to occur often, the process mapping became more complex (see Figure 5). As such, the identified additional steps adding to the complexity of the process were found as the key finding of the first rough round of mapping innovation processes. By mapping the different processes against each other, not only differences but especially similarities can be identified. Many innovation steps consist of similar key elements described in the basic innovation process. At the same time, many additional process steps occurring variously in different orders of the basic innovation process can be found which add to the complexity of a general innovation process. This complexity needs to be broken down into a multi-level process in the further steps.

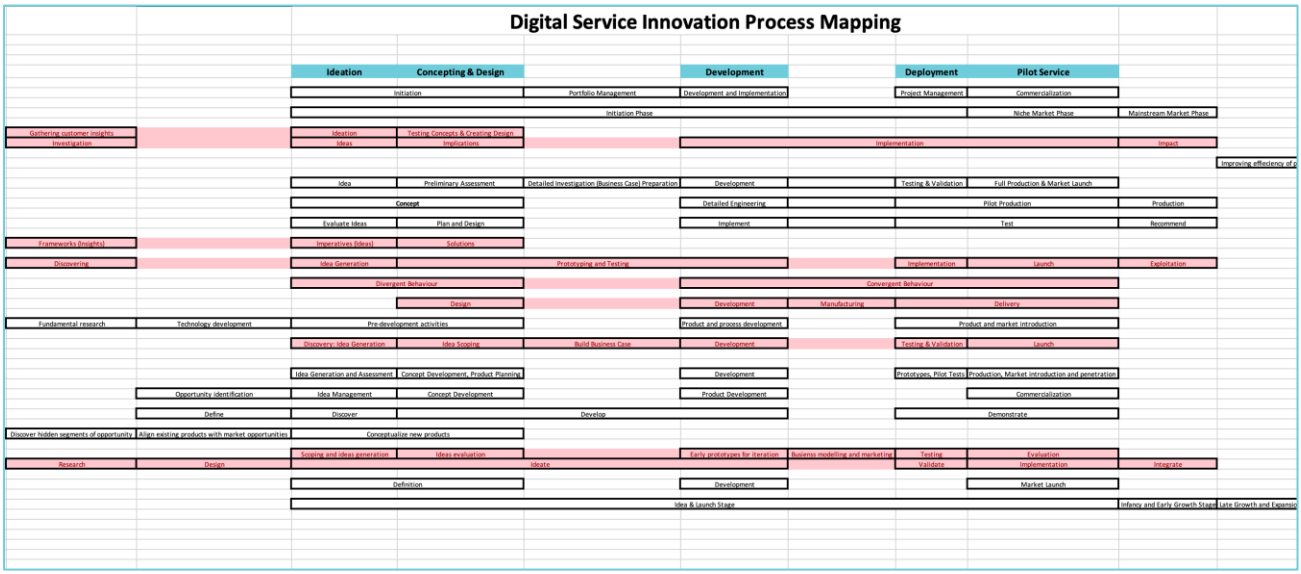


Figure 5: Extract of the complex process mapping (own depiction).

Reviewing innovation process in detail

In a second round, the roughly mapped innovation processes are reviewed in more detail. This includes identifying and distinguishing the specific activities and tasks within each process step to check their fit to the chosen step, their similarity to other process theories, as well as certain differences. Main focus is put on identifying key activities involved within a certain phase such as 'concept generation' or similar phrasing as well as concrete and very specific

tasks such as ‘conducting customer behavior research’ in order to generate a concept. Similarities between different innovation processes are highlighted putting particular emphasis on those activities which are mentioned several times. Moreover, activities and tasks specific to service innovation such as ‘development of different service elements’ are especially isolated. Identifying the various similarities within the different process steps contributes to the overall goal of recognizing commonly agreed steps which occur during innovating. At the same time, service-specific key elements remain in focus and are added to the steps. Figure 6 illustrates the detailed inspection of the process steps.

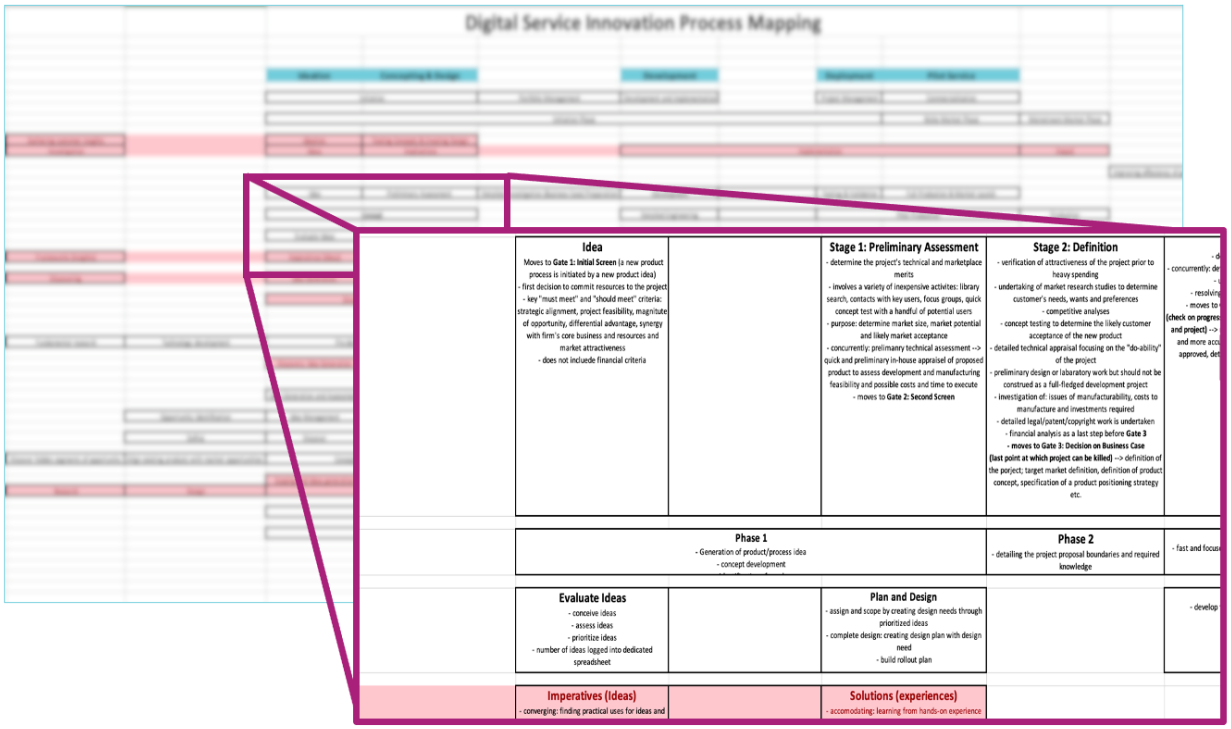


Figure 6: Extract of the detailed review of innovation process steps (own depiction).

Simplifying the overall innovation process

In a last round of process mapping, the highlighted similarities and service-specific activities are used to simplify the complex innovation processes. During the act of summarizing and combining the process steps, it became clear that the innovation process can be simplified on three different levels. On the broadest level, simplification was done by summarizing the highlighted detailed process steps into overall, wide, and general terms. In order to do so, the key detailed process steps were listed in order of occurrence within the innovation process. For instance, the general first step of all innovation processes was described as some sort of ‘gathering of insights’ followed by ‘identifying needs’. After having listed all the relevant process steps in detail, it is evident that these most important process steps can be again summarized and elaborated on at the same time. Consequently, these detailed process steps represent merely the second level within an innovation process (see Figure 7).

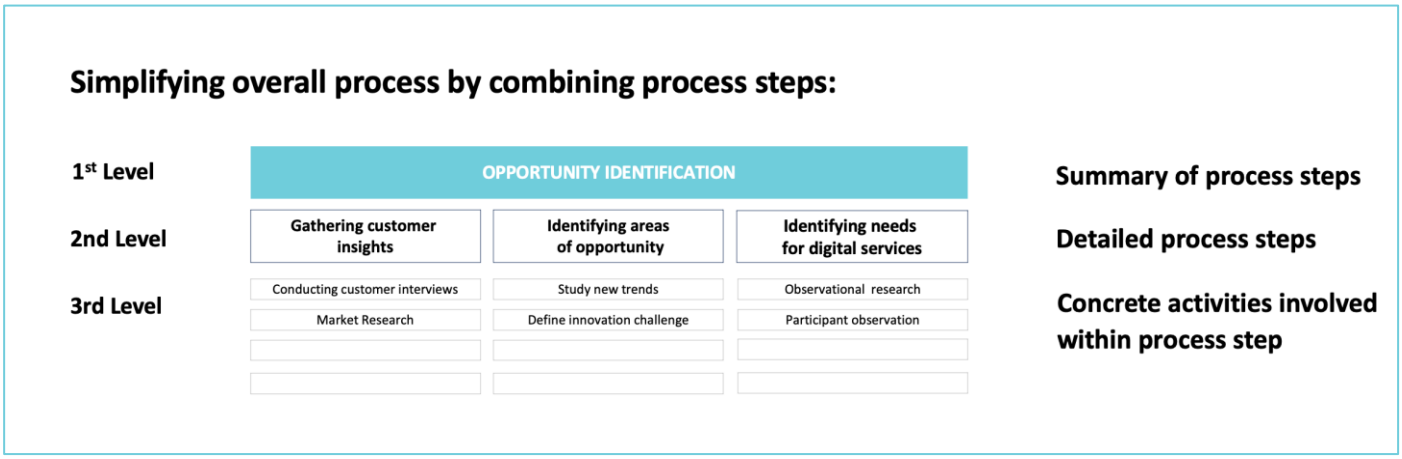


Figure 7: Extract of Three-Level Process Step Summary (own depiction)

Summarizing the detailed process steps yet again create the first level of innovation process whereas adding the specific tasks involved within the process steps showcase a third level in the innovation process. The preliminary digital innovation process for services is introduced in more detail in the following chapter.

Section 5

Preliminary Digital Innovation Process for Services

5. Preliminary Digital Innovation Process for Services

To account for the specifics of service and digital innovation, these specific elements were highlighted throughout the process mapping. The result of the process mapping consists of a digital innovation process model for services. In total, six overall process steps were summarized on the first level (see Figure 8) which, in turn, contain 19 different detailed process steps on the second level. Various exemplary concrete activities complete the third level to account for company context elements, especially the context of small and medium-sized enterprises. A full overview of the three-level process can be seen in Figure 9. The first level of the digital innovation process for services goes as follows:

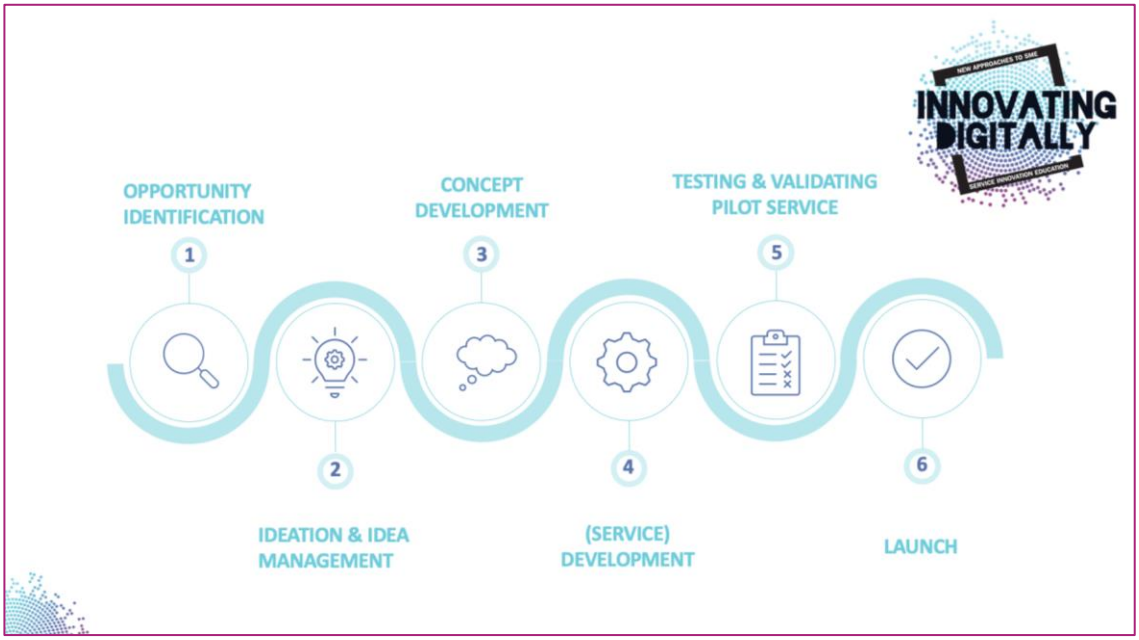


Figure 8: 1st Level stages of the Preliminary Digital Innovation Process for Services (own depiction).

The first process step is *Opportunity Identification*. It consists of firstly gathering customer insights, then, identifying areas of opportunities from these insights and lastly, identifying customer needs for services. Concrete activities, for instance, would involve conducting market research and customer interviews, study new trends and technology and observing customer and target groups. This step is necessary to understand and scope a problem based on the needs of customers and/or users.

The second process step is *Ideation and Idea Management*. During process mapping, it became clear that the 'Ideation Phase' not only involves the creation of ideas, but the complete decision-making process involved. Therefore, the second process step entails, in detail, idea generation, idea scoping, idea assessment, and idea prioritizing and selection. These steps comprise concrete activities from brainstorming, sketching out service blueprints over risk evaluation to ranking the ideas. The focus is not only on idea generation but puts equal emphasis on selecting the right idea that is based on the problem identified.

The next step that follows is *Concept Development* which includes detailed process steps such as concept generation, concept description, concept selection and concept testing. This process phase focuses on, among other activities, very detailed and advanced ideation with concepting activities, describing practical use cases, and creating first prototypes and first drafts of the idea that are tested with customers. During this phase, the idea is enhanced with more details and brought to life. Important aspects are concretized such as the value proposition.

As the fourth process step, the *(Service) Development* phase takes place. Explicitly process steps that are relevant for

service innovation have been established which are the implementation of changes after having tested the concept, experimentation and/or simulation of the implemented ideas, the development of different service elements as well as the preparation for validation of the service innovation. In this process stage, implementation and integration activities such as software development would be a focus, design activities, many rounds of prototyping and developing a pilot service. Validation activities are prepared for the next stage such as planning usability tests.

The fifth stage is *Testing and Validating the Pilot Service*. This includes the installment and deployment of developed services, setting up the pilot service and testing and validating the pilot service. Overall, this phase is characterized with preparational activities for the pilot service, setting up a way to showcase the pilot service such as setting up a pilot store and doing many different customer tests such as field tests, beta tests or in-home use tests. All of these tests will be focused on acquiring direct feedback from first-time users or customers or gaining insights into their behavior.

The last stage is the *Launch* of the service innovation which mainly focuses on commercialization. Commercialization would entail concrete activities such as implementing a market launch plan, generating first sales, and continuous verification of the solution.

All of these six phases are meant to follow an *iterative approach* which allows to iterate within each phase but also between different phases. Therefore, during the many testing activities, for example, it is possible to gain significant insights which lead to having to backtrack in the process phases to redefine certain implications or make necessary changes to the idea or development. Therefore, this preliminary digital innovation process model for services is not to be understood as a fixed sequential model but allows for some stages to be skipped and for some to go in parallel to each other.

A full overview of the three-level process with all synthesized insights from the 25 identified innovation processes can be seen in Figure 9. While the first level refers to the overall steps as briefly described above, the second level presents a more detailed procedure of steps. Finally, the third level refers to specific tasks which are considered to be part of the respective process step.

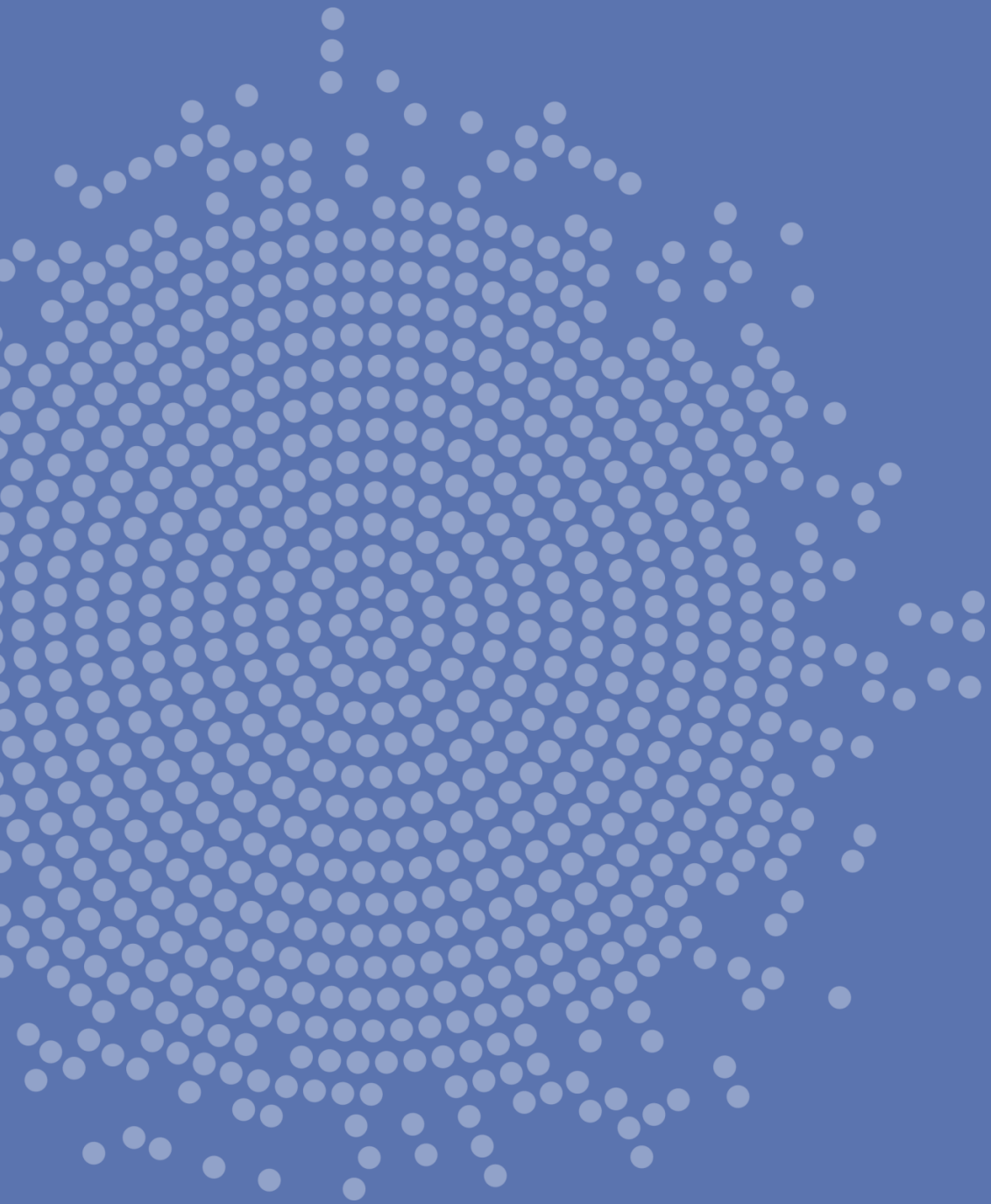
1st	2nd LEVEL	3rd LEVEL
OPPORTUNITY IDENTIFICATION	1. Gathering customer insights	Market Research Customer Interviews Identifying nuggets and user stories Identifying dimensions of user behavior Creating timelines e.g. day-in-the-life timelines Gathering information about consumer's preferences e.g. in form of photos or videos
	2. Identify areas of opportunity	Study new trends, approaches and technology Define innovation challenge Identify Job-to-Be-Done and outcomes for each job Desktop research Problem scoping
	3. Identify needs for digital services	Fundamental research Observational or Ethnographic research Participant observation Non-Participant observation Separation of user experience into phases Testing initial assumptions Prepare preliminary roadmap for observation and interviewing
IDEATION & IDEA MANAGEMENT	4. Idea generation	Generating ideas for products, services and environments Generating ideas with different perspectives e.g. customer-oriented, technology-oriented, cost-oriented Generating ideas using different methods e.g. brainstorming, customer journey, touchpoint approach, story telling, lead user method Questioning and challenging existing assumptions Explore solutions through various combinations and substitutions Identify new paradigms for potential solution generation Seek solutions from outside knowledge databases Apply solutions from nature's problem solving Include customers by letting them provide ideas interaction with service ecosystem actors
	5. Idea scoping	Visualizing and detailed descriptions of ideas using sketches, service blueprints or customer journeys Stakeholder analysis Problem scoping and definition Determining customer demands using skills workshops, life cycle analyses or trend analyses Focus ideation efforts on specific performance metrics
	6. Idea assessment	Determining implications of ideas (people, time, cost) Finding practical uses for ideas Assessment according to solving problems and needs of users/customers Assessment according to attractiveness, risk and alignment with existing projects Evaluate ideas against the same specific performance metrics to determine which ideas will get the job done
	7. Idea prioritizing & selection	Sorting and prioritizing ideas Evaluating against outcome expectations Strengthen and shaping ideas

1st	2nd LEVEL	3rd LEVEL
CONCEPT DEVELOPMENT	8. Concept generation	Very detailed ideation with concepting activities More detailed research activities e.g. about customer behavior Soliciting feedback from potential users Logical or intuitive concept generation techniques e.g. morphological analysis, brainstorming, sketching or word association
	9. Concept description	Creating concept descriptions using use cases, blueprints or service process description Building use cases Formulate value proposition Discussion of background processes Build rollout plan
	10. Concept selection	Selecting concepts based on decision tools and prioritization methods
	11. Concept testing	Creating first prototype (first drafts of e.g. service user interface visualization) Determining learning goals Refining concept designs into many prototypes (products, services and process concepts) Validating prototype by testing concepts with handful of stakeholders and customers Acquiring feedback from users or customers (iteratively)
(SERVICE) DEVELOPMENT	12. Implementation of changes	Complete detailed design of new service Technical and system-based implementation or integration activities like software development Develop test plan (integrated rollout plan)
	13. Experimentation/Simulation of implemented ideas	Setting up pilot systems Prototyping Detailed tests Marketing and operation plans Including customers as co-creators and testers
	14. Development of different service elements	Finalizing service elements like user interface design Design of systems that allow and sustain new user experience Further rounds of prototyping and testing Pilot service development
	15. Preparation for validation	Planning of customer and user interviews Planning of usability tests Design reviews
TESTING & VALIDATING PILOT SERVICE	16. Installation and deployment of services	Preparational activities for pilot service
	17. Setting up pilot service	Setting up a way to showcase pilot service e.g. a pilot store with service and tangible components of service solution
	18. Testing and validating	Doing customer tests: user or field trials (testing service under actual use conditions) Beta tests In-home tests Trial sell and usability tests Collecting data from customers and users: behavior or feedback Finalizing designs and service components
LAUNCH	19. Commercialization	Implementation of market launch plan and operations plan Generating sales Continuous solution verification

Figure 9: Three-level stages of the Preliminary Digital Innovation Process for Services (own depiction).

Section 6

Methodology of Expert Interviews



6. Methodology of Expert Interviews

After having analysed scientific literature on innovation process theories and approaches to bring about a preliminary digital innovation process for services, expert interviews were conducted with lecturers of innovation-related courses in HEI. These were meant to enrich and finalise the preliminary model to combine theory with practice approaches. Before going into detail on the specific interview results and insights found, the exact research design, interview guidelines, and data collection and analysis methods shall be described.

6.1 Research Design

According to the requirements stated in the project proposal, at least 24 qualitative interviews shall be collected to enrich the preliminary model with insights from teaching practices. These expert interviews specifically aim at enriching the insights from literature on innovation processes, digital innovation, and service innovation with current practices and perceptions of HE lecturers and academics in Europe. In the following, the aim and content of the interviews, the target group, and the detailed interview strategy as well as procedure shall be discussed.

Aim and content of the interviews

The aim of the interviews is the inclusion of the network of HE organizations to add to the theories and findings of the literature review with the final goal to construct a “final digital innovation process for services”. By directly involving practicing educators in the research phase of the audit, authenticity of the results is ensured as well as invaluable insights gained.

Put simply, the interviews aim to address the following three fundamental questions:
1) How does an up-to-date innovation process look like and how do educators teach innovation processes in HEI?
2) How does servitization, more specifically the innovation for services, influence innovation processes?
3) How does digitalization, more specifically digital tools, influences innovation processes?
3) Which challenges are currently faced in teaching innovation processes and how should these challenges be met?

The first question focuses on the innovation process as such and the current teaching practices of educators in HEI. In the interviews, participants will be asked to provide information on their perception of an optimal innovation process and insight on their current innovation process teaching practices as well as the theories and methods on which they are built.
The second question deals with the specific influence of the trends servitization and digitalization on innovation processes. In the first step, participants are asked to report how service innovation or a service-centered approach influences the innovation process and which capabilities are specifically needed to account for this. After that, the interviewer asks about the influence of digitalization on innovation processes, which tools facilitate the innovation process and how so, and which capabilities are specifically needed to be able to integrate digitalization in the innovation process.
Lastly, the third question shall approach the current needs for improvement within innovation processes teaching referring to needs as educators as well as those of internal and external stakeholders. A specific focus shall be placed on servitization and digitalization, again.

Target group

The interviews target ‘practicing digital innovation educators’, with a proven track record of teaching innovation management and innovation processes, especially with a focus on service innovation and digital innovation, as defined earlier.

Therefore, relevant educators were defined according to the criteria visualized in Table 6. As mandatory requirements, interview candidates are educators or lecturers in HEIs in Europe who are teaching in the area of innovation processes. Acknowledging the wide field of innovation-related courses, the interviews were aimed at covering as many different fields as possible to include different perspectives. Therefore, an exemplary overview of (1) relevant research and publication fields, (2) teaching areas and study programs, (3) exemplary courses, and (4) keywords was prepared to

facilitate the selection of suitable interview candidates (see appendix). In addition, optional criteria were considered to include expertise on the use of digital tools as well as on services and service innovation.

Table 6: Criteria for expert selection

Criterion	Description
Educators or lecturers in HEI ***(mandatory)***	Interview candidates have to be educators or lecturers in HEIs in Europe who are acquired from the wide network of the project partners including experts in the partners' organisation as well as within their network of higher education institutions.
Teaching in the area of innovation processes in diverse study ***(mandatory)***	While the general criterion of teaching innovation-related courses – innovation processes, digital innovation, service innovation – should be met, overall, it was aimed for diversity including different fields of study, thus, perspectives. To facilitate and clarify this criterion and to give examples of relevant fields of innovation-related teaching, a list of (1) most significant fields of research and publication, (2) possible areas of teaching and study programmes, (3) exemplary courses, and (4) further keywords was prepared (see appendix).
Use of digital tools ***(optional)***	Optimally, educators are using digital tools in teaching innovation processes or are able to report on using digital tools in innovation processes.
Expertise on services ***(optional)***	Optimally, educators have experience in service-related topics and can report on specifics for service innovation.

Table 6: Criteria for expert selection

It should be noted that HE innovation educators are mainly present in the managerial and technical as well as societal perspective on innovation processes, thus, it will be specifically searched for participants from these fields. Overall, a minimum of 24 interviews with innovation educators across 6 European regions are expected.

Interview strategy

To carry out qualitative interviews and collect relevant insights, a multitude of research strategies was prepared and offered. As such, it was left open to the researcher to select the most suitable strategy for the specific situation he or she faces at the organization and network. The following strategies were offered:

- Structured qualitative interviews (one-on-one; recorded and summarized according to template)
- Structured questionnaire (written answers in online survey)
- Local focus groups (recorded and summarized according to template)

All three options are based on the same questions to ensure comparability of results. Therefore, the overall interview questionnaire shall be introduced in the next chapter.

6.2 Interview Questionnaire

Overall, the interview questions are based on the previously defined terms. As such, a shorter version of the definitions was presented to the interview candidate before starting into the questionnaire. By this, it shall be made sure that the candidate shares the same understanding of relevant terms. This was followed by the core questions of the interview as outlined in Table 7.

Table 7: Interview questionnaire

Section	Guiding questions to be asked
PART I: INTRODUCTORY QUESTIONS	
1. Background of interview candidate	In which organisation do you work as an innovation educator? Which position do you take within the organisation?
2. Relation to innovation management	In which way do you come across innovation process related topics in your teaching? Overall, what courses do you teach which are connected to innovation processes? At what level, in which programs and for how many students are these courses designed?

PART II: INNOVATION PROCESSES	
3. Innovation process	Please, illustrate the innovation process steps which you teach in this/these course/s. Which steps are part of an innovation process? If needed, take a look at the following exemplary process: 
	Please, describe the steps in more detail.
PART III: DIGITALIZATION	
4. Inclusion of digitalization	How does digitalization promote the innovation process?
5. Digital tools	Which digital tools do you regard as helpful in facilitating the innovation process? In which steps should the digital tools be applied in the innovation process?
6. Specific capabilities for digital innovation	Which capabilities must be developed to successfully apply digital tools in an innovation process?
PART IV: SERVICE INNOVATION	
7. Inclusion of service innovation	Imagine an innovation process which leads to the invention of a new service offering. In which way is the service innovation process different from the innovation process illustrated earlier?
8. Specific capabilities for service innovation	Which capabilities must be developed to successfully apply a service innovation process?
PART V: TEACHING INNOVATION PROCESSES	
9. Aims and methods of teaching	How do you teach innovation processes? What does the course outline look like? Which didactics do you use?
	On which theories or methods is / are the innovation course/s based? How do you apply these theories and methods?
	What are the expected outcomes or learning objectives associated with the course(s) related to innovation processes?
10. Personal challenges	Which challenges do you face in teaching innovation processes?
11. Challenges of stakeholders	Which internal and external stakeholders are involved in the course(s)?
	Which challenges do these stakeholders mention?
12. Ideas for improvement	How would you improve the innovation process to solve these challenges?

Table 7: Interview questionnaire

This questionnaire was used as a guideline for the one-on-one interviews. Furthermore, it was transformed into an online questionnaire via the survey software Qualtrics. The respective link to the survey was then shared with interview candidates via e-mail. In addition, the subtopics were used to lead through potential focus groups.

While most interview candidates were teaching in the field of innovation processes, some few additional survey answers were collected reporting on the information technology (IT) perspective to get more detailed insights on the use of digital tools. Therefore, the interview questions were adapted to fit to the context of interview candidates, who are working in HEIs but are more concerned with developing digital tools than teaching innovation processes. Please refer to the appendix for the adapted interview questionnaire for IT experts.

6.3 Data Collection and Analysis

Interview procedure

Leaving some freedom in choosing the interview strategy, a general interview procedure was provided to ensure that all necessary steps were carried out to lead to high quality results. Although these steps are slightly different depending on the chosen interview strategy, they follow an overall approach. See Figure 10 for the interview procedure overview. A more detailed description is provided in the interview guidelines which was shared with the partners. In the first step, the research strategy was formed as well as interviews prepared, and suitable interviews contacted. This was followed by a period of interview conduction from 15th of January 2021 to 15th of March 2021. Step three, the data collection, was done simultaneously by directly summarizing interviews after having conducted them. Therefore, templates for the invitation e-mail, the data consent form, and the interview questionnaire as well as for writing the interview summary were provided to the researchers. This was followed by the final step of qualitative interview analysis which will be explained in more detail underneath. Overall, 26 expert interviews and survey were conducted.

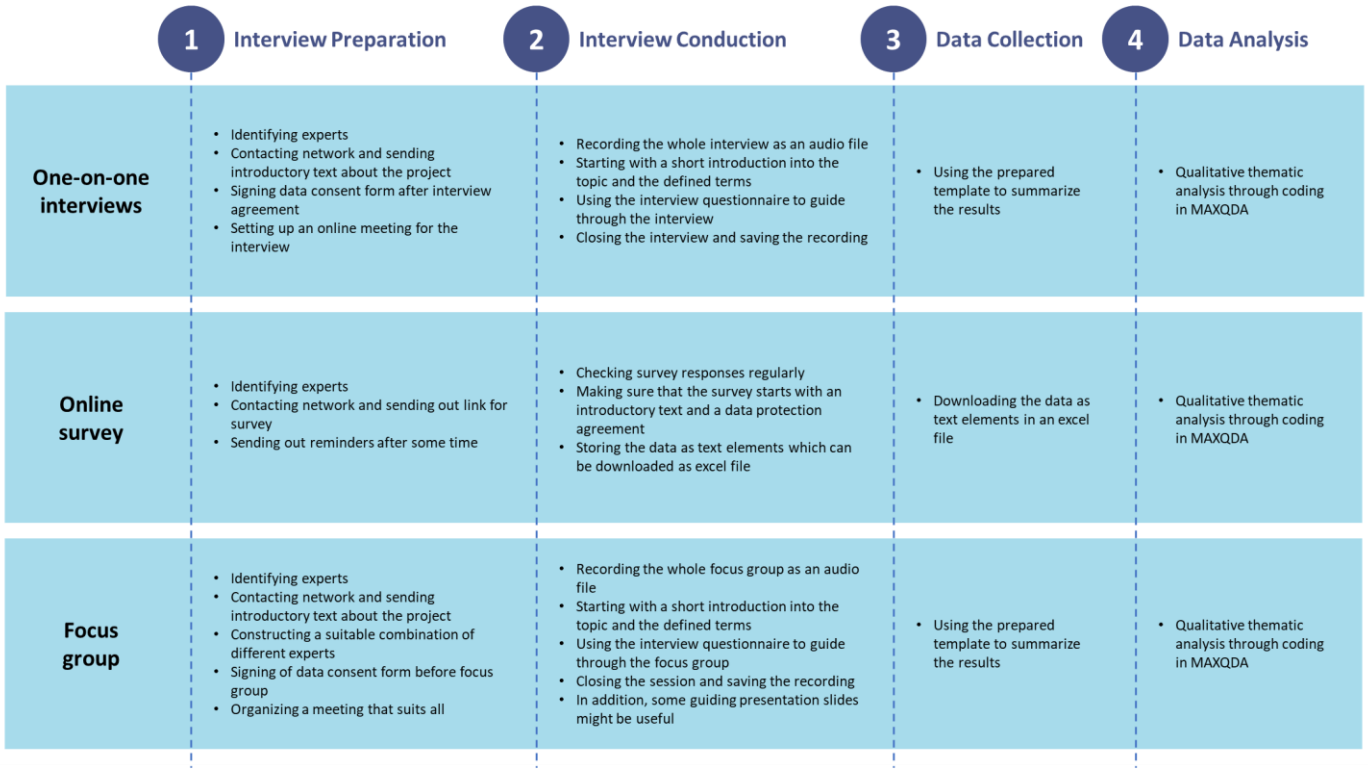


Figure 10: Research process

Methodological approach

After having conducted the interviews or focus group or made participants complete the online survey, the data was extracted. While the online survey data could be downloaded in an excel format, the interviews and focus groups had to be summarized according to the interview summary template.

In a first step, before going into the qualitative analysis, some prior descriptive statistics were built to give some indications about the interviewees' background, expertise, and connection to innovation processes. While the main aim was to check whether the requirements according to the proposal were met, we also wanted to get an overview of the interviewees' specific expertise to better interpret the data. As the main requirement was to interview at least 24 experts with relevant qualifications, we followed some pre-set criteria as outlined in Table 7. Thus, we checked for their type of organization, position inside the organization, and outlined activities connected to innovation management. These are described in chapter 7.1. Another important metric was the title of the courses taught by the interviewees. These have been categorized according to the criteria of managerial, technical, or societal focus as outlined in Table 9.

Furthermore, a quantitative comparison of some key characteristics of the taught innovation process courses such as

size, level, learning objectives and outcomes, teaching practices, and used theories in relation to the course category – managerial, technical or societal perspective – was done. The key results are highlighted in chapter 7.5 in Table 10
After that, all interviews and survey results were analyzed with the qualitative data analysis software MAXQDA. Overall, a thematic analysis was done to identify key themes or patterns from the data set for further exploration and to enrich and test existing theories in terms of innovation processes in the practical setting. As such a mainly inductive approach was taken to identify key patterns within the fields of innovation teaching, digital innovation, and service innovation. In contrast to this, a deductive approach was taken for the analysis of the innovation process part to compare the interview insights with the previously constructed preliminary digital innovation process for services (Saunders, Lewis, & Thornhill, 2016).
Consequently, a priori codes were set for the overall topics of TEACHING, SERVICE INNOVATION, DIGITAL INNOVATION, and INNOVATION PROCESS. Furthermore, a foundational innovation process was provided as reference for the interview participants, thus, these process steps were also added as a priori codes underneath the topic INNOVATION PROCESS to highlight the theoretical foundation (see Figure 11). In the first coding step, an open coding approach was chosen within the different topics. As such, different insights were derived which were constantly revisited to identify underlying themes in a next step. In the end, this process led to the following code tree as visualized in Figure 12. Based on this coding scheme, key findings shall be highlight for each topic in the next chapter.

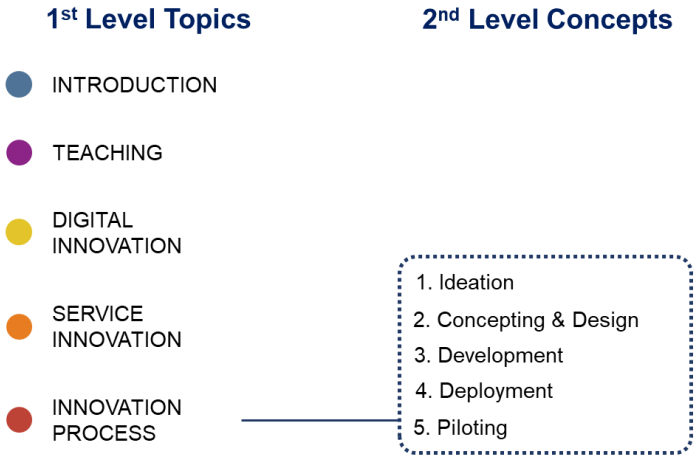


Figure 11: Initial coding scheme

In the first coding step, an open coding approach was chosen within the different topics. As such, different insights were derived which were constantly revisited to identify underlying themes in a next step. In the end, this process led to a four-level code tree. While the first two levels, as depicted in Figure 12, visualize the first level and second level topics, level three and four represent underlying, more detailed insights and themes. An example of third and fourth level codes are presented in Figure 13. These codes follow an in vivo coding procedure to focus on the detailed insights in the respective sub-topics. These will be further discussed in the next chapter. The whole coding scheme can be found in the appendix.

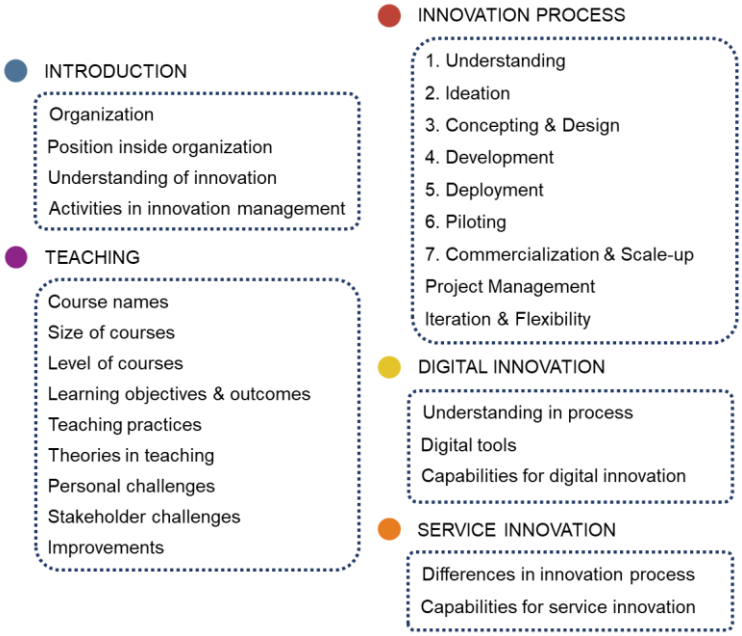


Figure 12: Final coding scheme on level one and level two of coding

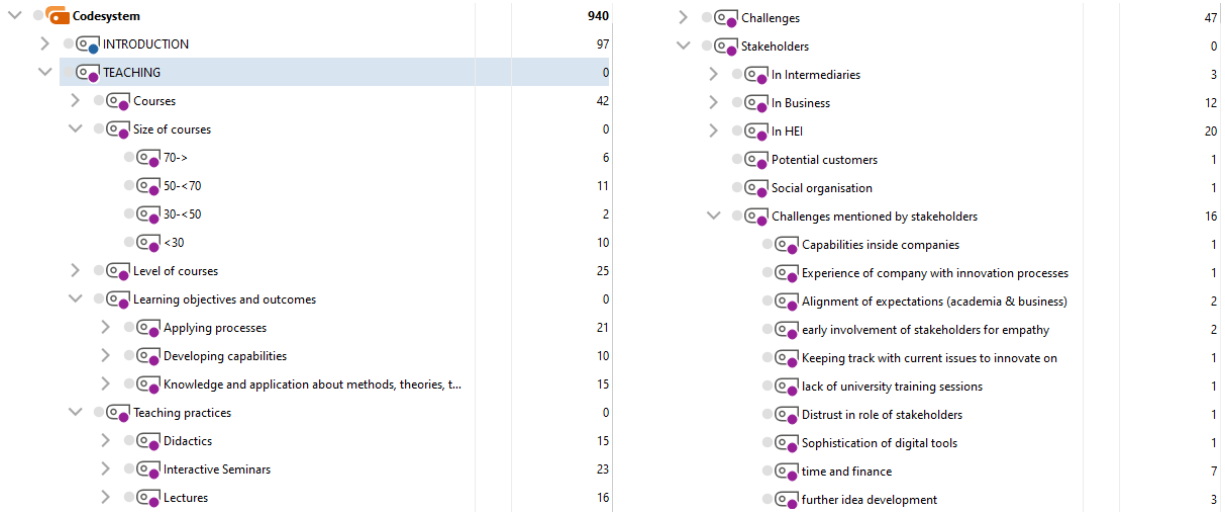


Figure 13: Exemplary screenshot of 1st to 4th level coding

Section 7

Key Findings of Expert Interviews

7. Key Findings of Expert Interviews

Following the coding structure outlined above, we will highlight the key findings of the expert interviews. Starting with a short introduction to the experts' backgrounds and their relation to innovation processes, this will be followed by collected insights on innovation processes. In this section, we will compare the collected insights of the interviews to the innovation process concept by Häikiö & Koivumäki (2016), before adding digital innovation and service innovation specific aspects in the next sections. Lastly, some insights on teaching practices and challenges shall be mentioned to provide first findings for the following intellectual outputs of this project.

7.1 Introduction into Expert Interviews Results

Overall, 26 expert answers were collected for the purpose of this project. Following different research strategies, 17 answers have been collected through the online survey (S01-S17). In addition, four IT experts filled in the slightly adapted questionnaire on digital tools (DS01-DS04). Furthermore, five detailed interviews were conducted via online meeting tools (I01-I05). After a first screening of the survey answers, two more detailed interviews were done with experts which reported some interesting insights in the survey (I06 and I07). To catch valuable insights in the following interview, the same responsible researcher conducted the interview building on the survey answers.

While partners from Belgium, Denmark, Ireland, Germany, the Netherlands, and Poland supported the conduction phase, the network reach yielded an even broader participant list including the countries England, Germany, Ireland, Lithuania, the Netherlands, Norway, Poland, Portugal, Spain, and Turkey. While all experts were required to be educators in HEIs, they indicated several other terms as their main position within the respective organisation[1]. As such, eight experts mainly identified themselves as lecturers or senior lecturers. Furthermore, 13 experts stated professorship as their main position including teaching. Another three experts mainly identified themselves as researchers and four as holding a position within the organisation's management. Relating to the diverse positions, further activities in connection to innovation management were indicated by the participants such as research activities, networking, execution of innovation-related projects, commercialisation of innovations, as well as building and working with digital tools. In connection to teaching, the experts indicated additional activities such as executing workshops, mentoring initiatives, and competitions, developing innovation process courses, and being consulted as external expert on innovation processes.

Transitioning to the innovation process related questions, some interviewees stated their specific perspective on innovation process understanding such as a focus on the innovation outcome to be a product, service or process, on the use of innovation methods in teaching, or on innovation as a driver for using digital tools. This reflects the wide range of innovation perspectives covered in the interviews which also show direct overlaps with the topics of digital innovation and service innovation covered in this project.

7.2 Insights on Innovation Processes

In relation to the main topic of the interviews – innovation processes – the experts were asked to indicate an optimal innovation process step by step. To provide a first reference point, the innovation process concept by Häikiö and Koivumäki (2016) was given as an exemplary process. As such, a comparison of innovation processes described by experts to the concept of Häikiö and Koivumäki appears to be a valuable analysis.

Process analysis

Overall, it can be found that two more process steps had to be added to the five steps indicated in the concept. Thus, the process starts with an initial step of *understanding* the problem. This is followed by the five steps presented in the concept – ideation, concepting and design, development, deployment, and piloting. In addition, a seventh step, commercialization and scale-up, was added. Although more process steps were described by the interview participants, not all steps were covered in the descriptions of each expert, following the definition of the steps. As such, the following insights need to be highlighted to support a better understanding of innovation processes:

[1] Participants were allowed to indicate several main positions within the organisation.

1. Innovation processes can start in different steps of the process.
2. Not all steps are covered in every innovation process.
3. Skipping steps is possible within an innovation process.
4. Innovation process can end in different steps of the process.

Keeping in mind these insights, the following Table 8 illustrates the steps described by each participant. In terms of the steps Ideation, Concept & Design, Development, Deployment, and Piloting, the definition of these steps – as outlined by Häikiö and Koivumäki – to correctly map the expert insights to the respective process step. As the steps Understanding and Commercialisation & Scale-Up were found while coding, they were not following a prescribed definition but were built iteratively. As not all participants referred to all process steps, Table 8 presents an overview of process steps which the experts mentioned in the survey or interview. It needs to be mentioned that for those experts, who filled out a survey first and were interviewed later, both – survey and interview – are analysed separately. In these cases, the relation to the respective interview or survey answer is indicated in brackets behind the interview or survey credentials. As om these cases, the interview builds on the survey answers, the survey was analysed first. Thus, for the interviews only additional insights were mapped for this expert. Consequently, the interview analysis touches upon additional or even completely different process steps.

Table 8: Comparison of innovation processes described by experts

Interview / Survey	Understan-ding	Ideation	Concept & Design	Development	Deployment	Piloting	Commerciali-sation & Scale-up
S01	x	x	x	x	x		
S02				x	x	x	
S03						x	
S04		x	x	x			
S05 (I06)		x	x	x			
S06		x	x	x	x	x	
S07		x	x				
S08 (I07)		x	x	x	x	x	x
S09		x	x	x	x		
S10			x	x			
S11				x	x		
S12		x				x	
S13		x	x	x	x	x	
S14		x	x	x	x	x	
S15	x		x	x	x		
S16		x	x	x	x	x	
S17		x	x	x	x	x	
I01	x	x		x	x		x
I02		x	x	x			
I03		x	x	x	x	x	x
I04		x	x	x	x	x	x
I05							x
I06 (S05)					x	x	
I07 (S08)		x	x	x	x	x	x

Table 8: Comparison of innovation processes described by experts

As shown in the above table, most experts followed the process depicted by Häikiö and Koivumäki (2016), while the

main reason for this insight lies in that it was given as an exemplary process which was often taken as reference. In addition, the understanding of the problem was mentioned as an initial step and the commercialization and scale-up as the final step, while the latter especially appeared in the more detailed interviews. Four experts – the IT experts - did not mention any kind of process which resulted out of the adapted interview questionnaire and their general focus on digital tools within innovation.

The step *understanding of the problem* was described as the "identification of a problem" (S13) which is concerned with the investigation and exploration of a situation, field, or current practices and empathizing with the stakeholders. It usually ends with the precise problem definition.

Next, a step of *ideation* was described as "idea creation" (I03), "idea generation" (I02), "idea development" (I04), or "idea management" (S12). While this can take different forms, it was often mentioned that it is about the contextualization of the problem to find diverse ideas. It can involve the application of creativity methods such as brainstorming or reaching out to customers or other stakeholders for inspiration, according to "open innovation paradigm" (I04). It also includes some form of idea assessment to select the most promising idea which is then further developed. According to the interviewed experts, this is an ongoing process without a clear ending point, thus, the transition into the next step is fluent considering the description of some interviewees involving "idea concepting and management" (S14).

As such, the step *concept and design* can also involve some form of ideation but on a more detailed level to construct a coherent concept behind the chosen idea. By adding to the initial idea, this step could also be labeled "idea development" (I04). Other experts describe this step more specifically as "planning of solution proposals" (S04) which highlights its more advanced stage of idea development into a coherent solution. Despite these few concept-conform insights, a wide range of descriptions was mentioned for this step, again, fluently transitioning in the later steps of prototyping.

This leads to the *development* step of the process. The development step is about the "preparation of a detailed implementation proposal" (S04) and the "development of a prototype" (S15) which is more concerned with the "service interface" (S01). Although some overlaps with the previous step can be found, it was made clear that this step is much more focused on the implementation of the solution, thus, requiring some concrete tasks to put it into practice, such as prototyping.

Moving into the *deployment* step, this includes the "testing in the market [and] validating the idea in the market" (I03). Thus, it is also called the "evaluation phase" (S15) which is about deploying the idea, evaluating responses, extracting lessons learned to improve the idea. Many experts, such as I06 and S02, stress the importance of this step to check the success of the idea prior to the piloting and to adapt it if necessary. Furthermore, this step is found to be of an iterative procedure going back and forth between development and deployment. Consequently, some experts even mention these two steps as one.

Next, the innovation process moves into the piloting step in which the final solution is implemented in the market for the first time. This is also seen as the first official "dissemination" (S12, S14) of a "market-ready version of idea" (I03). As this step was often seen as the last step in the innovation process, it was also sometimes referred to as the "commercialization" (I04) of the idea.

Nevertheless, some experts were specifically referring to a further step of *commercialization and scale-up* which is about the further growth or "up-scaling" (I05) of the solution on a long-term basis. In terms of launching the solution in the market, experts stress the importance but also the difficulty of this step which is not happening for all developed solutions.

Additional process insights

Next to the discussed process steps, experts also highlighted some general issues and characteristics of innovation processes – namely project management, flexibility, and iteration – which shall be discussed.

While most innovation-related tasks can be assigned to specific steps within the process, there are some more general tasks which shall be summarized under *project management*. As described by the experts, this aspect is concerned with "organizational issues" (I04) which can be seen as the framing of the innovation process. Furthermore, it is based on the "strategic orientation" (I04) of the project.

Despite the illustrated linearity of the innovation process steps described above, a few insights on some *flexible* elements within the process have also been highlighted. I01 and I02 specifically support the flexibility aspect by stressing the flexible nature of innovation processes. I07 adds that, although some general process steps might be outlined, not all steps have to be followed. This makes the process adaptable to the project's context and loosens its linear nature.

Adding to the flexibility insight, *iteration* is mentioned as a "key component to the innovation process" (I01) which leads to an "iterative process cycle" (I06). It is concerned with reviewing the already taken steps and improve them if necessary. As such, iteration is possible on the process level as well as in-between specific process steps.

7.3 Insights on Digital Innovation

Understanding of digital innovation

Adding to the insights on the innovation process analysis, some digital innovation characteristics shall be outlined. Firstly, experts were asked to describe their understanding of digital innovation and how digitalization might influence the innovation process. In this context, the interview participants stressed that digitalization is an important and integral part of innovation. Digitalization is described as a "catalyst or driver of innovation" (I04). It shall boost organizational and innovation programs and strategies and speed up processes. More specifically, in terms of the innovation process, it is sometimes seen as a pre-requisite or an enabler in different process steps. Interestingly, experts referred to different process steps and tasks in which digital tools might facilitate – such as for information accumulation, data collection, up-scaling and development of ideas, and simulation of scenarios. Furthermore, experts refer to the use of digital tools for reflection, prototyping and validation, and analysis and presentation. More radical opinions see digitalization as causing a "rearrangement of the whole innovation process" (S11). Overall, beneficial aspects of increased effectiveness and efficiency are often related to digitalization of the innovation process. Furthermore, it is highlighted that the integration of digital tools is concerned with the tech-human interaction. Although the tools might not be complicated to understand, a specific focus should be laid on change management and training of the project team as well as the reconsideration or new project constellations due to the new possibilities offered by digital tools.

Facilitating digital tools

More specifically, experts were further asked to explain which digital tools can be used and how they can be used in the innovation process. This yielded very diverse results as visualized in the cloud of digital tool codes in Figure 14. While a range of different tools have been mentioned by the experts, the code cloud is limited to digital tools which were mentioned at least two times. Although the diverse tools mentioned, some general insights can be extracted. The detailed tools will, later on, be used for the digital tools platform in this project.

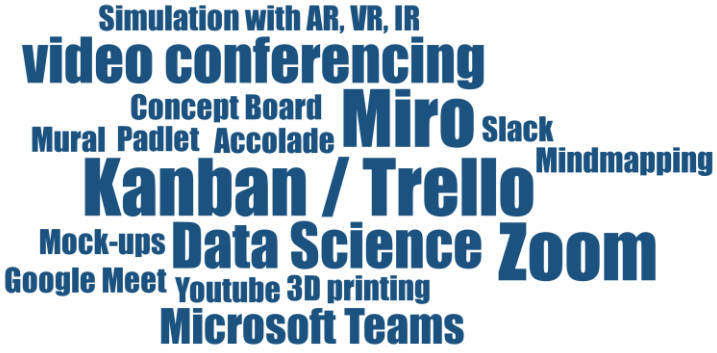


Figure 14: Identified digital tools as code cloud
(prepared with MAXQDA; minimum frequency of codes = 2)

Mostly, tools were mentioned *in relation to the first level process steps* – understanding, ideation, concept & design, development, deployment, piloting, and commercialization & scale-up. Overall, digital tools can be found useful in all steps of the process. While only some specific tools can be used throughout the whole process, most tools are more explicitly targeted to a specific step in the innovation processes, such as for ideation, concept and design, development, or implementation. Furthermore, gamification elements within digital tools can be used to facilitate the innovation process. As S07 and I07 indicate, digital tools can help "from the fuzzy front-end to the harry back-end", meaning from the blurry first steps of the innovation process to the agonizing last steps. While front-end tools are, for example, concerned with idea co-creation in a team, back-end tools might evaluate the idea post-launch.

More often, we can find tools mentioned *in relation to their functionalities*. In this context, most tools refer to communication and networking purposes such as video conferencing tools or social media. Other functionalities include project and task management (e.g. Microsoft Teams, Trello), collaboration with digital whiteboards (e.g. Miro, Mural), prototyping (e.g. mock-ups, virtual reality), information collection and analysis (e.g. Biobox, data science), surveys with stakeholders (e.g. Mentimeter), idea presentation (e.g. PowerPoint, Prezi), or document storage via cloud (e.g. Drive, Dropbox).

With regard to digital tools, it shall further be highlighted that the main focus should be laid on how to integrate the tool to use it effectively. Furthermore, it should be kept in mind that some tools appear to be too complex in functionality and too expensive for the project at-hand. Thus, further criteria for the tool mapping on the digital tools platform might be derived from these insights.

Capabilities for digital innovation

As the use of digital tools in an innovation process introduces changes to the procedure, it seems logical that specific capabilities are required to successfully go through this process. In this regard, technical capabilities appear as the major focus. Nevertheless, further capabilities such as motivation and mindset, process management capabilities, interaction capabilities, and data management capabilities are also needed. In addition, some experts mention capability frameworks as reference points such as key enterprise capabilities surrounding entrepreneurial thinking and acting and specific frameworks considering digital capabilities (e.g. JISC Digital Capabilities). Although these concepts seem to be of relevance, the focus should be laid on the specifically mentioned single capabilities.

In this regard, *technical capabilities* have been extensively described. Although basic technical skills might be required, this also involves knowledge about how to use and apply the digital tools in a specific context. With regard to *motivation and mindset*, innovators are required to have good analytical thinking skills, show motivation and willingness to use digital tools in the process, express creative thinking abilities and openness to new tools, and stay flexible in the process. Furthermore, *process management capabilities* include teamwork, leadership, and moderation skills within the process as well as assertiveness to break down prejudices, understanding the difference of digitally enabled innovation processes and seeing the greater concepts behind the tools to master the digital innovation process. Additionally, *interaction capabilities* are needed to communicate successfully, stay human-centered surrounded by technologies, and be able to understand dynamics of online communities. Lastly, in terms of *data management*, innovators are asked to have an awareness for the competitive character of knowledge management and keep in line with data management and safety regulations as well as governance policies.

7.4 Insights on Service Innovation

Understanding of service innovation

After having gained some insights on digital innovation, we want to look deeper into service innovation from different perspectives. First, experts were asked to state their understanding and perception of service innovation, to identify process-specific characteristics. Interestingly, interview participants reported no major difference in innovation processes leading to service offerings. But, despite this first impression, certain differences were identified.

Before looking into the process and output perspective, light should be shed on the core of services – "*customer-centricity*" (I03). This means there is a need for "more knowledge about the target group" (DS03) to develop customer-

oriented service offerings. Therefore, customer data or potential users shall be directly involved in the early stages as well as later stages of the innovation process. The interaction with customers is regarded as essential to develop a successful service offering, while it also complexifies the innovation process and measuring the innovation outcome. Nevertheless, focusing on the people side is at the center of innovation, while "co-creation" (I01) or "co-design" (S15) might involve more people than just customers. As such, tasks of resource collection and networking are important responsibilities for the innovation process to offer participation of stakeholders.

This new focus is also reflected in the *process perspective*. A major role is given to empathy to identify customer needs, while prototyping seems to be of less importance as services do not have physical but more variable process aspects at its center. Overall, service innovation processes appear to be "shorter and not linear" (I04), "faster" (S03) with "quick decision making" (DS03), "easier" (S05) in terms of prototyping, and "more agile making iteration necessary" (I04). As later steps involving prototyping are of less importance, validating steps shall be done earlier to involve customers' feedback.

From an output perspective, service innovation does not only observe the overall output to be a service offering instead of a product, but it is more specifically concerned with the different types of services, such as "internal servicing of other departments or business functions" (S01) and external services targeting different types of customers. Furthermore, certain processes or methods can also be considered as services. In this context, the same steps and data used in the innovation process might lead to different outputs. To manage the different outputs, service innovation is considered to be part of service portfolio management.

Capabilities for service innovation

Considering capabilities for service innovation, rather similar capabilities to those for digital innovation can be observed. As service innovation takes a focus on customer data and needs, a certain level of *technical skills* is also regarded necessary in this context to use novel technologies for the purposes of better customer understanding. Furthermore, a general *understanding for service characteristics* as well as being able to empathize with customers and manage the interaction with other stakeholders are considered as valuable capabilities. Next to this, certain skills connected to the *understanding, application, and management of the process* need to be considered. These involve more specifically analytical, creativity, and critical problem-solving skills as well as teamwork, lean and agile management, intellectual property (IP) knowledge. It also includes the capability to translate insights into outputs, to be able to simplify the process, and to understand models applied in it. Additionally, it involves more general *enterprise, network development, and regional development capabilities* as well as a generally *open mindset* of innovators.

7.5 Insights on Teaching Practices and Challenges

Innovation process courses and teaching practices

While the outlined capabilities for digital innovation and service innovation as well as the insights on the innovation process in general facilitate the construction of an up to date HE course on digital innovation process for services, the current teaching practices and challenges shall also be analysed. Therefore, some key characteristics of innovation process courses such as name, size, level, learning objectives and outcomes, teaching practices, and used theories shall be regarded. Furthermore, some challenges of educators as well as stakeholders shall be observed.

In terms of innovation process courses, a range of different course names and resulting foci can be identified. The range of identified courses is displayed in Table 9. Next to regular courses, some study programs and massive open online courses (MOOCs) were also found. Most experts indicated teaching courses in the field of management, some with a technical focus, and only a few with a societal perspective. Nevertheless, these three fields fit to the previously identified main relevant fields of teaching and research concerning innovation processes, digital innovation, and service innovation. Most courses taught by the interviewed experts are on a Bachelor level and only a few on a Master or even Doctoral level. Furthermore, it was found that courses tend to be of a medium size with 50 up to 70 students or of a small size with less than 30 students. Some few courses were taught with over 70 students.

Table 9: Categorization of identified courses

Managerial Focus	Business Planning	Innovation Financing
	Commercialization	Innovation in the Enterprise
	Creativity and Innovation	Innovation Management
	Digital Business	Intellectual Property Rights
	Digital Innovation with Design Thinking	Lifelong Learning
	E-Commerce and Logistics	Marketing and Management
	Entrepreneurship	Organization and Information Management
	Innovative and Digital Business Models	Project Management
	Innovation and Change Management	SME Innovation
	Innovation Design	Start-up Development
	Management and Organization of Technological Innovation	
	Digital Business and Innovation Management (Study Program)	
Technical Focus	Business Information Systems	Innovation Labs
	Business Intelligence	Live Analytics
	Data Science	Technology and Innovation Management
	Energy and Innovation	Technology Transfer
	Researching and Reflecting on Technology-Enhanced Learning	
Societal Focus	Innovation in Safety and Health	Sustainable Innovation

Table 9: Categorization of identified courses

With regard to the course size, specific teaching practices were also selected. While larger courses tend to be held in a lecture style, smaller courses are taking place in an interactive seminar format. Furthermore, different teaching materials and means could be found such as the use of graphics and films, handbooks, case studies and assignments as well as group work with an international group of students and the use of gamification elements. In terms of learning objectives and outcomes, these followed three different fields – developing knowledge about theories, methods, and techniques surrounding innovation processes, applying the innovation process or parts of it, or developing specific capabilities in students such as the before mentioned technical skills or creative and open-minded thinking. To achieve these objectives, HE lecturers make use of a range of innovation theories and models which are taught with a project- or problem-based learning approach or an active- and experience-based learning approach. Most identified theories and models such as Design Thinking and Stage-Gate Model have already been included in the literature review of this project. Some educators use more university-specific models or well-known theories which are not following a process approach; thus, they have been excluded from the project-specific literature review but are added in the appendix for review. Some few experts also indicated that they do not follow a specific theoretical approach but leave it up to the students or use specific practical methods and tools instead.

Next to these qualitative results, we set these key elements into relation to the identified course categories – managerial, technical, and societal perspectives – to identify typical teaching styles. Thus, Table 10 shall summarize the key findings in terms of course size, level, learning objectives, teaching practices, used theories, and relation to other course categories.

Table 10: Key elements of teaching styles in innovation-related courses

Key Element	Managerial perspective courses	Technical perspective courses	Societal perspective courses
Size (number of students in one course)	Mostly <30 or 50-<70; few with 30-<50 and 70 or more	Mostly <30 and 50-<70	Mostly larger courses with 50 or more
Level	Mostly bachelor followed by master courses	Mostly bachelor followed by master courses; only one post-graduate course	Mostly advanced level such as post-graduate courses

Learning objectives	• Applying the innovation process • Developing wider knowledge and apply methods, theories, and techniques • Some, specifically about developing student skills	• Applying the innovation process • Developing wider knowledge and apply methods, theories, and techniques	• Applying the innovation process
Practices	Almost even distribution of interactive seminars and lectures; especially, use of didactics such as case studies, group work, and gamification elements	More lectures than interactive seminars; especially, use of didactics such as handbooks, case studies, and group work	More courses are taught as interactive seminars than as lectures; no specific didactics could be identified
Used theories	• Mostly use of well-known innovation process theories • Only rarely use of field- or organisation-specific theories as well as diverse techniques and methods	• Mostly use of organisation- or IT-specific theories • Only rarely use of well-known theories such as the Innovation Matrix by Pfeiffer	• Use of field- or region-specific theories • Also use of a pragmatic approach focused on tools and techniques
Connection to	Major relations to technical courses	Major relations to managerial courses	Some relations to managerial courses

Table 10: Key elements of teaching styles in innovation-related courses

As the table shows, we could analyze more complex results for the managerial and technical perspective as the societal perspective was restricted to only two course cases. Nevertheless, we could see a very clear connection between managerial and technical courses which can especially be seen in the course level and teaching practices as well as learning objectives.

Overall, *managerial courses* can be found on a bachelor as well as master level offering a range of course sizes from smaller seminars to large lectures with over 70 students. In terms of learning objectives, students are expected to learn, first and for most, how to apply an innovation as well as to gain a wider knowledge and apply methods, theories, and techniques. Furthermore, some courses were specifically targeting students' skill development. Therefore, most courses were taught in an interactive seminar style or lecture format. Often, lecturers made use of case studies, group work, and gamification elements in their courses. Connected to the learning objectives, we could identify a range of well-known innovation process theories which served as a foundation for these courses.

Although *technical courses* show a high relation to managerial courses, some main differences can be highlighted. These courses are found to be either of a small size (<30) or a middle size (50-<70). While most courses are on a bachelor or master level, there was also one course reported on a post-graduate level. Furthermore, technical courses show similar learning objectives but lack statements in terms of skill development. Some differences can also be found in terms of used theories. Here, we can identify more organization- or IT-specific theories and just on a limited basis well-known innovation process theories such as the innovation matrix of Pfeiffer.

Lastly, some key elements shall be derived for the *societal courses*. The two reported courses appeared to be medium to large in size with 50 or more students. Furthermore, they were found to be on a more advanced level such as in post-graduate programs. Regarding learning objectives, these courses focus on the application of innovation processes which is done in interactive seminars. In this context, some smaller connections to managerial courses can be identified.

Consequently, we find different teaching styles with specific combination of key elements. Nevertheless, the managerial perspective can be found as a central element for the two other perspectives.

Teaching challenges, stakeholder challenges, and improvement ideas

Considering the complexification outlined for service innovation and the new capabilities needed for the use of digital tools for service innovation, certain challenges in teaching are assumed. In the course of these expert interviews, a range of different course formats have been reported, thus, a similar range of challenges can be identified which might not appear in all courses but are rather situation-specific and must be kept in mind when deciding on a specific course format.

Challenges in teaching can be found on the educators' side as well as on the students' side. Although some challenges might be similar connecting both sides, most take diverse ways. While lacking technical skills are found in educators, students are missing out the right mindset in terms of motivation, inspiration, and open-mindedness to be innovative. Although educators express a need and motivation to update their current courses to optimize their teaching practices, they report a lack of time and money to update theoretical knowledge and to incorporate practical projects. Furthermore, educators express a dependency on internal political decisions in terms of their teaching practices and usage of digital tools. On the other sides, educators could identify challenges of students to develop a basic understanding for the scientific knowledge surrounding innovation processes and successfully apply it in practice. Consequently, they are lacking the connection between theoretical knowledge and practice. When it comes to project work in courses, educators mention problems in interactive, international teamwork. Especially, in terms of innovation processes, students are unable to empathize with partners, generate creative ideas, and assess them correctly. To give an overview of the identified challenges, see Table 11.

Table 11: Challenges in teaching innovation processes

Challenges of Educators	Challenges of Students

• Developing sufficient technical skills to keep up with current technologies
• Lack of time and money to update courses and learn to apply digital tools
• Being dependent on internal political decisions in terms of teaching practices and usage of digital tools
• Finding a balance between academic knowledge and incorporating practice in courses
• Need for updating knowledge about innovation processes
• Working with too large classes
• Coordinating and facilitating groupwork as a time consuming task
• Lack of digital tools to be used in the process
	• Developing a basic understanding for the scientific knowledge around innovation terms, theories, and processes
	• Identifying the connection between theoretical knowledge and practice
	• Working in (international) teams
	• Lacking a client focus if external partners are involved in the course as a project
	• Lacking the right mindset
	  ○ Lacking motivation and inspiration
	  ○ Unable to unlearn old habits
	  ○ Narrow-mindedness of students
	• Applying the innovation process successfully
	  ○ Lacking creativity for idea generation
	  ○ Lacking an understanding for the business case
	  ○ Lacking ability to assess innovations

Table 11: Challenges in teaching innovation processes

From another perspective, the theoretical as well as practical possibilities of innovation process teaching open up options to include internal as well as external stakeholders in the course. Overall, additional stakeholders can be identified within the HEIs as well as in the business or societal context and connected intermediaries. More specifically, university administration as well as internal and external examiners might influence the course format and the digital tools which might be involved. Furthermore, guest lecturers from academia and businesses are mentioned by many experts to be included in teaching innovation processes. Opening up teaching to the business context, there is also the possibility to involve smaller and larger companies as well as start-ups in the practical part of teaching. In addition, start-up supporters such as business angels and venture capitalists are mentioned as potential connection points. To better build up those connections, intermediaries such as innovation and entrepreneurship promotion agencies were also mentioned by the experts. Finally, potential customers of the innovated service offerings might also be consulted. Seeing the wide range of stakeholders, several challenges were uncovered. Table 12 summarizes the main challenges. According to the experts' perceptions, a lack of time and financial resources are considered the main challenges of stakeholders to successfully be involved in an innovation process. Furthermore, the expectations connected to the

innovation process course differ between educators and external stakeholders, in fact companies. Next to this, experts identified a lack of experience with innovation processes found in companies leading to insufficient capabilities to successfully handle these until commercialization of the innovation. More specifically, a lack of technical skills was expressed making it difficult to incorporate digital tools in an innovation process.

Table 12: Challenges of stakeholders connected to innovation process courses

Challenges of Stakeholders

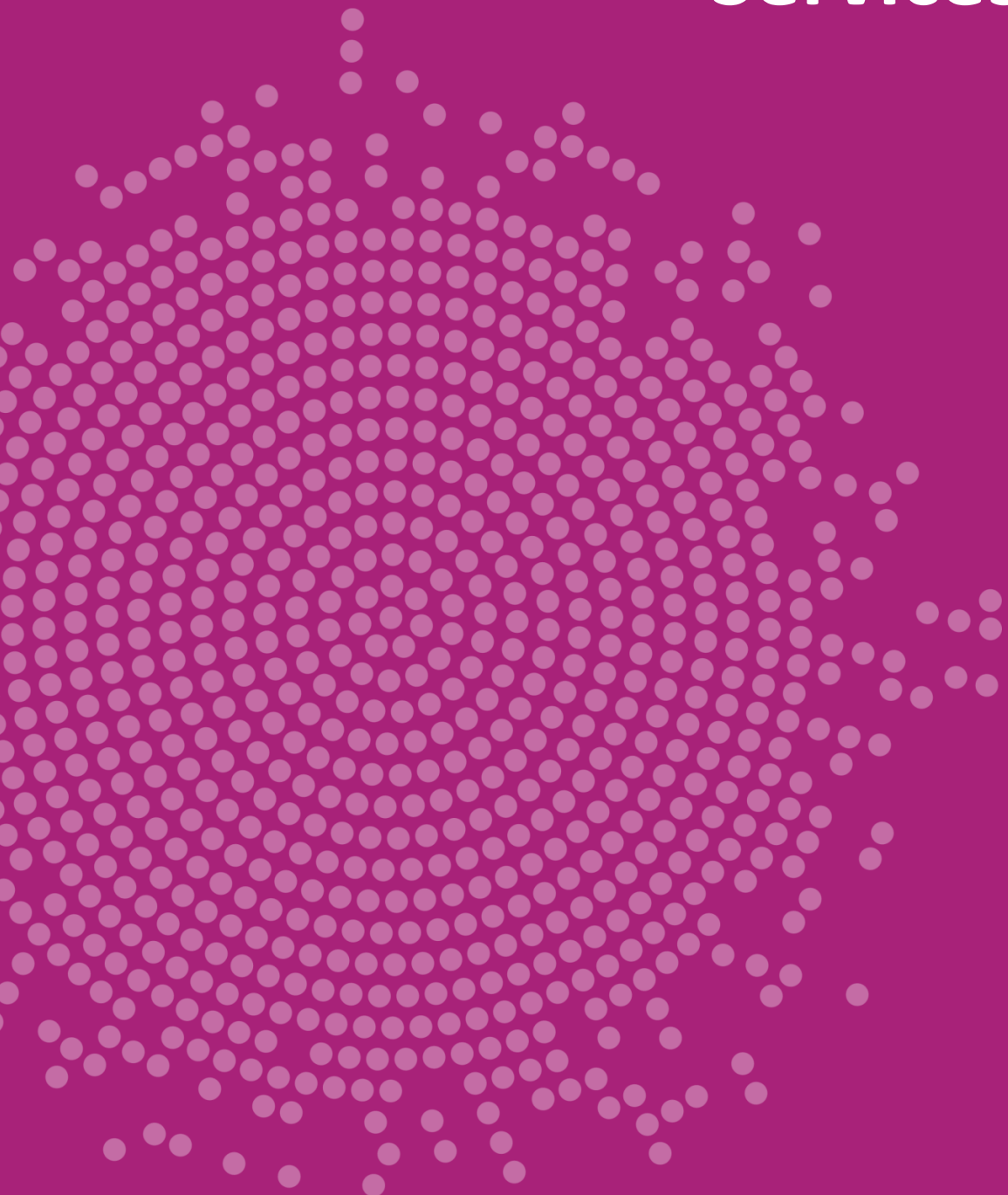
• Lack of time to go through an innovation process
• Lack of financial support to follow an innovation process or buy necessary digital tools
• Need for early involvement of stakeholders in the course to create empathy for the project; leading to distrust
• Missing alignment of expectations between academia and businesses
• Lack of experience in companies in terms of innovation processes
  ○ Problems keeping track in innovating to the current issues and difficulties with further commercialization
  ○ Lack of sufficient training to develop capabilities inside companies
• Problems handling more sophisticated digital tools

Table 12: Challenges of stakeholders connected to innovation process courses

Following the challenges, interviewees were asked to come up with potential *improvements* to manage the identified challenges. Although the improvement suggestions cannot be regarded as extensive, they might lead to useful ideas for the later stages of this project. In terms of innovation process *teaching*, ideas were diverse following the common concept of customizing the course format according to the individual situation while working in smaller groups to incorporate practical parts in the form of project-based learning. In this context, customization refers to the innovation process, to offer more specialized courses instead of teaching on a broad level and adapt the process start, steps, and ending point according to the needs. While keeping an eye on not complexifying the process, educators are encouraged to make use of digital tools in their teaching which might help to let students work more freely. With regard to the innovation process, further research and development is encouraged to update literature. Meanwhile, a more agile process is envisioned. Furthermore, experts consider teaching innovation processes at a younger age with more time for development and the opportunity for encouraging a long-term cultural change. This should be accompanied by better financing and networking to create value going beyond a single innovation process project.
While these improvements are focused on research and teaching around innovation processes, further improvements considering the innovation process *environment* shall be considered. These are mainly about communication and involvement of other stakeholders to improve the working style and output generated. Next to this, certain strategic goals should be realigned to combine business and digital goals into a coherent future vision. Lastly, training considering *digital skills* is seen as necessary, especially for educators, to enable their role as facilitator in the digital innovation process.

Section 8

Final Digital Innovation Process for Services



8. Final Digital Innovation Process for Services

Combining the insights of the literature review and the expert interviews, a final digital innovation process for services shall be constructed. Overall, this visualisation shall not make the preliminary process redundant but enrich it with specifics. Therefore, the aspects innovation process, digital innovation, and service innovation shall be addressed separately to introduce their role in the model. Furthermore, their relation to each other will be highlighted.

At the centre of the layered model is the three-level innovation process as presented in the preliminary model. To simplify the visualisation only a rough representation of the innovation process is shown. Nevertheless, it shall stand for the full three-layered innovation process as mapped earlier. Having been built on scientific literature, it also shows viability in expert interviews, thus, shall represent the basic innovation process in the final model. Furthermore, the identified insights of a flexible starting point, individual configuration or steps, and a flexible ending point shall be added. Next to that, some further characteristics shall be added around this process to stress digital and service elements.

As such, the foundation of this model is made of a digital toolbox which takes the role of facilitating the innovation process. On the basis of the expert interviews, digital tools were found to just have a supporting and facilitating role and should not be at the centre of attention. Furthermore, while digital tools were reported to function in all process steps, there are differences in usage depending on the type of tool and innovation situation. Consequently, we see digital tools as a toolbox from which tools can be picked according to certain criteria. This idea of a toolbox will later be visible in the final digital tools platform. Accordingly, the development of the toolbox and its features will be explained in the next chapter. Thus, the main attention shall stay on the innovation process, while digital tools only facilitate and enable the successful process. Although some tools could be mapped to specific tasks, this toolbox is kept rather open to make it customizable for a specific situation. Depending on the project team, context, and other requirements, digital tools can be picked from the collection. Nevertheless, it stays as an underlying level which puts the innovation process first and only takes a supporting role.

On the upper layer, there are additional service innovation highlights. As the name says, these take the role of highlighting service characteristics in the process. Therefore, the characteristics flexibility, co-creation, and customer-centricity shall be stressed. Their appearance and importance vary depending on the innovation situation, project process, and involved stakeholder.

Customer-centricity refers to the general focus on customer needs which makes empathy an important element in all process steps. Whether it is in opportunity identification to gather customer insights, in ideation and idea management to assess ideas based on customer needs, in concepting to select the right concept for the target group, in development while simulating ideas, in pilot testing and validating when testing the solution in the market, and in the launching step when officially starting the service solution and interacting with customers.

In addition, *co-creation* is strongly connected to customer-centricity. While customer-centricity takes the approach of putting the customers' interests and needs at the centre of the innovation process, co-creation refers to the active involvement of customers or other external stakeholders in the innovation process to develop and shape ideas. Co-creation is a central element of service solutions as outlined by Lusch and Nambisan (2015). As such, the customer and other stakeholders influence the quality of the service offering and should also be involved in needs identification, ideation, building and developing concepts and pilot solutions, as well as in the later testing before launch.

As a third element, *flexibility* is outlined. While the process already integrates an iterative aspect, additional highlight should be given to the flexibility and agility within the process. Accounting for the individual situation of innovation projects, flexibility shall not only stand for the customization of the innovation process but also as a support mechanism to incorporate customer-centricity and co-creation. In this context, we would like to stress three aspects – (1) iterations between different process steps (e.g. moving between process steps including going back to previous steps or skipping steps), (2) flexibility and customization in the process (e.g. staying flexible in the process to quickly adapt to situational changes and customize the process to the own needs), and (3) Adaptation of digital tools (e.g. creating and customizing templates to account for the specific innovation situation).

Together, these elements form a strong and holistic innovation process where the process steps are at the centre. Digital tools further facilitate the work of the innovation project team to implement the service-specific elements of flexibility, customer-centricity, and co-creation. Figure 15 shows a visual representation of the described model.

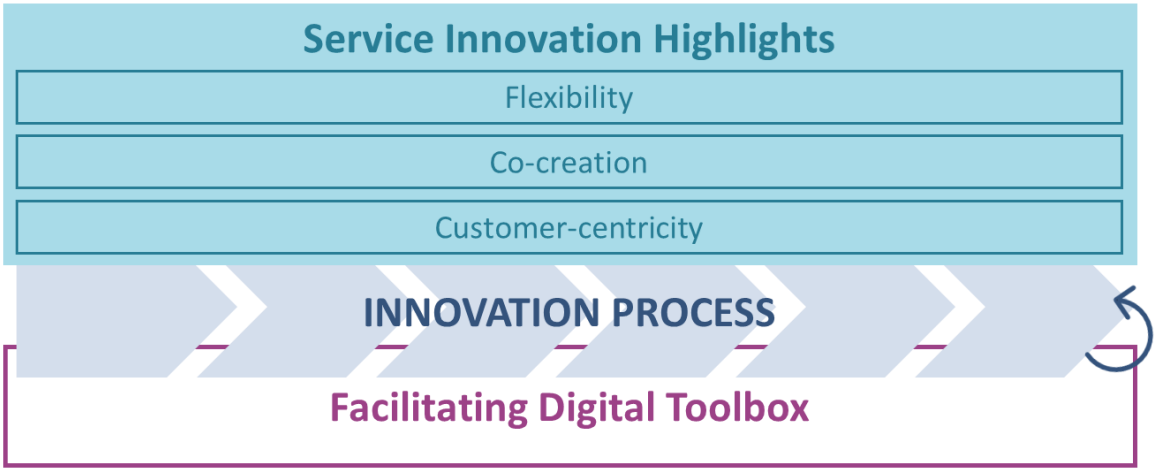


Figure 15: Final digital innovation process for services

Section 9

Digital Tools Platform and Mapping Methodology

9. Mapping of Digital Tools

The extensive literature research and the interview analysis resulted in a finalized digital innovation process for services. As the main goal of this work is to shine light on how the service innovation process can be digitally facilitated, the finalized digital innovation process for services shall now be used to map specific digital tools to the process steps. By mapping available digital tools on the market to the final innovation process, it shall be outlined which tools facilitate specific innovation activities and therefore support the innovation process. The final output shall be a crowdsourcing digital tools platform focusing on how to enhance innovation with the available tools on the market

Development of the platform

When developing the platform components, it was important to focus on the user experience and which functionalities would truly bring value to the user of the platform and why. The aim of the platform is to give a selected overview of tools and detailed information on how these tool can facilitate which innovation process steps and why. The most important feature of the platform is therefore the mapping of the digital tools. This feature will be showcased in two different ways: (1) firstly, as a mapping overview on the front page where various tools will be aligned to those of the six digital innovation process steps that they can facilitate (see Figure 16**)** , and (2) secondly, as a filter function of the available tools in a list format (see Figure 17**)**. Mock-ups were provided to the programmers in order to visualise these functions. The mapping overview shall help the user gain a quick visual comparison and summary of the digital tools and in which innovation phases they can give support. The filter function gives a more detailed comparison of tools in order to let the user choose the perfect tool for his or her needs. Additionally, the platform shall provide specific information on how the tool can facilitate and help during the innovation process. This information is based on the three levels of the digital innovation process steps for services. However, to broaden the scope of the platform, the service-specific components of the innovation process were generalised to fit a more general digital innovation process. Moreover, it was an important aspect to make the platform crowdsourced by allowing users to add a tool if a desired one has not been already added to the platform. This function shall let the platform benefit from the users knowledge. To provide this feature, a questionnaire based on the digital innovation process for services was developed which the user shall fill out when wanting to add a new tool to the platform. In order to keep the quality of the platform to a high standard, an admin shall verify the users and the tools before the desired tool may be mapped to the platform.

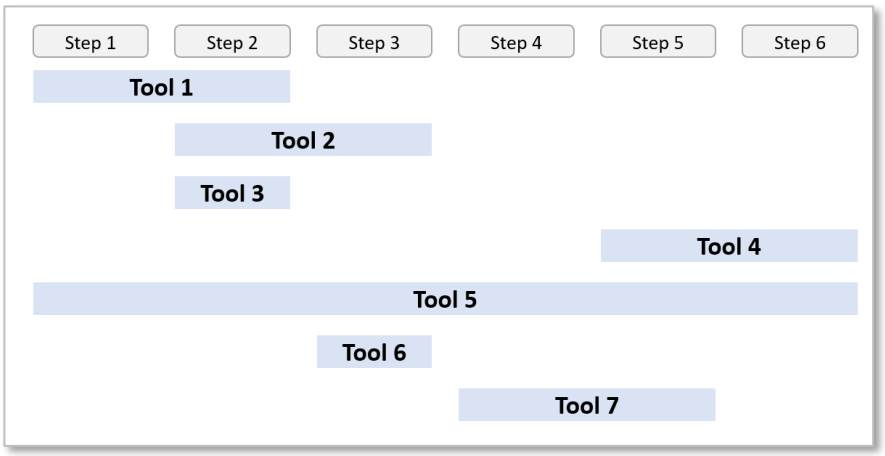


Figure 16: Mock-up design of the mapping overview (own depiction).

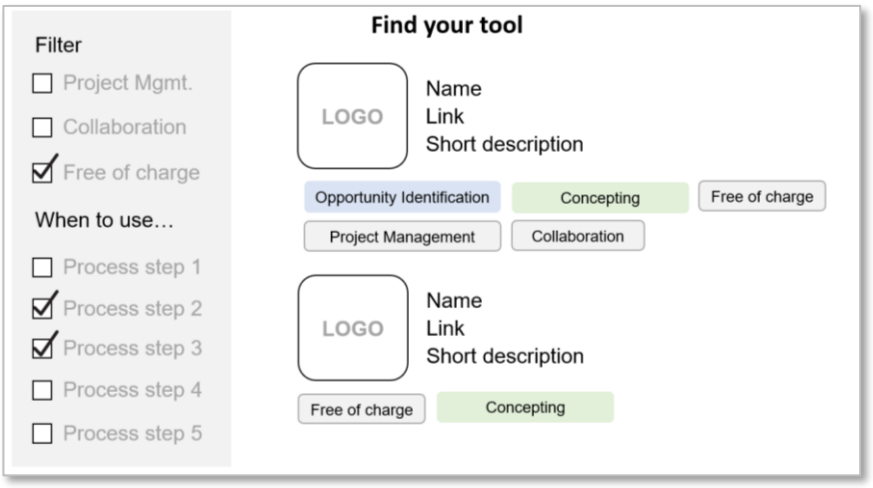


Figure 17: Mock-up design of the filter function (own depiction).

Definition of criteria for mapping

During the process of building the digital tools platform, a set of criteria were defined – as part of the mapping methodology – to map the tools on the platform. As a basis for defining these criteria, we built on the findings of this audit as presented in the literature review and the expert interview analysis. Thus, the first reference point is the final digital innovation process as presented in Figure 15.

According to the model, digital tools have a facilitating or supporting role throughout the whole process without further structure. Thus, we started with a unsorted collection of tools – the *toolbox*.

Next, in line with the model, the *innovation process steps* are considered the main criteria for mapping the tools. Therefore, we refer to the first, second, and third level process steps as displayed in Figure 9. The first level steps are considered as the main criteria which shall be offered for filtering on the platform, although the mapping of the tool will be done on the second level steps by constructing statements which can be ticked. Furthermore, the third level tasks of the process model are used in info boxes to offer a more detailed description and examples for the mapping statements, thus, offering further clarification. Figure 18 visualizes the relation between the developed digital innovation process and the selected process steps.

Figure 18: Exemplary visualization of the process step mapping methodology

In addition to the process criteria, we also like to account for the service highlights – customer-centricity, co-creation, and flexibility – as outlined in the model (Figure 15). To offer collaboration and interactivity and collaboration with customers and other stakeholders, a set of criteria regarding project management and external collaboration are mapped. Under *project management*, we separate (1) organization and work in the project to systematically plan, govern, and control internal and external resources for innovation, and (2) provision of interfaces for internal collaboration and communication to optimize content-related, complex, interactive work in the project team. In terms of *external collaboration*, the criterion refers to the provision of interfaces for collaboration and communication with external stakeholders to facilitate open innovation logic by facilitating contributions from externals, especially customers. Lastly, the highlight flexibility shall be met with the criteria under *process flexibility* which include (1) iteration between different process steps to facilitate reflecting and moving between and within process steps as well as skipping steps, (2) flexibility and customization in the process to enable customized arrangement of process steps according to the innovation project context, and (3) settings for creating and customizing templates for optimal design of process tasks.

Furthermore, some technical criteria are added which are considered as important in the selection process. These include different *pricing* options – free of charge, freemium, paid, and subscription – and *compatibility* options – desktop and / or online versions.

All mentioned criteria are presented in Figure 19.

Process Steps

Opportunity Identification
- Gathering customer insights
- Identifying opportunities or areas of opportunity
- Identifying user or customer needs

Ideation & Idea Management
- Generating ideas
- Scoping ideas
- Assessing ideas
- Prioritizing and selecting ideas

Concepting
- Generating concepts of the ideas
- Describing concept ideas
- Selecting the right concept
- Testing the concepts with users or customers

Development
- Implementing changes on the concept idea
- Experiment with and / or simulating the ideas
- Developing different components of the solution
- Preparing for the validation phase

Pilot Testing & Validating
- Installing and deploying the solutions
- Setting up a pilot solution
- Testing and validating the solution

Launch
- Launching the service

Additional Criteria

Process Flexibility
- Iteration between process steps
- Flexibility and customization in the process
- Settings for creating and customizing templates

Project Management
- Organizing and working in the project
- Interface for internal collaboration and communication

External Collaboration
- Interface for collaboration and communication with external stakeholders

Technical Criteria

Pricing
- Free
- Freemium
- Paid
- Subscription

Compatibility
- Desktop
- Online

Figure 19: Mapping criteria

Selection and mapping of digital tools

The platform shall provide a first selection of digital tools as a starting point which will be the basis for its growth through user-added tools. The first digital tools were selected from various sources: (1) the European E-learning Institute's (EUEI) *Digital Changemakers toolkit,* (2) a list of mapped digital tools provided by the Universytet Szczecinski, (3) tools that were mentioned in the expert interviews, and (4) various tools used in the Master's program "Digital Business and Innovation Management" at the Münster University of Applied Sciences. The mapping of the digital tools was based on the finalized digital innovation process for services. The second and third level of the digital

innovation process was taken as a baseline and orientation to map the digital tools to the first level of innovation process steps. The mapping process was completed in an Excel sheet following a similar mechanism as the mapping of innovation processes (see Figure 20). Overall, over 70 tools were mapped, and 28 tools were selected in particular.

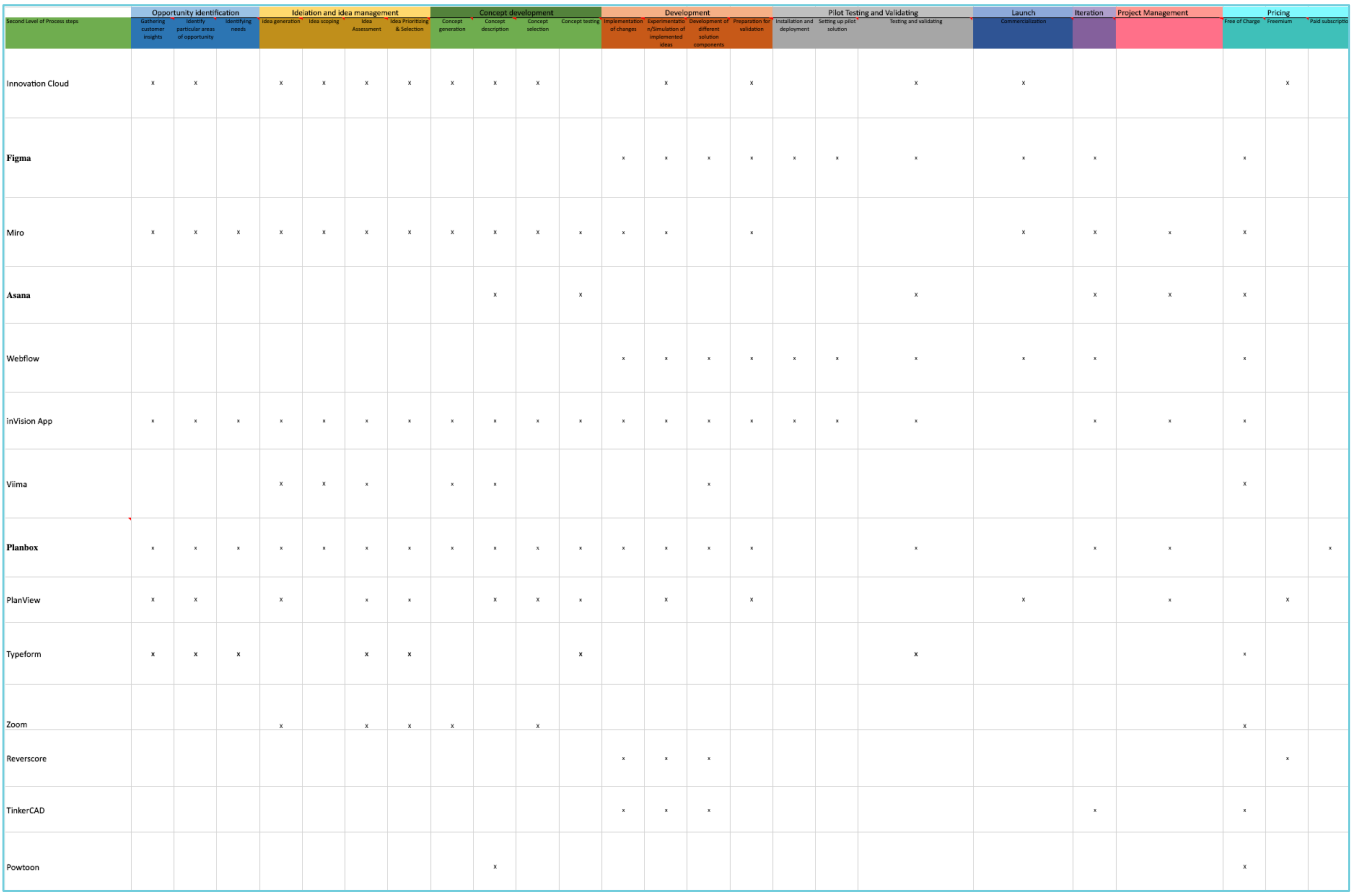


Figure 20: Extract of mapped tools in Excel (own depiction).

The final platform

The front page of the digital tools platform starts with a big header picture which shows a short introductory text about the purpose and the background of the platform. The main page continues to a general mapping overview which showcases which tools can be used during which innovation process steps. When clicking on the tool's name, the platform takes the user to the tool's profile where the user receives a short description of the tool and information about which stages of the innovation process it facilitates and how specifically so as well as information about the pricing of the tool. The overview of tools page lists all the mapped tools on the platform and allows the user to filter the desired criteria so that a more detailed comparison is given on the selected tools. This page is the most valuable feature of this platform for the users. In the following figures 21-25 screenshots of the current platform are provided. The digital tools platform concludes the first output of the project "Digital Innovation in the Service Sector".

Link to the final platform: https://scanner.innovatingdigitally.eu

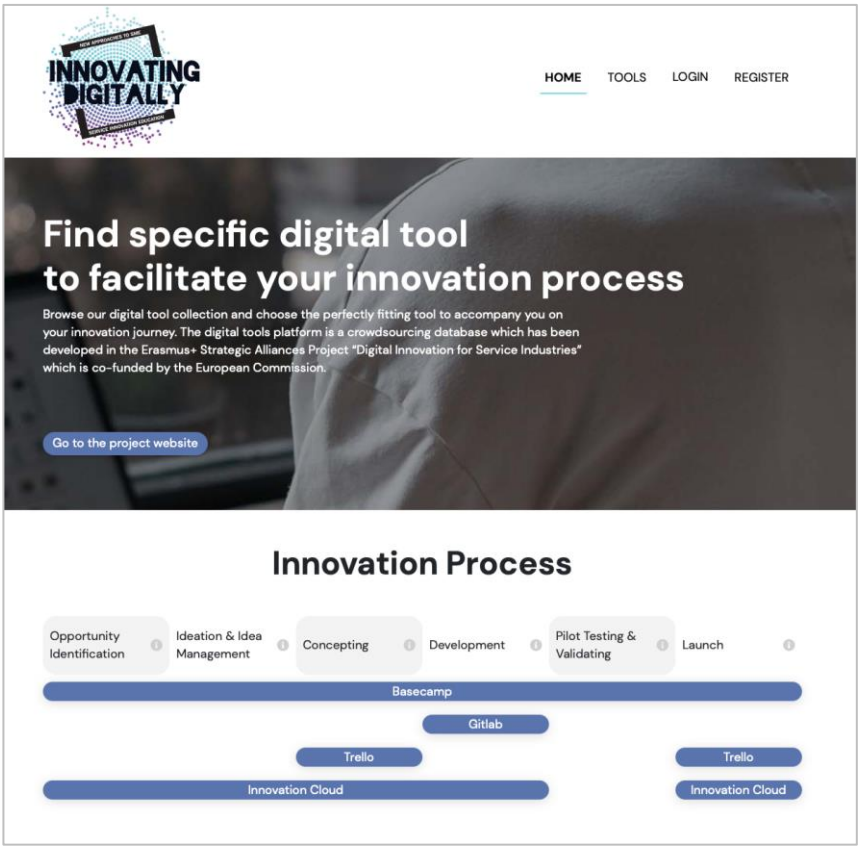


Figure 21: Front page of the digital tools platform.

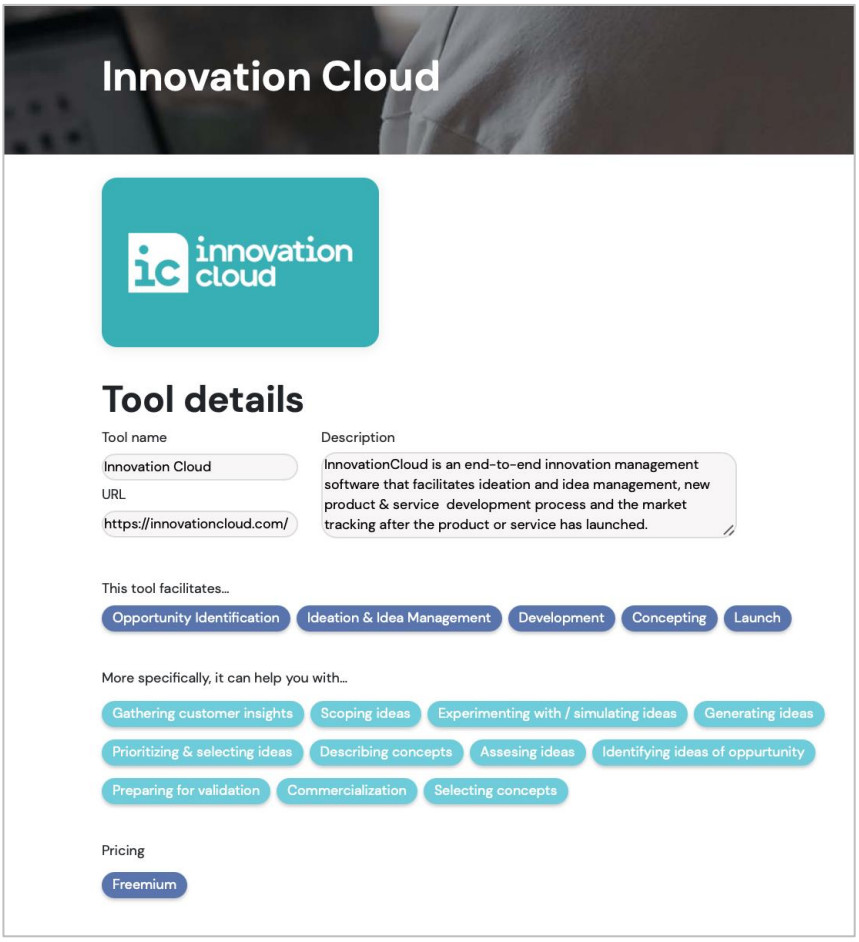


Figure 22: Example of a detailed tool profile.

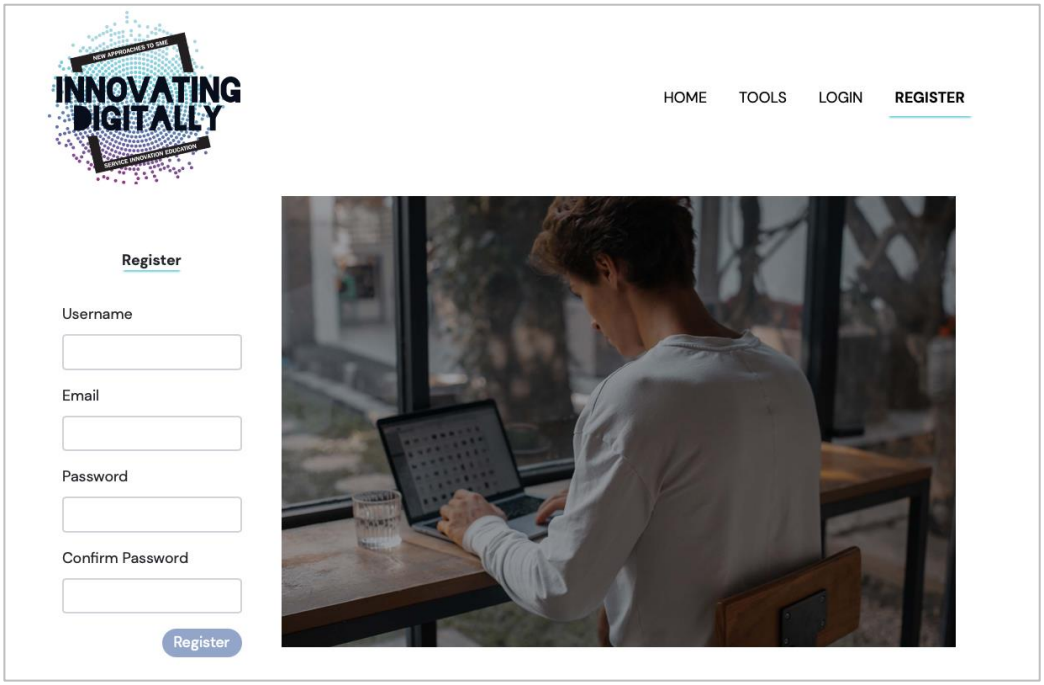


Figure 23: Register Page of the platform.

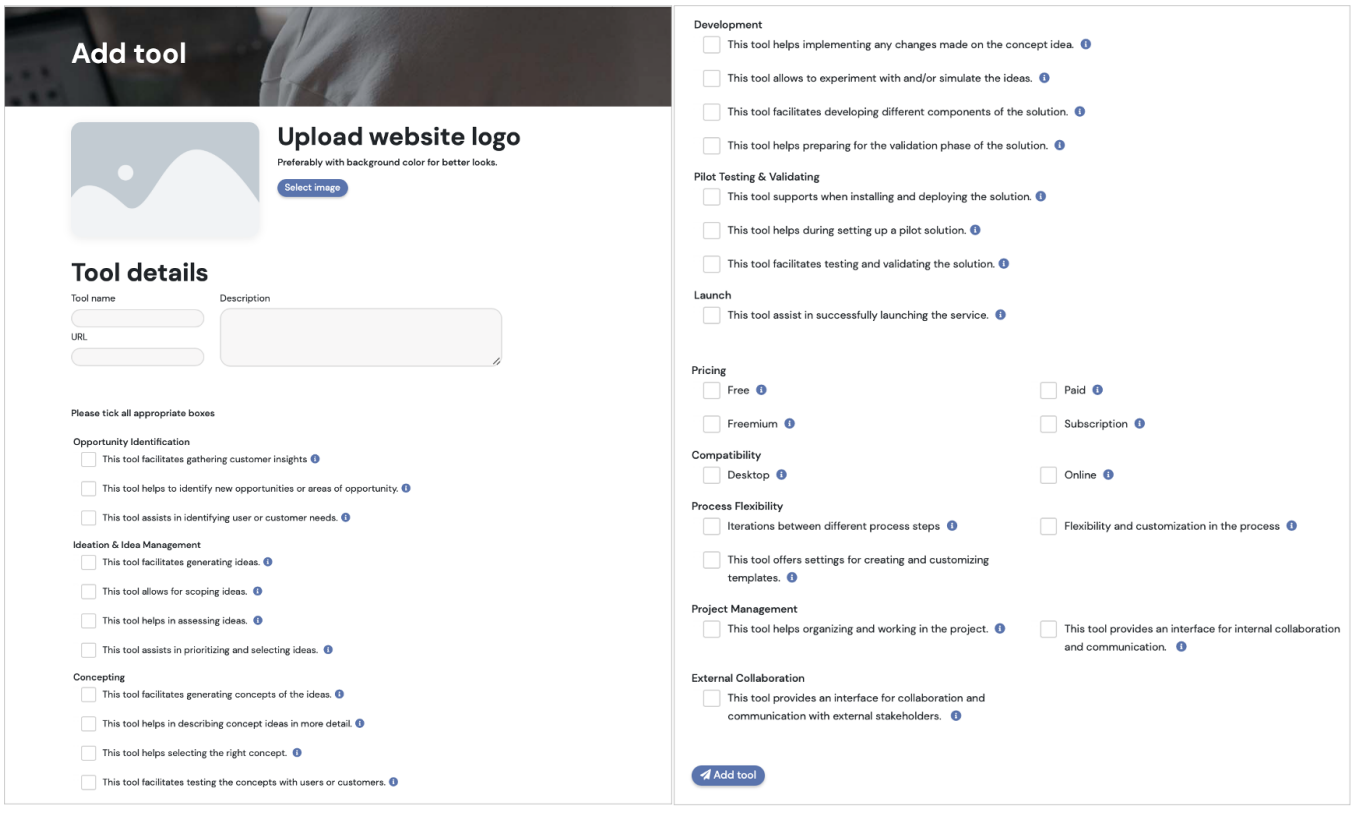


Figure 24: The necessary questionnaire in order to add a tool.

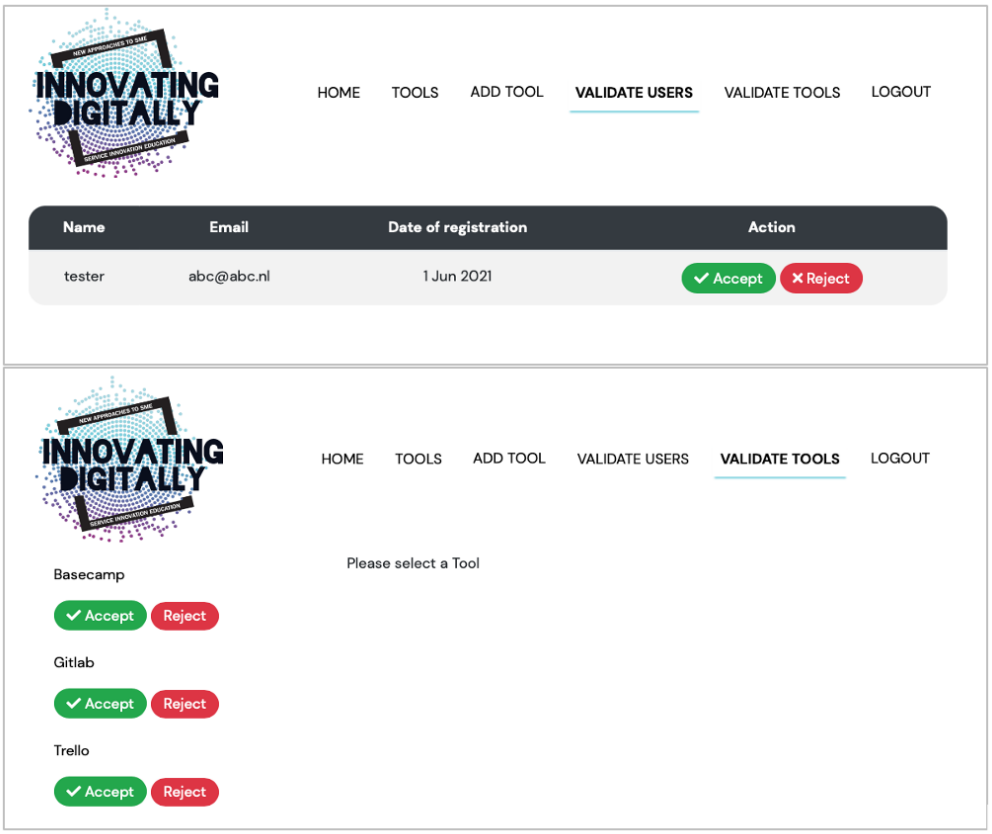
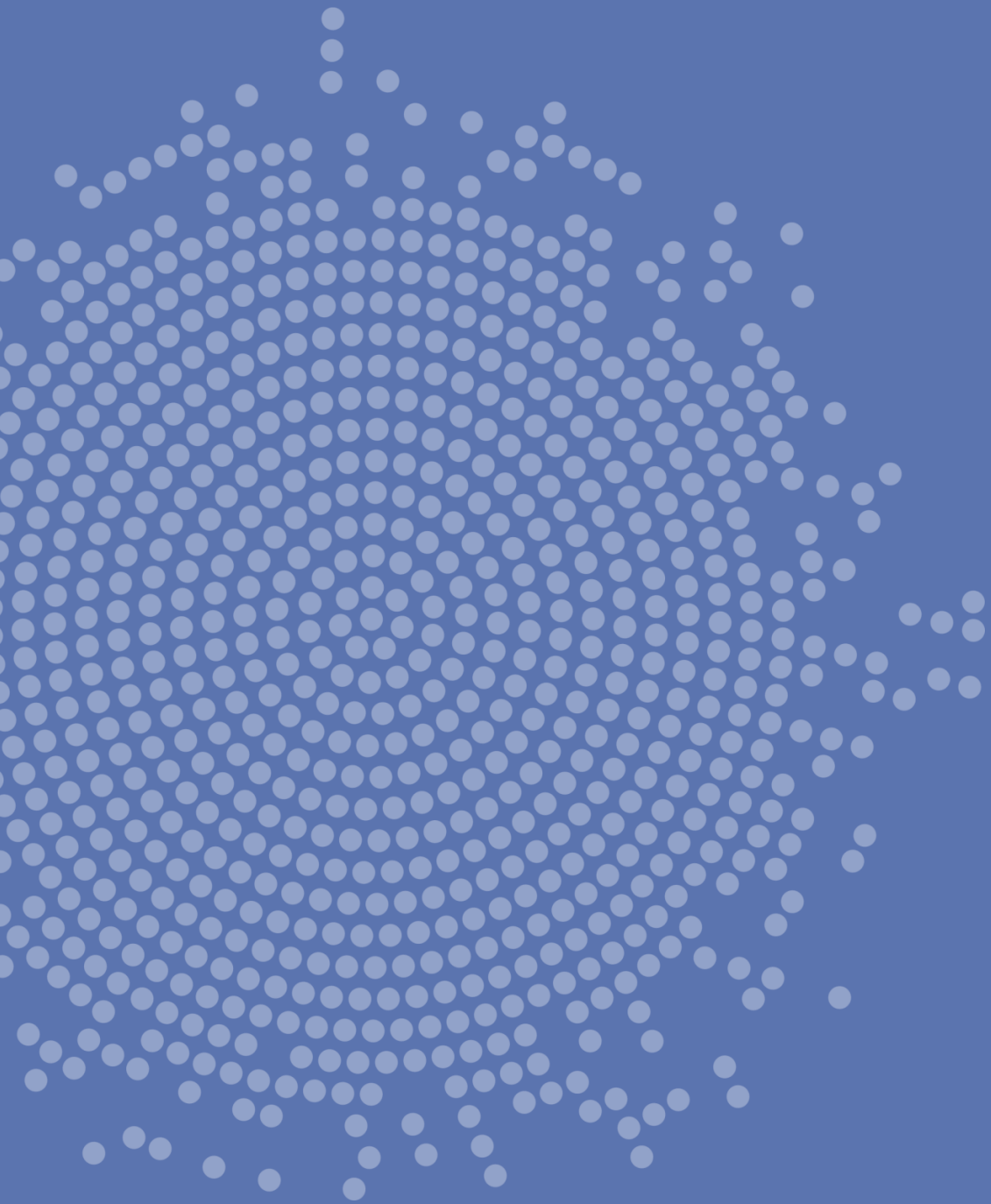


Figure 25: Admin view of validating tools and users.

Section 10

Conclusion



10. Conclusion

Seeking to develop a new understanding and a new model of service innovation processes in a digital format, through our analysis, this study makes several contributions to theory and practice.

Firstly, reviewing existing literature from a process perspective, this audit highlights the divergent discussion on linear and non-linear process models and their inclusion of iterative elements. The detailed mapping of 25 innovation process theories enables a consequent analysis of these theories to construct a digital innovation process for services. Further, this review contributes to practice in teaching future innovation experts and enabling companies to perform digital innovation for services by providing a scientifically grounded while practice-oriented process model.

Secondly, the conduction of 26 interviews and the inclusion of practical expert knowledge enriches the mapping of the innovation process as well as the understanding of digital innovation and service innovation. Thus, this audit fills the gap of providing an innovation process which highlights digital and service specifics and is easy to apply due to its practical nature. The targeted selection of relevant interviewees within the field of teaching innovation management in HE makes these expert insights valuable for the final outcome of this audit.

Thirdly, the rich results of the literature- and interview-based research are taken to practice by translating the findings into criteria for mapping digital tools and constructing a user-friendly digital tools platform which offers a selection of up-to-date digital tools and an easy filtering of these tools for the own innovation project needs. Furthermore, it allows interaction with the wider network through the collaborative nature of the platform which offers users the contribution of further digital tools. Thus, a constant updating of the platform can be maintained serving a long-term impact of the project.

Additional documents are provided in relation to the three major milestones – literature review, expert interview analysis, and digital tools platform – of the audit. This audit as well as the developed further resources shall form a basis for the next intellectual outputs – (IO2) the digital innovation benchmarking tool and (IO3) the problem-based learning open education resources.

Section 11

References

11. References

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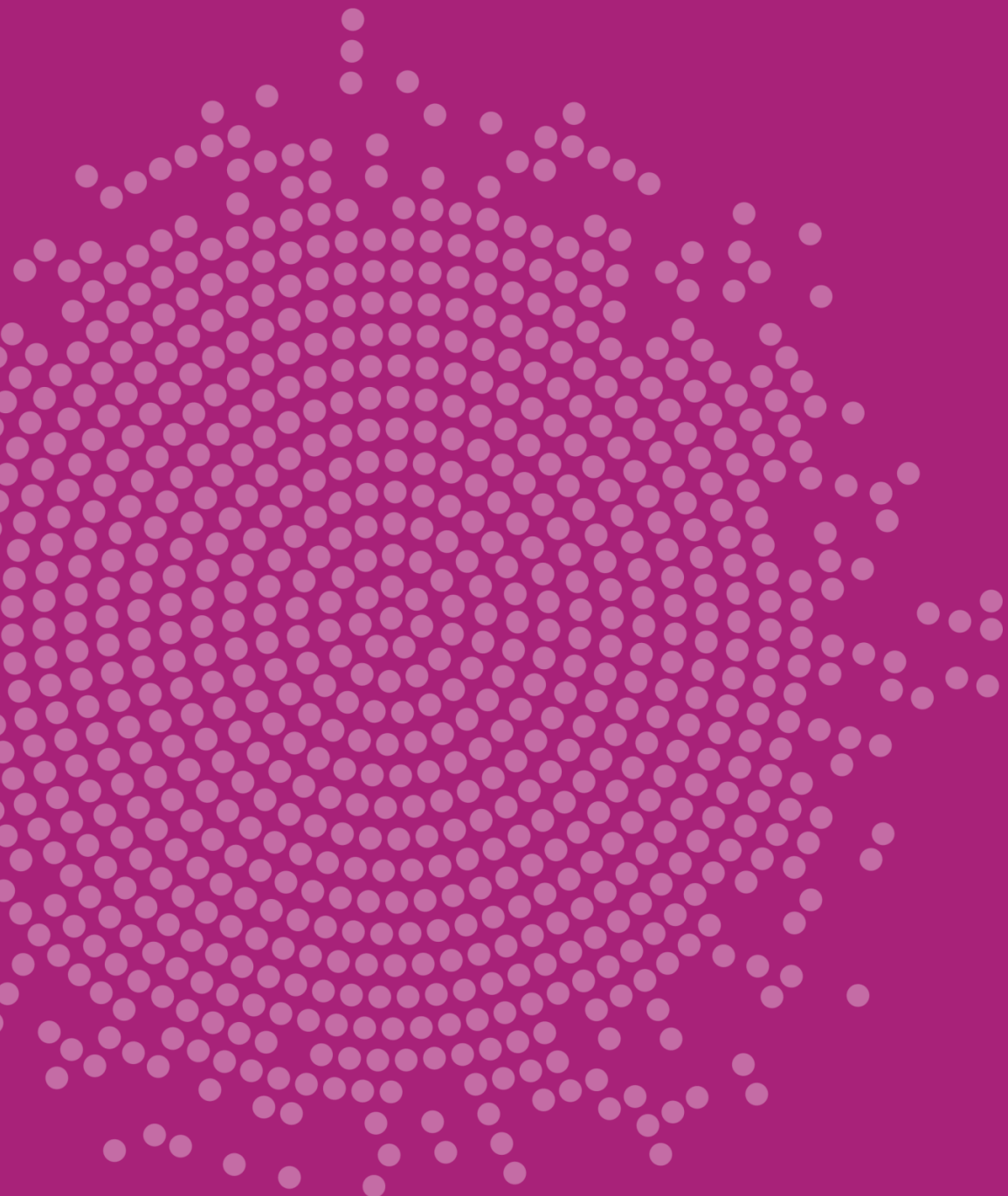
Section 12

Glossary



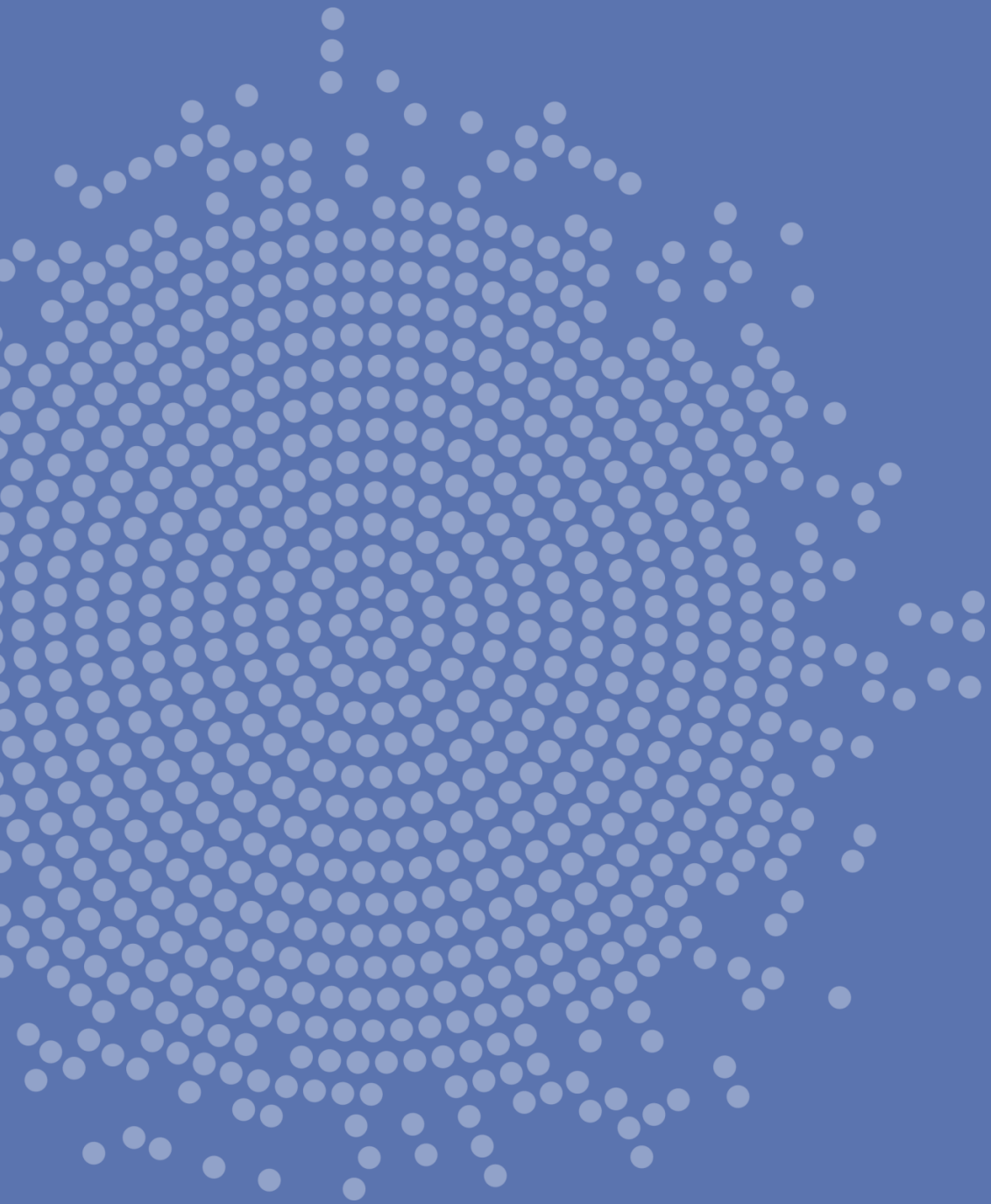
12. Glossary

To create a common understanding, key terms have been defined for the scope of this project based on scientific literature. Please, use the following definitions in the course of this audit.

Digitization	Digitization is the transformation from analog to digital data.
Digitalization	Digitalization is the application of digital technologies to society.
Digital Innovation	Digital innovation is the use of digital technology during the process of innovating.
Digital Service	A service offering based on and delivered through digital technology, e.g., an app.
Digital Innovation Process for Services	An innovation process that aims to create a service offering while using digital technology as a facilitating factor during the process of innovating. The output of this innovation process does not necessarily need to be a digital service. The term 'digital' refers specifically to the role of digital technology during the innovation process.
Innovation	Innovation is the production or adoption, assimilation, and exploitation of value-added novelty in outputs – such as products, services, and markets – which are implemented. It is both a process and an outcome.
Innovation process	Innovation process is a nonlinear cycle of divergent and convergent activities that may repeat in unpredictable ways over time. It is highly iterative and organizations may enter the process at different stages and backtrack to earlier points but engaging in innovation follows a broadly agreed life cycle.
Servitization	Servitization is the transformational process of shifting from a product-centric business model and logic to a service-centric approach.
Service Innovation	Service innovation is the rebundling of diverse resources and change of roles and composition of the actor network involved in the value creation processes.

Section 13

Appendices



13. Appendices

Appendix A – Criteria for the selection of interview candidates

Criteria and examples for identifying suitable interview candidates

Based on research about
(1) relevant research and publication fields,
(2) Teaching areas and study programmes, and
(3) exemplary courses
with the keywords **'digital innovation', 'service innovation', and 'innovation process'** the following specifics were identified to faciliate the search for suitable interview candidates:

Key Findings:
- Business Administration is by far the strongest area for innovation related courses
- followed by courses about social and environmental change
- Informatics might be helpful to consider, but needs to be considered in terms of the application of digital tools to faciliate the innovation process
- usually engineering includes a management specialisation to account for innovation related courses

(1) most significant fields of research and publication	
Technical Perspective	Technovation
	Technology
	Computer Science
	Informatics
	Information Management
	Information Systems
	Telecommunications Policy
	Technology & Engineering
	Engineering
Managerial Perspective	Business Administration
	Strategic Management
	Marketing Management
	Organisational Management
	Futures & Planning
	Management and Organisational Behaviour
	Product Innovation Management
Societal Perspective	Technology in Society
	Social and Behavioral Sciences
	Environmental Innovation and Societal Transitions
	Environmental Science
	Energy
	Social Sciences

(2) possible areas of teaching and study programmes	
Business Administration	
	Management
	Marketing
	Product Management
	Business Model Innovation
	Innovation Management
	Innovation and Entrepreneurship
Informatics / Information Technology	
	Computer Science
Engineering (different areas, mostly with a management specialisation)	
Sustainability / Responsibility	
	Social Change
	Corporate Social Innovation
	Environmental Change

(3) Exemplary courses	
Innovation: From Creativity to Entrepreneurship	These courses have been extracted from:
Strategic Management and Innovation	https://www.edx.org/learn/innovation
Creativity, innovation and transformation	https://www.udemy.com/topic/innovation/?persist_locale=&locale=en_US
Futures Thinking	https://www.coursera.org/search?query=innovation&tab=all
Corporate Entrepreneurship: Innovating within Corporations	https://www.academiccourses.com/Courses/Innovation/
Design Thinking for Innovation	
Strategic Innovation: Managing innovation initiatives	
Creative problem solving	
New Product Development	
Becoming a changemaker: Introduction to Social Innovation	
Value Creation through innovation	
Design thinking for business strategy and entrepreneurship	
Digital Business Models	
Developing Innovative Ideas for New Companies: The First Step in Entrepreneurship	
Innovation and Entrepreneurship - From Design Thinking to Funding	Possible keywords for courses
Innovating in a digital world	innovation
Managing an Agile Team	entrepreneurship
Customer-centric Innovation	innovation strategy
Driving Digital Innovation through Experimentation	Design Thinking
Innovation Strategies for Electric Mobility	Creation
Thinking & Acting like an Entrepreneur	business model
User Innovation & Entpreneurship	financing innovation
Business Model Innovation	product marketing
From Corporate Social Responsibility to Corporate Social Innovation	entrepreneurial mindset
Managing Technology & Innovation: How to deal with disruptive change	corporate innovation
The Iterative Innovation Process	creativity
Innovation: From Plan to Product	innovation management
Innovation and Creativity Management	business model innovation
Innovation Leadership	creative thinking
Introduction to Corporate Sustainability, Social Innovation and Ethics	social innovation and ethics

Appendix B – Adapted interview questionnaire for IT experts

Table 13: Adapted interview questionnaire for IT experts

Section	Guiding questions to be asked
PART I: INTRODUCTORY QUESTIONS	
1. Background of interview candidate	In which organisation do you work as an expert for digital tools? Which position do you take within the organisation?
PART II: RELATION TO DIGITAL TOOLS & INNOVATION PROCESSES	
2. Relation to digital tools and innovation processes	In which way do you come across innovation process related topics in your work? Overall, what types of digital tools do you work with? How do you work with them?
PART III: DIGITAL INNOVATION & INNOVATION PROCESSES	
3. Innovation process	How can digitalization promote an innovation process?
	Imagine an innovation process which is taught or carried out in a higher education course. You are welcome to use the exemplary innovation process underneath or refer to a different innovation process that you have already worked with. Please, describe how digitalisation can promote these steps? 
	Please, describe the influence of digitalisation on these steps in more detail.
PART IV: DIGITAL TOOLS	
4. Digital tools	Which digital tools do you regard as helpful in facilitating the innovation process? In which steps should the digital tools be applied in the innovation process? Exemplary process (if used as reference in the question above):

	
5. Specific capabilities for digital innovation	Which capabilities must be developed to successfully apply digital tools in an innovation process?
PART V: TREND - SERVICE INNOVATION	
6. Inclusion of service innovation	Imagine an innovation process which leads to the invention of a new service offering. In which way is the use of digital tools in service innovation process different from the innovation process illustrated earlier?
7. Specific capabilities for service innovation	Which capabilities must be developed to successfully apply a service innovation process faciliated by digital tools?
PART VI: CHALLENGES IN DIGITAL INNOVATION	
8. Challenges	Which challenges can you identify in implementing digital tools for facilitating innovation processes?
9. Ideas for improvement	How would you improve the innovation process or the digital tools to solve these challenges?

Table 13: Adapted interview questionnaire for IT experts

Appendix C – List of codes

List of Codes	Frequency
Code System	940
INTRODUCTION	97
Organisation	0
Turkey	1
Bogazici University	1
Spain	0
University of Alcalá	1
Lithuania	2
Vilnius Gediminas Technical University	2
England	1
Lancaster University	1
Norway	1
NTNU - Norwegian University of Science and Technology	1
Portugal	3
University of Aveiro	1
University of Minho Interface	1
University of Porto	1
Ireland	4
Lyit University	1
LIT - Limerick Institute of Technology	1
National University of Ireland Maynooth	2
Poland	3
University of Szczecin	1
University of Warszawa	1
University of Lodz	1

Germany	5
Münster University of Applied Sciences	5
The Netherlands	0
Amsterdam University of Applied Sciences	4
Vrije University Amsterdam	1
Position inside organisation	0
Management	0
Data Protection Management Commissioner	1
E-learning manager	1
Director of TTA	1
Vice-director at C&I centre	1
Lecturer	2
Lecturer	5
Senior lecturer	1
Researcher	3
Professor	13
Understanding of innovation	0
Innovation is always accompanied with business context	1
can be a product service or process	1
digitalisation can but need not be part of innovation	1
Innovation processes in teaching methods	1
Innovation process as contextual or justificational element	1
Innovation as driver of tech	1
Activities in innovation management	0
Building and working with digital tools	6
Research	3
Networking	1
Intermediary between research and business	1
Networking	2
Projects	0
Case studies	2
Participation in international projects	1
Business projects	1
Commercialisation	0
Database management for venture creation	1
IP / Patenting	1
Commercialisation of projects, business ideas, etc.	1
Teaching & Constructing courses	2
using innovation process as a framework in teaching	1
Initiatives	1
Students workshops, mentoring, competitions	3
Development of innovation process course	3
Online learning	1
Expert / Consultant on Teaching	3

Professionals' workshop	2
Lifelong Learning Centre	1
TEACHING	0
Courses	42
Societal Perspective	0
Courses_Innovation in Safety and Health	1
Courses_Sustainable Innovation	1
Technical Perspective	0
Courses_Data Science	2
Courses_Live Analytics	1
Courses Business Intelligence	1
Courses_Energy and Innovation	1
Courses_Business Information Systems	1
Courses InnovationLabs	1
Courses_Technology transfer	1
Courses_Reseraching and reflecting on Technology-enhanced Learn	2
Courses Technology and Innovation Management	1
Managerial Perspective	0
Courses_Digital Business	1
Courses Innovation Design	1
Courses_Commercialisation	1
Courses_Startup development	1
Courses Business planning	1
Courses_Innovation management	2
Courses_Marketing and Managment	1
Courses Entrepreneurship	2
Courses_Innovation and Change Management	1
Courses_Innovation Financing	1
Courses Intellectual Property Rights	1
Courses_SME Innovation	1
Courses_Innovative and Digital Business Models	1
Courses_Creativity and Innovation	1
Courses_Innovation in the enterprise	1
Courses_Lifelong learning	1
Courses_Management and Organization of Technological Innovation	1
Courses_Digital Innovation with Design Thinking	1
Courses_Project Management	2
Study Programme_Digital Business and Innovation Management	1
Courses_Creativity and Innovation	1
Courses_Organisation and Information Management	2
Courses_E-Commerce & Logistics"	1
MOOC	2
Size of courses	0
70->	6

50-<70	11
30-<50	2
<30	10
Level of courses	25
Master	7
Bachelor	14
All levels	1
Postgraduate	3
Learning objectives and outcomes	0
Applying processes	21
practical application of end-stages of innovation process	2
Evaluating innovatoin	2
Creating future start-ups / Developing their PhD topic	2
Interest in innovation processes	1
Developng ideas and prototypes	3
Analyse entrepreneurial process	3
Understanding the role of innovation processes	4
Being able to guide through an innovation process	2
Applying innovation process	2
Developing capabilities	10
Acquire practical technical skills	2
Client-based thinking	1
creative and open-minded thinking	4
Working in (international) teams	2
Reflection on the own capabilities	1
Knowledge and application about methods, theories, techniques	15
Learning research methodology	1
Basic understanding of innovation and its types	1
Understanding of a model	3
Understanding the relation betwee practice and performance	1
Knowing about the determinants of innovation in an enterprise	1
Applying theories in their professional ecology	1
Learning different methods and techniques and how to use them	3
Understanding and applying innovation theories	4
Teaching practices	54
Didactics	0
Use of graphics	1
Case studies	4
Handbooks	3
Gamification	2
group work	2
International and diverse teams	1
Films	1
Assignments	1

Interactive Seminars	23
Involvement of students automatically produce good results	1
Seminar (regular meetings, protocols, group work, discussions)	4
Practical application	10
Peer-to-peer learning & interdisciplinary approach	1
flipped classroom	1
Use of digital tools for practice in groups	2
Interactivity	1
project-based / with companies	3
Lectures	16
Examples	1
Presentation of cases	3
Informational lectures	7
State of the art literature	5
Theories in teaching	0
Included in literature review	0
Jobs-to-be-done	2
Open innovation paradigm	2
Co-creation	2
Frascati theory	1
Stage gate	8
Design Thinking	7
Trott	1
Tidd & Bessant model	1
Osterwalders Business / Value Proposition	1
Classical Process Optimization Model (Logistics)	1
Entrepreneurial journey	1
Innovation matrix by Pfeiffer	2
Bossink Innovatiemanagement	1
Nasa innovation process as relevant in EU	1
Project- or problem-based learning	1
Active and experience-based learning	1
Networked learning theories	1
Ecuational Design Research Methodology	1
Innovation Excellence Model	1
Adaptive theory	1
Business development stages	1
Jolly model	1
Digital Business and Business Intelligence	1
no theory but pragmatic approach	6
Up to students	1
Techniques and tools	3
Challenges	47
Lack of time and money	2

Political debates	3
Set-up of classes	2
Too large classes	2
Application of process	11
Lack of understanding of business process	1
Lack of applications to use in the innovation process	4
Idea creation	2
Ability to assess innovation	2
Going further than creativity	1
Facilitating the process for the students	1
Student Mindset	7
Inspiration and motivation	3
Difficult to unlearn odl habits	1
Narrow-mindedness of students	1
Motivating students	2
Academia vs. Practice	9
no client focus	2
Lack of professional experience	1
Lack of industry examples	2
Challenge to integrate different industrial areas	1
Navigating between academia and practice	2
Lack of practice partners	1
Teamwork	2
Time consuming interaction	1
Working in teams	1
Knowledge	8
Need of an update of knowledge in innovation	1
Lack of basic knowledge and market opportunities	3
Lack of knowledge about innovation processes	1
Making students aware of ethics and relevant legislation	1
Finding the right level	1
Language of literature, knowing terms	1
Technical (up-to-date) skills of teachers	3
Stakeholders	0
In Intermediaries	3
public administration bodies	1
Innovation and business support infrastructure	1
Innovation and entrepreneurship promtion agencies	1
In Business	12
Small businesses	1
Venture capitalists	1
Business angels	1
Companies	8
Start-ups	1

In HEI	20
Instructional designers	1
Internal and external examiners	1
Academic / industry guest lectures	9
Students	2
School	7
Potential customers	1
Social organisation	1
Challenges mentioned by stakeholders	16
Capabilities inside companies	1
Experience of company with innovation processes	1
Alignment of expectations (academia & business)	2
early involvement of stakeholders for empathy	2
Keeping track with current issues to innovate on	1
lack of university training sessions	1
Distrust in role of stakeholders	1
Sophistication of digital tools	1
time and finance	7
further idea development	3
Improvements	0
Developing better digital skills in teachers	2
on innovation processes in general	8
Longterm cultural change	1
Start at a younger age	1
Make process more agile	1
Research and development	1
Development of a common training	1
More funding	1
Culture of failing	1
Improve financing and networking	1
In the course	15
Challenging ideas	1
Mentors	2
More case studies for problem-based approach	1
Expanding practical knowledge	1
Smaller classes	1
Teaching about ethics and legislation	1
More training	1
Where to start	1
Making use of applications, tools	1
Offering freedom to students through controlling tools	1
Use a simple approach instead of a complex theory	1
More specific courses instead of broad	1
Flexibility and diversity in teaching	1

Lecturer should test the process before teaching	1
Improvements in the surrounding	1
Aligning business goals with digitalisation goals	1
With Stakeholders	5
Good structure of communication to share difficulties & solutio	1
Early involvement of stakeholder in the process	1
When to include which stakeholders	1
Good communication between stakeholders	1
Working together	1
no improvements needed	1
SERVICE INNOVATION	90
Differences in innovation process	47
Related to output	8
Type of service innovation	2
Driven by design	1
Not necessarily an output but a process or method	1
Service portfolio management	1
Steps and data used might be the same, different outcomes	1
Output different	2
Related to process	12
Process designed to not require initial skills	1
big role of empathy	1
less prototyping	1
Validation should be done much earlier	2
Shorter	1
Faster	2
Easier	1
more agile and iterative	2
Different focus	1
Customer Focus	17
More stakeholders included / Co-design	4
Driven by customers	9
Co-creation by customers makes the measuring more difficult	3
Focus on people	1
No difference	10
Capabilities for service innovation	0
Open mindset	2
Understanding, applying, and managing the process	13
Response	1
Analytical skills	1
Teamwork	1
Lean and agile managment	1
Creativity	2
Knowledge about IP	1

Critical problem solving	1
Translation of insights into outcomes	1
simplification	2
KISS	1
Understanding about models to apply	1
Deeper process understanding	1
Understanding services	3
Rethinking old services with practical tools	1
Understanding difference between product and service	2
Empathising with customers	15
Being able to carry out co-design	1
Empathy	6
Understanding customer journeys	1
Understanding of customer	6
Managing the interaction with customers, users	1
Regional development capabilities	1
Network development	2
Enterprise capabilities	2
Technical skills	5
DIGITAL INNOVATION	0
Understanding in process	0
Understanding the customer	2
People vs. Tech	9
Need to overcome digital illiteracy first	1
For training	1
New configurations (people, firms, etc.)	4
More about human interaction and cooperation	1
Low-tech vs. High-tech versions	1
Need for change management	1
HEI vs. business	4
Facilitating in teaching	2
more barriers for companies than for HEI	1
Often initiated by the students	1
Changing specific process steps	13
Information accumulation	2
For reflection	1
Clusters of technologies	1
Data as an important part of the innovation process	2
As programming support to facilitate the whole process	1
For up-scaling and development of ideas, not prototyping	2
Rearrangement of the whole innovation process	1
In simulation of scenarios	1
Offering better and nicer ways of analysis and presentation	1
In prototyping and validation	1

Digital products	3
Different depending on the type of innovation searched for	1
More about digi in products and less about in processes	2
Increasing effectiveness and efficiency	13
ICT applications for shortening the innovation process	1
New opportunities for improvement	8
More transparent, easier to follow and agile	1
Low-tech for effectiveness and efficiency	1
More efficiency and effectiveness	1
decreasing limits of space	1
Integral part of innovation	11
Boosting organisational and innovation programmes and strategie	2
Digitalisation as a catalyst or driver of innovation	1
Speeding up processes	2
pre-requisite for innovation process	1
Integral part in process and industries	4
Part of life / "cannot without"	1
Digital tools	0
For up-to-date literature and news used in lectures	1
Process-related	0
For Development	2
Concept and Design	2
Gamification	1
!More about people than tools	1
Fuzzy front end (brainstorming and co-creation)	2
Harry back end (post-launch evaluation	2
In every stage	6
Accolade	2
About customer insights	1
Design Thinking elements	2
For implementation	4
for ideation	2
Ideation tools	2
Brainstorming, moodboard, brainwriting, 6 thinking hats, etc.	1
Information collection and analysis	5
Biobox	1
Data Science	4
Information search tools	1
Collaborative tools	0
Digital Whiteboards	0
Mural	2
Digital boards	1
Mindmapping	2
Padlet	2

Magic walls for collaboration	1
Miro	5
Post-its as key element	1
Concept Board	2
Zoom Whiteboard	1
Collaborative tools (Google docs)	2
Features of tools	0
Thinking about how to integrate	2
Open source tools	1
tools are often too powerful, too complex or too expensive	1
Building own tools to do specific tasks	1
Communication and Networking Tools	0
Networking Tools	1
Instagram	1
Facebook	1
LinkedIn	1
Communication Tools	1
video conferencing	4
For communication and networking	2
Google Meet	2
Youtube	2
Virtual Rooms	1
Zoom	5
Microsoft Teams	3
Slack	2
Project Management	0
Project management tools	3
Kanban / Trello	5
Mastertask	1
Prototyping	1
Easier app development	1
Business Model Canvas	1
Simulation with AR, VR, IR	2
3D printing	2
Mock-ups	2
Survey tools	2
Online questionnaires	1
Mentimeter	1
Presentation Tools	1
CleII - Comics for inclusive english language learning	1
Visual tools	1
Prezi	1
Powerpoint	1
Clouds for document storage	2

Cloud services	1
Drive	1
Dropbox	1
Capabilities for digital innovation	63
Capability Frameworks	4
Key enterprise capabilities	3
JISC Digital Capabilities framework	1
Data Management	0
Awareness for competitive capability of knowledge management	1
Data management, safety, and governance	3
Interaction capabilities	1
Communication	1
Understanding dynamics of online communities	1
human-centred	1
Motivation and Mindset	14
Analytical thinking	2
Flexibility	1
Creative Thinking and openess	6
Motivation, Willingness	3
Process management	9
Leadership	1
Understanding for the difference of digital innovation activ.	1
Seeing and understanding the greater concepts	1
Teamwork	2
Mastering the innovation process	1
Moderating a process	2
Assertiveness	1
Technical Capabilities	28
Knowledge about how to use and apply	15
Stronger internet infrastructure	1
No technical capabilities needed	1
Technical	11
INNOVATION PROCESS	116
Whole process	23
0. Project management	3
0. Iteration	6
0. Flexibility	3
1. Understanding	5
2. Ideation	14
3. Concepting & Design	14
4. Development	18
5. Deployment	16
6. Piloting	10
7. Scale-up, commercialisation	4

Table 14: List of Codes

Appendix D – Theories identified in the expert interviews

Included in the literature review:

- Jobs-to-be-done
- Open innovation paradigm
- Co-creation
- Frascati theory
- Stage gate
- Design Thinking
- Trott
- Tidd & Bessant model
- Osterwalders Business / Value Proposition

Other more specific theories:

- Classical Process Optimization Model (Logistics)
- Entrepreneurial journey
- Innovation matrix by Pfeiffer
- Bossink Innovatiemanagement
- Nasa innovation process as relevant in EU
- Project- or problem-based learning
- Active and experience-based learning
- Networked learning theories
- Ecuational Design Research Methodology
- Innovation Excellence Model
- Adaptive theory
- Business development stages
- Jolly model
- Digital Business and Business Intelligence

Pragmatic approaches:

- Theories can be picked by the students
- Techniques and tools instead of theories