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Digital Innovation in Corporations: Deriving a Practical Framework for the Measurement of Success of Digital Innovation Units

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Abstract

Confronted with entirely new challenges resulting from digital technologies, established corporations increasingly set up dedicated digital innovation units (DIUs) to foster digital innovation and to explore opportunities for the digital future. Although DIUs recently face criticism with regards to their performance and impact on the core organization, literature lacks in suitable approaches to assess the success of DIUs. Therefore, we derive a practical framework for the measurement of success of DIUs in the course of this research project. We develop this framework by identifying critical success factors (CSFs) and key performance indicators (KPIs). Subsequently, we merge our results with existing literature. To determine these CSFs and KPIs, we designed an explorative, qualitative-empirical case study research approach. The research design is based on a mixed-method approach that combines semi-structured interviews as core component with a supplementary survey. Conducting nine cross-industry case studies, we identified 16 CSFs and 38 objective related KPIs. Thus, the framework derived in this thesis contributes to practice and literature by addressing the existing gap in DIU and performance measurement research.

Keywords: Digital innovation units, performance measurement, critical success factors, key performance indicators, qualitative case studies

1. Introduction

Digital technologies have been a game changer shaking up traditional approaches to innovation and posing entirely new challenges for established corporations (Fichman, Dos Santos, & Zheng, 2014; Yoo, Henfridsson, & Lyytinen, 2010). Numerous industries have been disrupted by digital innovation already (Hund, Drechsler, & Reibenspiess, 2019). Hence, organizations need to maintain existing business while exploring opportunities for the digital future (Fuchs, Barthel, Herberg, Berger, & Hess, 2019). To address these developments and to foster digital innovation, organizations increasingly build up dedicated organizational units (Holotiuk, 2020), which appear in various forms and types (Sindemann & von Buttlar, 2018). Within this study, we define DIUs as "organizational units with the overall goal to foster organizational digital transformation by performing digital innovation activities for existing and novel business areas" (Barthel, Fuchs, Birner, & Hess, 2020, p. 4).

Several studies revealed the high adoption of DIUs among corporations. A large-scale report published by the Boston Consulting Group revealed, that among 570 corporates from Germany, Austria and Switzerland, 19% had already established at least one DIU in 2018 (Brigl, Gross-Selbeck, Dehnert, F., & Steffen, 2019). While as of today, central research and development (R&D) is still perceived as most important source of innovation for corporations, DIUs are expected to replace R&D as most important innovation source in five years from now (Thompson, Bonnet, & Jaballah, 2020), showing the increasing importance of DIUs as corporate innovation vehicle.

Despite the growing interest, DIUs have been criticized recently with regards to their performance and impact on the core organization. The hype around DIUs has flattened as the expectation to transform corporations towards an agile and flexible company was oftentimes not sufficiently met (Meyer, 2020). Frequently, DIUs were established without having a clear concept in place (Kyriasoglou, 2020) and without incorporating clearly defined objectives (Raabe, Horlach, Drews, & Schirmer, 2020). Hence, DIUs might not be able to meet the high expectations of the core organizations, which is one of the reasons why some DIUs were sufficiently downsized or even shut down completely (Kyriasoglou, 2020).

Due to the increasing importance from a practical point of view, DIUs have also gained broad attention by academia

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over the last years. So far, research has covered various DIU related topics, including the innovation process for digital innovation (Fichman et al., 2014), the organizational design (Fuchs et al., 2019; Holotiuk, 2020), the typology of DIUs (Barthel et al., 2020) and objectives (Raabe, Drews, Horlach, & Schirmer, 2021). Although DIUs are facing criticism in regard to their success, related literature is rare. Hence, practitioners and scientific research increasingly ask for approaches to measure the performance of DIUs including success factors and lucid measures (Barthel et al., 2020). So far, literature covered key challenges of measuring design thinking activities at DIUs (Mayer, Haskamp, & De Paula, 2021) and derived several requirements for Performance Measurement Systems (PEMS) in DIUs (Haskamp, Lorson, de Paula, & Uebernickel, 2021).

However, research is still limited when it comes to CSFs for DIUs, which are important areas that should be addressed to be successful and to fulfill respective objectives (Bullen & Rockart, 1981). Moreover, existing literature lacks in regard to objective related KPIs that are or should be used to measure the performance of DIUs. To close this research gap, we aimed at answering the following research questions:

> RQ1: What are CSFs for DIUs to fulfill their objectives?
> RQ2: Which KPIs are or should be used by DIUs to measure their performance?

Due to the novelty of the research field, we designed an explorative, qualitative-empirical case study research approach that utilizes a mixed-method research design with semi-structured interviews as core component. To answer the research questions, we draw data resulting from nine cross-industry case studies as well as additional case related findings from a supplementary survey that is conducted to make the research project more comprehensive.

We merged the identified 16 CSFs and 38 objective related KPIs with existing literature and derived a practical framework for the measurement of success of DIUs that consists of six guiding steps and covers success related factors for DIUs. Thus, we address the existing research gap and contribute to DIU and performance measurement research. In addition, the framework sets the foundation to measure the success of DIUs in a practical way, through guiding DIU employees, responsible for success and performance measurement, in regard to establishing or improving the measurement of success of their DIU.

Initially, Chapter 2 provides a lucid introduction of the evolution of DIUs. Following, Chapter 3 sets the theoretical foundation through closely analyzing performance measurement at DIUs, including different perspective on CSFs, PEMS and the application of KPIs to measure digital innovation. In Chapter 4, an extensive introduction of the applied research design is provided. Subsequently, the results of this study are introduced in Chapter 5. Through merging the findings of this study with existing literature, the new framework for the measurement of success of DIUs is derived and presented in Chapter 6, which additionally covers insights regarding implications, limitations and future research, all being concluded in Chapter 7.

2. The evolution of DIUs

To develop a comprehensive understanding of why and how DIUs are set up by established corporations, it is essential to get an overview of specific DIU features. Therefore, we will now take a closer look at selected underlying concepts, before we subsequently show several approaches to distinguish different types of DIUs. Concluding, we will provide an overview of objectives that are pursued by DIUs.

2.1. Underlying concepts

To better understand the purpose of DIUs, we introduce digital innovation, which is oftentimes fostered by an innovation process particularly for digital innovation, which also enables, in case of its successful execution, organizational ambidexterity. In the following, these concepts are defined consecutively.

Digital innovation: Several definitions for digital innovation have emerged over the last years (Fichman et al., 2014; Nambisan, Lyytinen, Majchrzak, & Song, 2017; Yoo et al., 2010). Compared to Yoo et al. (2010), who rather take a process-based view on digital innovation, the definition provided by Fichman et al. (2014) emphasizes an outcome-based view on digital innovation. Nambisan et al. (2017) combine these views, focusing on digital innovation as process and outcome (Hund et al., 2019). We follow this definition and define digital innovation as "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al., 2017, p. 224). Moreover, digital innovation can have an internal (i.e. organizational) and external (i.e. market) orientation (Barthel et al., 2020; Kohli & Melville, 2019; Nambisan et al., 2017). Oftentimes, innovation projects involve high degrees of uncertainty (Koen et al., 2001), which can be addressed by applying a multi-stage innovation process (Fichman et al., 2014).

Innovation process for digital innovation: Similar to digital innovation itself, multiple authors have already addressed the innovation process for digital innovation (Fichman et al., 2014; Huesig & Endres, 2019; Kohli & Melville, 2019). Within this paper, we follow Fichman et al. (2014), who split up the process into four consecutive stages: discovery, development, diffusion and impact. The innovation process is applicable for product and business model innovation, as well as organizational, internally-oriented, process innovation (Fichman et al., 2014). Discovery, the first stage, aims at identifying new ideas. The key activities of this stage consist of identifying ideas for digital innovation within an organization and evaluating external ideas for development or adoption. The second stage, development, consists of developing usable digital innovations based on the previously identified and selected ideas. Depending on the type of innovation, this stage includes different activities. For product and business model innovation, the core technology as

well as added complementary services are developed. The core technology and the surrounding service together form the digital innovation. Besides, the selection of technology features and their utilization is applied for process innovation. Diffusion, the third stage, aims at disseminating the developed solution across potential users. Within this stage, the resources, necessary to give potential users access to the solution, are assigned. In addition, diffusion strives for the adoption of the solution by its users. The last stage, impact, strongly focuses on the effects of digital innovation once it is diffused. These can be twofold, improve existing costs or increase revenues. One of the activities is "managing intellectual property and the ecosystem of complementary products and services" (Fichman et al., 2014, p. 336). Moreover, impact aims at improving and adapting the solution in order to take advantage of new opportunities (Fichman et al., 2014). With digital innovation as main objective (Barthel et al., 2020; Raabe et al., 2021), DIUs oftentimes embody particular design features to enable ambidexterity of the core organization (Holotiuk, 2020).

Organizational ambidexterity: Initially introduced by Duncan (1976), organizational ambidexterity has been widely discussed by the scientific community (Birkinshaw & Gibson, 2004; Duncan, 1976; O'Reilly III & Tushman, 2013; Tushman & O'Reilly III, 1996). Organizations oftentimes face the challenge of balancing exploration (e.g. utilizing new opportunities) and exploitation (e.g. leveraging existing resources). Hence, a trade-off in regard to assigning existing resources accordingly arises (March, 1991). Whereas multiple types of ambidexterity exist, structural and contextual ambidexterity are seen as most common (Holotiuk, 2020). Structural ambidexterity describes the need for dual structures within organizations in order to manage innovation appropriately (Duncan, 1976). Contextual ambidexterity is defined as "the capacity to simultaneously achieve alignment and adaptability at a business-unit level" (Gibson & Birkinshaw, 2004, p. 209), allowing employees to individually allocate their resources (e.g. time) to exploration and exploitation operations based on particularly established systems and processes (Duncan, 1976; Gibson & Birkinshaw, 2004; Tushman & O'Reilly III, 1996).

As established organizational designs seem to address the potential and challenges that come along with digital innovation insufficiently (Nambisan et al., 2017; Yoo et al., 2010), organizations increasingly set up dedicated DIUs (Holotiuk et al., 2020; Sindemann & von Buttlar, 2020). DIUs occur in various forms and types and help established organization to foster organizational ambidexterity (Holotiuk, 2020).

2.2. Typology of DIUs

Although DIUs have been widely adopted by established organizations, the research field is still novel from a scientific point of view (Barthel et al., 2020). Hence, taking a practical perspective first, before considering existing literature seems to be an effective approach to fully grasp existing definitions of DIU types. Concluding, several ideal types of DIUs that allow distinguishing DIUs dependent on specific criteria are introduced.

2.2.1. Practical perspective on DIU types

Although various relevant approaches of practitioners to characterize DIUs exist, they lack in consistency and have not been derived in accordance with scientific research guidelines.

Over the last years, several practitioners (e.g. consultancies), have developed multiple approaches to characterize different types of DIUs (etventure, 2021; Ramus & Velten, 2016; Sindemann & von Buttlar, 2017, 2018, 2020). Ramus and Velten (2016) differentiate between four DIU types. Whereas innovation labs and company builder focus on new ideas and startups, accelerators and incubators mainly aim at existing ideas and startups. Similar, Sindemann and von Buttlar (2017) differentiate between innovation labs, accelerators and incubators. Innovation labs utilize internal resources and combine these in interdisciplinary teams with the objective to develop digital innovation. In contrast, accelerators aim at supporting external startups within a given program set up and time frame to develop novel ideas. Characterized through more individual relationships, incubators primarily focus on supporting external startups in regard to developing ideas (Sindemann & von Buttlar, 2017). In 2018, Sindemann and von Buttlar updated this classification and replaced incubators through company builders. Compared to incubators, company builders aim at establishing startups based on novel ideas for digital business models through internal and external resources (Sindemann & von Buttlar, 2018). The latest DIU typology derived by Sindemann and von Buttlar (2020) differentiates DIUs on a more generic level. Whereas startup labs, for example accelerators and incubators, focus on collaborations between the core organization and external startups, innovation labs aim at developing digital innovation mainly in collaboration with employees from the core organization. This does not exclude irregular collaboration with universities, startups and other established companies. Furthermore, DIUs can be clustered, dependent on the market focus of their digital innovation activities, into DIUs that mainly target innovation close to the core business and innovation distant to the core business (Sindemann & von Buttlar, 2020).

Concluding, another DIU characterization was developed by the consulting company etventure (2021). It includes innovation labs, that aim at fostering digital culture and allow employees of the core organization to work on new ideas and business models. Company builders focus on establishing startups based on selected, oftentimes internal, ideas. In contrast, incubators target at supporting existing, external startups. The last type, digital units, enable interdisciplinary teams to develop innovative ideas, business models and novel ways of working (etventure, 2021).

While the DIU types and characterizations derived by practitioners are relevant, "the proposed characterizations are neither consistent nor theoretically sound" (Fuchs et

al., 2019, p. 635), highlighting the necessity for profound, theory-based, DIU classifications (Fuchs et al., 2019).

2.2.2. Theoretical perspective on DIU types

While recently several approaches to classify and characterize DIUs have emerged in scientific research, the development of DIU archetypes, that include relations between organizational dimensions, seems to be a suitable approach to fully grasp the organizational complexity of DIUs.

Similar to the contributions by practitioners, literature addressed DIUs as research field by deriving different ways of characterizing DIUs (Barthel et al., 2020; Fuchs et al., 2019; Holotiuk, 2020; Hund et al., 2019; Raabe et al., 2020). One way of distinguishing DIUs is based on the organizational design, which can be separated into several dimensions, such as motivation & vision, setup & alignment, governance, employees & staffing and operations (Holotiuk, 2020). A more extensive categorization was provided by Fuchs et al. (2019). Likewise, DIUs are distinguished based on their organizational design, however, the organizational dimensions were clustered into categories (i.e. objectives & scope, staffing & collaboration, funding, governance & structure and origins). In addition, Fuchs et al. (2019) derived particular characteristics within each category "providing a theoretically sound and empirically derived taxonomy for the characterization of digital units" (Fuchs et al., 2019, p. 643), which is depicted in Appendix 1. Although this taxonomy could be utilized as a blueprint for designing and establishing DIUs, it does not indicate any relations between specific dimensions and characteristics, for example the impact of objective and scope on staffing and collaboration (Fuchs et al., 2019).

This gap was addressed by Raabe et al. (2020) through identifying two DIU archetypes and linking mechanisms to the core organization. The key criteria to distinguish between these types is their specific focus area: Whereas type one, the coaching & screening type, mainly focuses on the discovery phase of innovation, fostering an innovative, agile mindset within the core organization and novel digital skills, type two, the center of excellence, additionally addresses innovation development, diffusion and the measurement of the innovation impact. An exemplary dependency between different organizational dimensions is the importance of an autonomous budget for being able to cover all innovation process stages. In regard to linking mechanisms, it is important for both types to shift employees between the core organization and the DIU in order to foster collaboration (Raabe et al., 2020).

As many DIUs primarily focus on creating digital innovation (Fuchs et al., 2019; Raabe et al., 2021; Sindemann & von Buttlar, 2020), Barthel et al., 2020 developed a typology of DIUs that emphasizes the "means-ends-relationship between objectives (ends) and design options (means)" (Barthel et al., 2020, p. 2). Organizational design patterns, suitable for specific innovation objectives, were identified. Furthermore, the concept of loose-tight-coupling was applied to identify how tight specific DIU types should be tied to the core organization dependent on the targeted innovation. Following this logic, three ideal types of DIUs were identified. Such ideal types "are theoretically founded abstractions to examine empirically observed real world cases" (Barthel et al., 2020, p. 5). This does not imply, that each real-world case has to follow the specific design pattern of an ideal type. However, similar organizational characteristics were identified (Barthel et al., 2020; Doty & Glick, 1994). The organizational dimensions considered were derived from the taxonomy provided by Fuchs et al. (2019) and are depicted in Appendix 2. Based on the specific DIU characteristics within the categories objective and scope as well as setting and design, the ideal types internal facilitator, external enhancer and external creator were derived by Barthel et al. (2020). Since it is crucial to develop a comprehensive understanding of how different DIUs types can be distinguished based on the specific objective and scope, a profound illustration of each ideal type is provided.

2.2.3. Ideal types: Internal facilitator, external enhancer, external creator

Each type is described based on the specific objective and scope of its digital innovation activities. In addition, suitable, respectively recommended, organizational settings and designs to achieve these objectives are introduced. The combination of both objective and scope and setting and design define the specific ideal type (Barthel et al., 2020).

Internal facilitator

Objective & Scope: The innovation orientation of type one is primarily internal (e.g. business process innovation). Hence, internal facilitators focus on existing business areas and markets. Thus, fostering the digital transformation of the core organization is more important than product- and service-related innovation. With regards to the innovation process, this type usually addresses idea generation, idea selection and innovation development. However, the remaining stages are oftentimes realized by another department within the core organization.

Setting & Design: Ideal type one should be embedded as executive department or separate legal entity, respectively. External cooperation is oftentimes not incorporated. This ideal type is usually integrated into the core organization and therefore tightly tied to it. Projects take place on- and offsite, are ordered by the core organization and autonomously selected.

Due to the internal innovation focus, tight coupling of internal facilitators, especially in regard to embedding and collaboration, seems to be a beneficial setup (Barthel et al., 2020). An overview is provided in Figure 1.

External enhancer

Objective & Scope: Similar to internal facilitators, the second type, external enhancers focus on existing business areas. In contrast to type one, type two is oriented primarily or purely external, respectively. Hence, fostering the market offering including new products, services and business models of the core organization is targeted. Although implementation and commercialization of the innovation is usually taken over by

Category	Dimension		Characteristic				
What? Objective & Scope	Innovation Orientation		Purely Internal	Primarily Internal	Balanced	Primarily External	Purely External
	Market Focus of Innovation		Existing Business Areas			Novel Business Areas	
	Scope of Innovation Process		Idea Generation	Idea Selection	Innovation Development	Innovation Implementation	Innovation Commercialization
How? Setting & Design	Embedding		Executive Department		Line Organization		Separate Legal Entity
	Collaboration	External Cooperation	None		Irregularly		Standard Working Mode
		Internal Ties	Core Organization Integrated		Regular Liaison		Sporadic Liaison
	Projects	Project Selection	Order		Mixed		Autonomously
		Location	Onsite		Mixed		Offsite

Figure 1: Overview of ideal type one: Internal facilitator
Note. Color code: dark blue = frequently identified characteristic, light blue = exceptionally identified characteristic, Figure taken from Barthel et al. (2020, p. 10).

a different department, some DIUs cover all stages of the innovation process.

Setting & Design: Similar to internal facilitators, external enhancers are integrated into the core organization, usually embedded as line organization, sometimes even as executive department. External cooperation takes place in most cases and is sometimes even incorporated as standard mode of cooperation. Projects can be selected autonomously or are ordered by the core organization and are usually conducted offsite.

Compared to type one, type two is usually coupled less tightly to the core organization induced by its embedding as line organization as well as the more frequent external cooperation (Barthel et al., 2020). The graphical overview is depicted in Figure 2.

External creator

Objective & Scope: Similar to type two, external creators are oriented externally. The key difference is the focus on novel business areas (e.g. new customer groups and markets). Therefore, innovation implementation and occasionally commercialization are addressed.

Setting & Design: Type three is usually embedded as separate legal entity and external cooperation is at least incorporated on an irregular basis, oftentimes also as standard working mode. External creators connect with the core organization on a regular basis if not integrated (internal ties). Projects are selected autonomously and conducted offsite.

Especially for creating digital innovation in novel business areas with an external focus, it seems beneficial to have a rather loose coupling to the core organization. Thus, frequent external cooperation and autonomous selection of projects should be realized (Barthel et al., 2020). The overview of ideal type three is provided in Figure 3.

Hybrid type

As the identified ideal types of DIUs are only theoretical abstractions of real-world cases, not all possible forms and types of DIUs are covered. Additionally, there are hybrid DIU types that for example cover both internal and external innovation orientation.

The provided typology by Barthel et al. (2020) is clearly focused on distinguishing different types of DIUs based on the specific innovation objective and scope, including innovation orientation, market focus and scope of innovation process. Thus, DIUs can be classified rather generically, meaning that for example company builders and accelerators can both be categorized as the same type, as long as the innovation objectives overlap. A clear set of objectives is one of the prerequisites for performance measurement (Kaplan & Norton, 1992). Therefore, it is crucial to understand which objectives are targeted by DIUs, that go beyond digital innovation.

2.3. Overview of DIU objectives

Whereas practitioners and scientific research have identified five objectives that are pursued by DIUs, digital innovation is unanimously recognized as primary objective.

So far, practitioners and literature have addressed objectives of DIUs directly (through explicitly identifying DIU objectives) or indirectly (through describing activities of DIUs that pay into specific objectives). An overview of existing contributions is depicted in Table 1.

Within the taxonomy derived by Fuchs et al. (2019, Appendix 1) one dimension specifically addresses the main objective of DIUs, the development of digital innovation. Dependent on the specific DIU type (section 2.2.3), the objective varies in regard to innovation orientation, market focus and stages covered within the innovation process (Barthel et al., 2020). In addition to digital innovation, DIUs oftentimes aim at fostering cultural change and the development of digital expertise within the core organization. These objectives can be realized indirectly, for example through integrating employees into specific projects of the DIU, or directly, for example by conducting workshops (Fuchs et al., 2019).

Building on Fuchs et al. (2019), Raabe et al. (2021) derived two further objectives, organizational design change

Category	Dimension		Characteristic				
What? Objective & Scope	Innovation Orientation		Purely Internal	Primarily Internal	Balanced	Primarily External	Purely External
	Market Focus of Innovation		Existing Business Areas			Novel Business Areas	
	Scope of Innovation Process		Idea Generation	Idea Selection	Innovation Development	Innovation Implementation	Innovation Commercialization
How? Setting & Design	Embedding		Executive Department		Line Organization		Separate Legal Entity
	Collaboration	External Cooperation	None		Irregularly		Standard Working Mode
		Internal Ties	Core Organization Integrated		Regular Liaison		Sporadic Liaison
	Projects	Project Selection	Order		Mixed		Autonomously
		Location	Onsite		Mixed		Offsite

Figure 2: Overview of ideal type two: External enhancer
Note. Color code: dark blue = frequently identified characteristic, light blue = exceptionally identified characteristic, Figure taken from Barthel et al. (2020, p. 11).

Category	Dimension		Characteristic				
What? Objective & Scope	Innovation Orientation		Purely Internal	Primarily Internal	Balanced	Primarily External	Purely External
	Market Focus of Innovation		Existing Business Areas			Novel Business Areas	
	Scope of Innovation Process		Idea Generation	Idea Selection	Innovation Development	Innovation Implementation	Innovation Commercialization
How? Setting & Design	Embedding		Executive Department		Line Organization		Separate Legal Entity
	Collaboration	External Cooperation	None		Irregularly		Standard Working Mode
		Internal Ties	Core Organization Integrated		Regular Liaison		Sporadic Liaison
	Projects	Project Selection	Order		Mixed		Autonomously
		Location	Onsite		Mixed		Offsite

Figure 3: Overview of ideal type three: External creator
Note. Color code: dark blue = frequently identified characteristic, light blue = exceptionally identified characteristic, Figure taken from Barthel et al. (2020, p. 12).

Table 1: DIU objectives covered by practitioners and literature

Author	DIU Objectives				
	Digital innovation	Cultural change	Digital expertise	Organizational design change	Digital innovation ecosystem
Barthel et al. (2020)	x	x	x		
etventure (2021)	x	x	x		x
Fuchs et al. (2019)	x	x	x		
Holotiuk (2020)	x	x	x		
Raabe et al. (2020)	x	x	x		x
Raabe et al. (2021)	x	x	x	x	x
Ramus and Velten (2016)	x				x
Sindemann and von Buttlar (2017)	x	x			x
Sindemann and von Buttlar (2020)	x	x			x

Note. Exemplary contributions.

and participating in, respectively developing, digital innovation ecosystems. The objective organizational design change

incorporates "that DIUs should initiate and enable the realization of various organizational concepts" (Raabe et al., 2021, p. 4), for example structural or conceptual changes. As organizational change might strategically impact the core organization, DIUs should be provided with high levels of authority when addressing this objective. The objective digital innovation ecosystem mainly targets at exploring the underlying ecosystem of digital technologies. Here, DIUs can either establish new digital ecosystems or participate in existing ones (Raabe et al., 2021). Furthermore, Raabe et al., 2021 identified seven areas of activity, directly or indirectly related to DIU objectives. As a detailed illustration would go beyond the scope of this study, an overview is provided in Appendix 3. One exemplary activity is to "develop and leverage digital expertise (and agile methods)" (Raabe et al., 2021, p. 4), which is directly related to the objective digital expertise and indirectly related to achieving cultural change, organizational design change and participating in the digital innovation ecosystem (Raabe et al., 2021).

Whereas the objective digital innovation is addressed by all authors (Table 1), other objectives are covered only partly, highlighting the importance of digital innovation as primary objective of DIUs. Barthel et al. (2020) and Raabe et al. (2021) support this conclusion. A profound, practically oriented study published in 2020, covers various aspects of DIUs, such as outcomes. It reveals, that 90% of the interviewed DIUs have a high or very high focus on digital opportunities that include tested ideas, solutions to problems and application of new technology (Holotiuk et al., 2020), which can be associated with the objective digital innovation.

By analyzing existing literature in regard to selected underlying concepts, approaches to distinguish different types of DIUs and objectives that are pursued by DIUs, we have developed a comprehensive understanding of why and how DIUs are set up by established corporations.

3. Performance measurement at DIUs

Performance measurement is a broad research field with various sub-topics, such as CSFs, PEMS and KPIs (Bourne, Neely, Mills, & Platts, 2003; Neely, Kennerley, & Adams, 2007). There is a strong relation between KPIs and CSFs as "key performance indicators (KPIs) tell management how the organization is performing in their critical success factors and, by monitoring them, management is able to increase performance dramatically" (Parmenter, 2015, p. 4). As we strive to develop a comprehensive understanding of performance measurement at DIUs, it is essential to get an overview of existing literature in regard to CSFs for DIUs. Furthermore, we investigate requirements for PEMS in DIUs. We take a general perspective on KPIs before concluding with ways to use KPIs for measuring digital innovation.

3.1. Critical success factors

CSFs are defined as "the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department or organization" (Bullen & Rockart, 1981, p. 7). Furthermore, "CSFs are the few key areas where "things must go right" for the business to flourish" (Bullen & Rockart, 1981, p. 7). In alignment with various other studies (Boynton & Zmud, 1984; Freund, 1988; Holotiuk & Beimborn, 2017; Leidecker & Bruno, 1984), we use this definition as basis for our research project.

3.1.1. Practical perspective on critical success factors

While the contributions by practitioners that cover recommendations and success factors for DIUs lack in theoretical foundation, the common characteristic is the application of clustering approaches that allow to aggregate individual factors into categories.

Similar to the different DIU types that were derived by practitioners over the last years (section 2.2.1), there are several contributions that cover recommendations for DIUs, respectively success factors (Sindemann & von Buttlar, 2017, 2018). Ramus and Velten (2016) for example identified several features that are important for DIUs to consider. The first one is space, meaning that it is important to set up an appropriate location to enable collaboration. Another aspect is infrastructure and technology, which consists of suitable, powerful IT infrastructures. Mentoring and operational support is important as well, as core organizations' employees oftentimes require support to implement agile ways of working (e.g. design thinking), which can be realized through workshops. Furthermore, funding, network and ecosystem are important for DIUs to foster networking and exchange across various players within the digital ecosystem. Two primary factors for the successful establishment of DIUs is teambuilding and talent management, as well as integrating the DIU into the digital strategy of the core organization (Ramus & Velten, 2016).

Sindemann and von Buttlar (2017, 2018) defined success factors of DIUs based on their definition of different types of DIUs (section 2.2.1). In total, six areas of success factors (e.g. governance, topics) were identified and further divided into subfactors (e.g. top management support, degrees of freedom). An overview of exemplary success factors is provided in Table 2.

Further contributions by practitioners addressed "clusters of success" in regard to digital innovation activities of DIUs, divided into innovation discovery, development and scaling (Sindemann & von Buttlar, 2019), as well as important factors with regards to creating digital innovation close and distant to the core business (Sindemann & von Buttlar, 2020).

Similar to the contributions by practitioners regarding DIU types (section 2.2.1), the provided success factors lack in consistency and theoretical foundation, showing the importance for theoretically profound CSFs for DIUs.

3.1.2. Theoretical perspective on critical success factors

Although existing literature provides several important factors and recommendation for DIUs, it lacks in regard to CSFs. However, CSFs were widely identified in other re-

Table 2: Exemplary success factors for DIUs

Governance:	Topics:	Core organization engagement:
• Top management support	• Targeted degree of innovation	• Business unit collaboration
• Degrees of freedom	• Selection criteria & process	• Internal communication
Methodologies:	Scaling:	Network:
• Selection of methodologies	• Integration of innovation	• Collaboration with partners
• Application of methodologies	• Scaling of innovation	• Collaboration with customers

Note. Table adapted from Sindemann and von Buttlar (2017, 2018).

search fields. A commonly observable approach is the aggregation of CSFs into specific categories and dimensions.

Unlike the development of DIU types (section 2.2.2 & 2.2.3), which was already widely addressed by academic research, CSFs of DIUs have been covered only partially so far. Holotiuk (2020) for example, derived "important aspects of the organizational design" (Holotiuk, 2020, p. 13), that allow ambidexterity to develop digital innovation at DIUs. Fuchs et al. (2019) derived a taxonomy for DIUs (section 2.2.2) and defined organizational patterns for DIUs. For example, most DIUs have access to "secured financial funding for their projects" (Fuchs et al., 2019, p. 643) and interdisciplinary teams, consisting of core organization and DIU employees (Fuchs et al., 2019). Similar, Barthel et al., 2020 identified suitable organizational design patterns that "appear to fit the different innovation objectives" (Barthel et al., 2020, p. 12). Furthermore, design features like embedding DIUs into the corporate digital strategy and support of the top management were explicitly described as "prerequisite for any DIU type" (Barthel et al., 2020, p. 13). Moreover, soft aspects like the culture within the core organization, were defined as success factors of DIUs. The focus on digital innovation that addresses real problems of the core organization's business areas is another important factor (Raabe et al., 2021). Similar, Holotiuk (2020) derived several recommendations that support DIUs in accelerating the digital transformation of the core organization, focusing on five dimensions (e.g. setup, strategy). An overview of selected dimensions and exemplary recommendations is depicted in Table 3.

While existing contributions rather focus on general recommendations, CSFs for DIUs to fulfill their objectives have not been derived so far.

In contrast, CSFs have already been widely explored within other areas of research including project management (Belassi & Tukel, 1996; Clarke, 1999), business performance management (Ariyachandra & Frolick, 2008) and agile software development (Abd El Hameed, Latif, & Kholief, 2016; Chow & Cao, 2008). Abd El Hameed et al. (2016) for example, identified CSFs for agile software development and clustered these into the dimensions people, project, product, technical, organization and process. A similar approach of clustering CSFs was applied by Chow and Cao (2008). So far, there are only few scientific contributions in fields related to DIUs, as for example digital transformation (Astri, 2015; Sahu, Deng, & Mollah, 2018; Wu, Huang, & Chen, 2011; Zhou, 2011).

Furthermore, Holotiuk and Beimborn (2017) derived a CSFs framework related to digital business strategy, consisting of 40 factors and clustered into eight dimensions. An overview of the framework is provided in Table 4.

Each dimension contains several CSFs. Sales & customer experience as well as organization were identified as most critical. The other dimensions, are depicted based on the specific importance in a descending order, starting with culture & leadership. Exemplary CSFs within this category are: foster & develop digital mindset, define set of values with focus on digital and allow failure as well as the commitment to transform (Holotiuk & Beimborn, 2017).

By comparing all contributions, including the ones by practitioners (section 3.1.1), a common approach is observable. Identified CSFs are usually aggregated into clusters derived from the underlying concept (e.g. agile software development, digital business strategy).

3.2. Performance measurement systems

Developing a thorough understanding of PEMS, not only from a general point of view, but also in regard to requirements specifically for DIUs, is important for the purpose of this study.

3.2.1. General perspective on performance measurement systems

While PEMS went through several transformations, some PEMS (e.g. balanced scorecard approach) have been widely adopted by corporations. Deriving measures for the (strategic) objectives of an organizations is an approach that can be found in various PEMS. While several approaches for the measurement of innovation exist, literature still lacks in regard to PEMS for DIUs.

PEMS, sometimes also referred to as "management control systems" (Haskamp et al., 2021, p. 3), were widely addressed by academic literate throughout the last decades (Bourne et al., 2003; Neely et al., 2007). PEMS usually include of a set of metrics (Bourne et al., 2003). Although the reasons for measuring performance are manifold (Behn, 2003), PEMS are usually set up by organizations to control their activities by making use of relevant data (Kerssens-van Drongelen & Cooke, 1997). Approaches for performance measurement and corresponding frameworks went through

Table 3: Exemplary recommendations for DIUs

Setup: • Reduce old ties to minimize risk of legacy • Set up small units to reduce financial investments • Ensure flexibility	Strategy: • Define strategic focus to provide guidance • Derive clear objectives to align actions • Look at innovations from start to end
Outcome: • Value all forms of outcomes of the DIU • Make intangible or qualitative outcomes visible and market them	Process: • Cover entire innovation process • Incorporate ideas from all employees • Integrate innovations into main organization

Note. Table adapted from Holotiuk (2020).

Table 4: Categories of CSFs for digital business strategy

	Culture & leadership	
Sales & customer experience	Capabilities & HR competencies Foresight & vision Data & IT Operations Partners	Organization

Note. Table taken from Holotiuk and Beimborn (2017, p. 996).

several transformations over time. Whereas traditional approaches have put a high focus on financial measures and metrics, such as return on investment (ROI), new approaches and frameworks that promote a more balanced PEMS, have emerged (Kaplan & Norton, 1992). Hence, these frameworks address the shortcomings of traditional systems (Bourne et al., 2003). Exemplary PEMS are the performance measurement matrix (Keegan, Eiler, & Jones, 1989), the SMART (strategic measurement and reporting technique) pyramid (Neely et al., 2007), the result – determinants framework (Fitzgerald, Johnston, Brignall, Silvestro, & Voss, 1991) and the balanced scorecard (Kaplan & Norton, 1992; Neely et al., 2007).

The balanced scorecard approach in particular has been widely adopted by organizations (Neely et al., 2007) and was refined in various forms (Gama, Da Silva, & Ataíde, 2007; Kaplan & Norton, 1996; Lawrie & Cobbold, 2004). One of its key elements is the deduction of performance measures (financial and non-financial) based on the strategy and vision of the organization. These performance measures are linked within the framework, including outcome measures as well as related performance drivers. The balanced scorecard consists of four dimensions. First, the financial perspective, which covers the long-term objectives of the organization. Second, the customer perspective, which aims at identifying relevant customer segments and markets for the organization. Third, the internal business process perspective, which includes crucial processes for the organization, such as fulfilling the value proposition for customers. The last perspective, learning & growth, targets at identifying important aspects to ensure long-term growth and future success (Kaplan & Norton, 1992; Kaplan & Norton, 1996). Based on the particular strategic objectives within each perspective, specific measurements are selected and linked to objectives (Kaplan & Norton, 1992; Kaplan & Norton, 1996; Lawrie & Cobbold, 2004).

While existing research highlights the importance and benefits of performance measurement for innovation activities (Davila, Foster, & Oyon, 2009; Ylinen & Gullkvist, 2014), and established approaches like the balanced scorecard have already been adapted to measure the value added by innovation (Gama et al., 2007), there is a gap in regard to measuring the success of digital innovation activities of DIUs.

However, identifying KPIs that are or should be used in DIUs and linking these to the DIU's objectives (section 2.3) seems to be a suitable approach to tap into this field. A similar and widely discussed approach was introduced by Bourne, Mills, Wilcox, Neely, and Platts (2000), who defined four phases for the development of PEMS, starting with the identification of key objectives and related measures (Bourne et al., 2000; Garengo, Biazzo, & Bititci, 2005; Henri, 2006; Neely, 2005).

3.2.2. Requirements for performance measurement systems at DIUs

There are several important requirements for DIUs in regard to PEMS. Due to the novelty of DIUs, these requirements mainly originate from related fields, such as PEMS for innovation.

So far, existing literature exploring success and performance measurement of DIUs is rare, which can be attributed to the novelty of the research field (Barthel et al., 2020). Recently, Haskamp et al. (2021) identified requirements for PEMS particularly important for DIUs. Based on existing literature, different categories of PEMS requirements were identified. These categories cover general requirements, re-

quirements in regard to innovation as well as requirements for digital innovation and agile ways of working. Furthermore, requirements particularly for PEMS in DIUs were derived (Haskamp et al., 2021).

The specific categories are illustrated in the following, starting with general requirements for PEMS (Table 5). General requirements for PEMS (RE 1-4) show a clear focus on data, including its collection, availability and usability. The required data and information for PEMS should be collected in a simple way (RE 1), based on existing organizational activities. In addition, data should be available for specific user groups to utilize and access it in an easy way to make decisions (RE 2 & 3). Furthermore, performance criteria shall be derived from the objectives of the organization and aligned with the corporate strategy (Haskamp et al., 2021).

As the development of digital innovation is the main objective for many DIUs (section 2.3), PEMS requirements in regard to innovation are depicted in Table 6. The requirements related to innovation particularly address relevant aspects that come along with innovation activities (section 2.1). This includes the type of innovation (RE 5, e.g. product) and different stages of the innovation process (RE 6 & 7, e.g. discovery). Furthermore, the requirements emphasize the flexibility of the PEMS, for example in regard to measurement approaches (e.g. input-oriented) and different performance dimensions (e.g. financial) as well as the ability to process different types of data (Haskamp et al., 2021).

An overview of requirements for PEMS systems that are important particularly for digital innovation and agile ways of working is provided in Table 7. PEMS should consider the requirements that result from the innovation process applied for digital innovation (section 2.1). As customer-centricity and market proximity are important aspects of digital innovation, novel metrics are required to address these aspects (RE 8). Furthermore, PEMS should be able to handle the requirements that result from the applied methodologies, such as design thinking (RE 9). Additionally, a certain degree of flexibility is important (Haskamp et al., 2021).

Moreover, Haskamp et al. (2021) identified three additional requirements for PEMS, that are particularly relevant for DIUs (Table 8). RE 10 highlights the importance of incentives in regard to experimenting and the resulting learnings. Here, potential failures that come along with experimenting need to be considered accordingly, meaning, failures should also become visible in selected metrics. However, in a positive way in order to support experimenting. Dependent on the innovation orientation and market focus of the innovation activities pursued within the DIU, the PEMS should be adjusted accordingly and enable data exchange (RE 11). As DIUs usually pursue innovation activities in the early stages of the innovation process (e.g. discovery), standard metrics are hard to apply. Moreover, DIUs are facing the challenge to collect data that is relevant for performance measurement on their own. Therefore, it is crucial to ensure credibility of the data (RE 12) within the PEMS (Haskamp et al., 2021).

After having defined requirements for PEMS at DIUs, it is crucial to analyze ways of measuring digital innovation on a more granular level. More precisely, we seek to explore ways of using KPIs for the measurement of digital innovation.

3.3. Measuring digital innovation

To develop a comprehensive understanding of ways to measure digital innovation, it is essential to take a general perspective on KPIs first, followed by the introduction of challenges, frameworks and exemplary KPIs that can be used to measure digital innovation.

3.3.1. General perspective on key performance indicators

Since KPIs are multifaceted and complex, we exclusively address the key aspects of KPIs from a general perspective. Considering digital innovation activities, deriving KPIs from specific organizational objectives is crucial for the underlying performance measurement.

Similar to PEMS, KPIs have been widely addressed by academic research (Kaplan & Norton, 1996; Kristiansen & Ritala, 2018; Lawrie & Cobbold, 2004). Beyond KPIs, several types of performance measures, such as key result indicators, exist (Parmenter, 2015), stressing the importance to define the term KPI. Among various definitions, one common feature that stands out is the direct relation between organizational objectives and KPIs (Bourne et al., 2003; Macmillan, 2021; Oxford, 2020; Twin & James, 2020). These objectives are oftentimes even described as strategic goals of the organization (Parmenter, 2015). Within this study, we define KPIs as “quantifiable measure used to evaluate the success of an organization, employee, etc. in meeting objectives for performance” (Oxford, 2020, p. 1). As a consequence, KPIs that are or should be used by DIUs to measure their performance should be directly related to the objectives specifically addressed by DIUs, which were introduced in section 2.3. Existing literature recommends limiting the number of KPIs that are used within the PEMS to 15-25. Additionally, the selected KPIs should be linked to specific target values, that are set by the organizations (Kaplan & Norton, 1992; Kaplan & Norton, 1996). Moreover, KPIs can be characterized from several point of views, for example, the separation into financial (e.g. ROI) and non-financial KPIs (e.g. customer satisfaction). Beyond that, KPIs can be of quantitative and qualitative nature and are usually assigned to specific perspectives and areas, as realized in the balanced scorecard approach (Kaplan & Norton, 1992; Kaplan & Norton, 1996; Lawrie & Cobbold, 2004).

Since discussing the general perspective of KPIs in more detail would exceed the scope of this research project, it is crucial to understand the role of KPIs in measuring digital innovation, including associated challenges. Therefore, measurement frameworks for structuring such innovation KPIs as well as suitable, exemplary KPIs need to be discussed. Thereby, these KPIs have the potential to be directly related to main objective of DIUs, digital innovation.

3.3.2. Using key performance indicators to measure digital innovation

Measuring digital innovation appropriately is perceived as challenging endeavor accompanied with several difficul-

Table 5: General PEMS requirements

Number	Description of requirement	Underlying literature
RE 1	The PEMS should allow to collect data in an easy way based on the organizational activities.	(Kerssens-van Drongelen & Cooke, 1997; Micheli & Manzoni, 2010)
RE 2	The PEMS should ensure the availability of data that can be utilized and contextualized. Based on this data, the user of the PEMS should be able to generate insights, derive implications and make decision.	(Globerson, 1985; Lill, Wald, & Munck, 2020; Neely et al., 2000; Wiesche, Bodner, & Schermann, 2012)
RE 3	The PEMS should have a high degree of usability and particularly address the interests of different user groups, such as stakeholders from the core organization but also from the DIU itself.	(Hamilton & Chervany, 1981; Henttonen, Ojanen, & Puumalainen, 2015; Kerssens-van Drongelen & Cooke, 1997)
RE 4	The PEMS should ensure the alignment of the specific performance criteria with the corporate strategy and derive these criteria from the objectives.	(Globerson, 1985; Neely et al., 2000)

Note. Table adapted from Haskamp et al. (2021).

Table 6: PEMS requirements related to innovation

Number	Description of requirement	Underlying literature
RE 5	The PEMS should consider different types of innovation individually (e.g. process, product & business model) and align the required mode of performance measurement and control.	(Barros & Ferreira, 2019; Chiesa, Frattini, Lamberti, & Noci, 2009; Curtis & Sweeney, 2016; Davila et al., 2009; Fichman et al., 2014; Schermann, Wiesche, & Krcmar, 2012; Ylinen & Gullkvist, 2014)
RE 6	The PEMS should include different measurement approaches (e.g. input- & output-oriented). Furthermore, the PEMS should consider different performance dimensions (e.g. financial, learning & knowledge), as well as different stages of the innovation process.	(Chiesa et al., 2009; Henttonen et al., 2015; Micheli & Manzoni, 2010)
RE 7	The PEMS should be able to process quantitative data (e.g. number of interviews) and qualitative data (e.g. customer satisfaction) throughout the applied innovation process.	(R. Adams, Bessant, & Phelps, 2006; Barros & Ferreira, 2019; Said, HassabElnaby, & Wier, 2003)

Note. Table adapted from Haskamp et al. (2021).

Table 7: PEMS requirements related to digital innovation and agile ways of working

Number	Description of requirement	Underlying literature
RE 8	The PEMS should have a close alignment with the innovation process for digital innovation. One reason for this is the new role of the IT department, which has become an important part of the business strategy. Therefore, customer-centricity and market proximity need to be more focused, which requires novel metrics.	(Brynjolfsson & Oh, 2012; Huang, Henfridsson, Liu, & Newell, 2017; Hund et al., 2019; Urbach et al., 2018)
RE 9	Similar to the methodologies applied to create digital innovation, the PEMS should set up accordingly to cope with agile ways of working (e.g. scrum) and exploratory methods (e.g. design thinking), as these approaches require shorter cycle times and a high degree of flexibility in regard to adjustments.	(Basili et al., 2007; Boerman, Lubsen, Tamburri, & Visser, 2015; Lee, Hsu, & Silva, 2020; Mayer et al., 2021)

Note. Table adapted from Haskamp et al. (2021).

ties, that also need to be faced by DIUs. Several approaches that strive to measure innovation performance use KPIs as fundamental component.

Existing literature already addressed difficulties of mea-

Table 8: PEMS requirements related to DIUs

Number	Description of requirement	Underlying literature
RE 10	The PEMS should provide incentives for employees that support experimenting and show resulting learnings.	(Haskamp et al., 2021)
RE 11	The PEMS should enable the exchange of data and information between the DIU and the core organization to support autonomous operations of the DIU.	(Haskamp et al., 2021)
RE 12	The PEMS data should be trustworthy and meaningful.	(Haskamp et al., 2021)

Note. Table adapted from Haskamp et al. (2021).

suring digital innovation, also within the scope of DIUs, and highlights the need for further research in this field (Barthel et al., 2020; Hund et al., 2019; Hund et al., 2019). First of all, difficulties might arise due to differences between traditional and digital innovation (Kohli & Melville, 2019). Beyond that, insufficiently defined objectives of DIUs (Raabe et al., 2020), which might also be caused by the novelty of the research field (Barthel et al., 2020), as well as addressing only selected stages of the innovation process (section 2.1 and 2.2.), might further increase the complexity of measuring digital innovation at DIUs. In addition, measuring specific aspects of digital innovation, for example customer centricity, through metrics is perceived as challenge (Frey, Holotiuk, & Beimborn, 2020; Micheli, Wilner, Bhatti, Mura, & Beverland, 2018). Therefore, qualitative KPIs seem to be more suitable for measuring explorative innovation activities (Bedford, 2015; Kerssens-van Drongelen & Cooke, 1997).

Recently, Mayer et al. (2021) identified several challenges of measuring digital innovation across various DIU areas (e.g. DIU objectives), particularly in the field of design thinking activities: Even though the metrics are derived from exploitive innovation activities, they are frequently used for explorative DIU activities. Additionally, there is a lack of metrics for measuring internal transformation. The expectations of the core organizations towards a diversified innovation portfolio challenges the DIU when it comes to allocating resources to particular projects. Oftentimes, the objectives of the innovation activities are not clearly defined and documented. Therefore, the performance of the DIU might be measured based on conflicting objectives. Beyond that, the time horizon of innovation activities impacts their measurement. Whereas the applied metrics are oftentimes short-term oriented, creating digital innovation and new ventures can be a lengthy process. Thus, applying financial metrics, especially for explorative activities, might be quite challenging. Hence, DIUs prefer qualitative KPIs to report progresses regarding digital innovation initiatives. However, these KPIs oftentimes conflict with the KPIs the core organization usually applies to measure success. On closer examination, one realizes that digital innovation activities might be highly specific, dependent on the project. Since cross-project applicability of KPIs might be challenging, maintaining a flexible way of selecting metrics is crucial. Concluding, softer objectives of DIUs, that go beyond digital innovation (e.g. cultural change and digital expertise) and therefore require more time, might be hard to track and difficult to relate to the DIU (Mayer et al., 2021).

As there is still a lack of existing academic research in regard to performance measurement of digital innovation (Barthel et al., 2020), we also take a closer look at traditional innovation performance measurement, which is, in contrast, widely discussed in literature (Dewangan & Godse, 2014). Several approaches for clustering innovation performance metrics exist (Collins & Smith, 1999; Cruz-Cázares, Bayona-Sáez, & García-Marco, 2013; Gama et al., 2007; Lazzarotti, Manzini, & Mari, 2011; Suomala, 2004). According to Dewangan and Godse (2014), established innovation PEMS lack in adequately addressing early stages of innovation (e.g. discovery). Each stage of the innovation process includes specific activities and outcomes. Instead of using established systems like the balanced scorecard entirely as PEMS, Dewangan and Godse (2014) recommend applying multi-dimensional metrics within each stage of the innovation process, considering selected guiding principles, such as the causal relationship between metrics. While a detailed explanation would exceed the scope of this work an overview of the framework is provided in Table 9, including exemplary KPIs (Dewangan & Godse, 2014).

Assigning selected KPIs to specific stages within the innovation process, as realized in the innovation performance measurement framework by Dewangan and Godse (2014), seems to be an adoptable approach for the innovation process for digital innovation (section 2.1). Complementary, Table 10 provides selected, commonly used, output- and input-related metrics, which were derived through an extensive survey covering top management and senior executives across various regions and industries (Chan, Musso, & Shankar, 2008).

To summarize, we developed a comprehensive understanding of ways to measure digital innovation including related challenges, frameworks and exemplary KPIs that can be used to measure digital innovation.

3.4. Research gap

Although DIUs are perceived as important vehicle for corporate digital innovation and widely established by practitioners, DIUs increasingly face criticism in regard to their success and impact on the core organization (Chapter 1). So

Table 9: Innovation performance measurement framework

	Innovation process stage	
Dimension	Generation & selection of ideas (1)	Incubation of ideas (2)
Non-financial		
Customer	Percentage of ideas generated with customer participation	Number of ideas incubated in collaboration with customers
Internal processes	Ratio of selected ideas to ideas submitted	Percentage of incubated ideas found viable for commercialization
Innovation & learning	Percentage of ideas generated in new domains	Number of patents filed
Financial	Average expenditure per selected idea	Current idea portfolio net present value
Dimension	Commercialization of ideas (3)	Realization of innovation (4)
Non-financial		
Customer	Rate of customer adoption of new offerings	Percentage impact on customer satisfaction index
Internal processes	Rate at which offerings are being launched	Percentage commercial success rate (i.e. innovations that met projections)
Innovation & learning	Number of marketing partners added	Percentage increase in innovation revenues per employee
Financial	Commercialization expenditure for the innovation portfolio	Innovation portfolio ROI realized

Note. Table taken from Dewangan and Godse (2014, p. 542).

Table 10: Selected innovation metrics applied by companies

Output Metrics	Input Metrics
Revenue growth (new products or services)	Number of ideas in the pipeline
Customer satisfaction (new products or services)	R&D spending (as percentage of sales)
Percentage of sales (new products or services)	Number of R&D projects
Number of new products or services launched	Number of employees actively devoted to innovation

Note. Table adapted from Chan et al. (2008).

far, existing literature has addressed various aspects of DIUs, such as underlying concepts (section 2.1), the typology of DIUs (section 2.2) and their objectives (section 2.3). With regard to performance measurement, research has already analyzed CSFs in related fields (section 3.1) and started to lay the foundation for measuring the performance of DIUs (section 3.2 & 3.3). However, existing literature is still limited when it comes to CSFs for DIUs and objective related KPIs to measure the performance of DIUs. To close this gap, we pose the following research questions:

> RQ1: What are CSFs for DIUs to fulfill their objectives?
> RQ2: Which KPIs are or should be used by DIUs to measure their performance?

To answer these research questions and to identify important aspects of performance measurement, such as CSFs and KPIs, relevant to the success of DIUs, we applied a case study approach that utilizes a mixed-method research design.

4. Methodology

In order to develop a comprehensive understanding of the applied methodology, we initially introduce the methodological basis of this study, the case study research approach. As we decided to apply a mixed-method design, the core component (semi-structured interviews) as well as the supplemental component (survey) are explained.

4.1. Case study research approach

Within this study, the case study research approach was applied. In total, a diverse sample that consisted of nine cross-industry cases was investigated through applying a mixed-method research design.

Although, DIUs have already been widely established by organizations, they still represent a novel research field from a scientific point of view (Barthel et al., 2020; Haskamp et al., 2021). An explorative, qualitative-empirical research approach is particularly suitable for such novel research areas (Benbasat, Goldstein, & Mead, 1987; Edmondson & McManus, 2007), as it allows to study recent phenomena in real-world settings (Yin, 2009). To be precise, we applied the

case study research approach according to Eisenhardt (1989) that allows building theory from cases, which is often "novel, testable, and empirically valid" (Eisenhardt, 1989, p. 532).

In total, we investigated nine cases, corresponding to nine DIUs. Hence, we followed a multiple-case study design that allows cross-case analysis to improve the robustness of the study (Benbasat et al., 1987; Yin, 2009). One of the most important steps in case study research is the selection of sample cases. In contrast to research that targets hypothesis-testing, Eisenhardt (1989) recommends theoretical sampling. Therefore, the sample should not be selected randomly, but instead, consist of cases that "are likely to replicate or extend the emergent theory" (Eisenhardt, 1989, p. 537). For the purpose of improving the external validity of the study, we aimed at selecting a diverse set of cases (Benbasat et al., 1987; Yin, 2009). Furthermore, we particularly targeted at a sample that includes multiple DIU types. Hence, we utilized a classification of DIUs provided by Sindemann and von Buttlar (2020) as a starting point for the case selection. DIUs were categorized based on their market focus of digital innovation activities into DIUs that mainly target innovation close to the core business and innovation distant to the core business. This feature is partly aligned with one of the key distinguishing characteristics of the DIU types derived by Barthel et al., 2020, the dimension market focus of innovation within the category objective and scope (section 2.2.3). Moreover, DIUs were classified dependent on the business field of the core organization (Sindemann & von Buttlar, 2020). Concluding, we aimed at selecting cases that differ in regard to industry, size and purpose. An overview of the sample is provided in Table 11.

Case study research design allows to utilize qualitative and quantitative data as "case studies typically combine data collection methods such as archives, interviews, questionnaires, and observations" (Eisenhardt, 1989, p. 534). Due to the growing complexity of recent research endeavors, literature is increasingly derived through the application of mixed-method designs, that allow the combination of qualitative and quantitative data collection and analysis approaches and enable to improve the research scope and quality (Sandelowski, 2000). As identifying important aspects of performance measurement, such as CSFs and KPIs, relevant to the success of DIUs can be classified as complex research endeavor, also caused by the novelty of the research field, we designed a mixed-method research approach.

4.2. Mixed-method research design

The mixed-method research design applied in this study consisted of semi-structured interviews (core component) and a survey (supplemental component). Whereas the data gathered through the interviews was used to answer both research questions, the survey complemented the results.

Combining several methods within one research project can take on different forms (Martha, Sousa, & Mendes, 2007). On the one hand, multiple-method research designs consist of two complete methods, that could both be published independently (Morse, 2003). Mixed-methods research design on the other hand consists of a complete core component and at least one supplementary component that is incomplete and cannot be published independently (Morse & Niehaus, 2009). The core component within the research project aims at answering the key aspects of the research questions and should fulfill the essential requirements to be published independently of the supplementary component. As the dominant and complete method it "must be conducted at a standard of rigor" (Morse & Niehaus, 2016, p. 23). Hence, it has to fulfill the standards of scientific research with regards to the underlying methodology. As the supplemental component consist of at least one incomplete method, it would be better considered as strategy instead of method (Morse & Niehaus, 2016). It "provides explanation or insight within the context of the core component"(Morse, 2010, p. 484) and can be incomplete due to multifaceted reasons, for example due to an insufficient sample size or lack of saturation (Morse, 2010).

We applied a mixed-method design that consisted of a qualitative, inductive core component and a quantitative supplementary component. Whereas both research questions were answered based on the data gathered through the core component, we aimed at making the research project more comprehensive through providing additional, case related information based on survey data (Morse, 2010). Specifically, we used the supplemental survey to identify the respective DIU type of each case. Such research designs are commonly used, but also come along with challenges, for example in regard to aligning data (Harris & Brown, 2010; Schoonenboom & Johnson, 2017). The detailed illustration of the core and supplementary component, including information on data collection and analysis, is provided in section 4.2.1 and 4.2.2.

Another important element of mixed-method research design is the point of interface, which is the point of integrating the supplemental research into the core component (Morse & Niehaus, 2016). Within this research project, the results point of integration was applied, meaning, that the results of the supplemental component were integrated into the results of the core component (Morse & Niehaus, 2016). Furthermore, simultaneous pacing was deployed. Hence, the data collection of both components was conducted at the same time (simultaneously) and independent from each other. From a methodological point of view, the correct notation of this research design is "QUAL + quan" (Morse & Niehaus, 2016, p. 25). Whereas the core component is written in capital letters, the supplemental method is displayed through the use of small letters. The "+" indicates the simultaneous conduction of both components (Morse & Niehaus, 2016). The sample of the core component does not necessarily need to be the different from the sample used within supplemental component (Morse, 2010). Within our research project, the same sample was utilized for both components of the mixed-method approach. Schoonenboom and Johnson (2017) identified further important dimensions that need to be addressed when designing mixed-method

Table 11: Overview of the sample

Case	Industry	Total employees / DIU employees	Revenue*	Interviews**	Role of interview partners
A	Machinery	~12,300 / 26	~2.65 bn. €	1	Managing Director (1)
B	Mechanical Engineering	~10,000 / 150	~2.00 bn. €	1	Head of Digital Innovation (1)
C	Healthcare	~65,600 / 17	~7.4 bn. €	2	Venture Consultant (1) Director Digital Operations (2)
D	Building Materials	~72,500 / 12	~24.05 bn. €	1***	Head of Digital Partnerships (1) Digital Lead Scale-Up and Acceleration (2)
E	Building Materials	~35,000 / 22	~10.00 bn. €	2	Director Digital Hub (1) Director Digital Transformation (2)
F	Multi-Industry	~12,300 / 10	~2.65 bn. €	1	Managing Director (1)
G	Home Appliances	~58,200 / 10	~13.20 bn. €	2	Venture Partner (1) Chief Digital Officer (2)
H	Pharma	~5,300 / 190	~1.53 bn. €	1	Managing Director (1)
I	Consumer Goods	~3,000 / 48	~0.72 bn. €	1	Head of Business Development (1)

Note. *Revenue end of 2019, **Number of interviews, ***One interview with two interview partners conducted.

research. The purpose for applying this methodology was to complement and expand the results of the semi-structured interviews with the results from the survey (Greene, Caracelli, & Graham, 1989; Schoonenboom & Johnson, 2017). The primary theoretical drive within this study was inductive, as semi-structured interviews were used as core component (Schoonenboom & Johnson, 2017).

After having defined the underlying research design, it is important to clearly illustrate the applied methods, including data collection and analysis.

4.2.1. Core component: Semi-structured interviews

Semi-structured interviews were conducted as core component for answering both research questions. The interviews were recorded, transcribed and consequently analyzed based on the content structuring qualitative analysis approach from Kuckartz (2016), utilizing inductive-deductive category formation.

As structured interviews are usually organized around predefined, standardized sets of questions, oftentimes closed-ended, there is little flexibility during the interview (Lune & Berg, 2017). Unstructured interviews on the other hand, are oftentimes conducted without pre-defined interview questions and offer high degrees of flexibility (Gubrium & Holstein, 2002). Semi-structured interviews combine aspects of both structured and unstructured interviews and are usually based on open-ended questions, that enable flexibility and provide guidance during the interviews (W. C. Adams, 2015; Segal, Coolidge, O'Riley, & Heinz, 2006). Within this research project, a semi-structured interview approach was applied.

An important aspect of semi-structured interviews is the development of an interview guideline, that supports the interviewer in organizing and structuring the interview (Creswell & Creswell, 2018). It is crucial to derive the guideline in accordance to the research questions (Rowley, 2012). The interview guideline within this study (Appendix 4) was split up into three parts and consisted of 11 open-ended questions. First, a short introduction including the research purpose, a short notice in regard to the complementary component as well as information concerning the confidentiality of the interviews. Second, two introductory questions that aimed at collecting general, case-related information and creating a pleasant interview atmosphere. Subsequently, the main part, focusing on performance measurement, consisted of questions in regard to CSFs and KPIs (nine questions in total). Due to the complexity of the research purpose, the interview guideline was distributed one day ahead of the actual interview. The interview partners were selected based on their current role within the respective DIU. We aimed at conducting interviews with upper management DIU employees that have a profound understanding of the DIU as a whole and are involved in performance measurement. Dependent on the preferences of the interview partner, the interviews were conducted in English or German. The interviews took place virtually via the online meeting tool "Zoom" and lasted between 25 and 50 minutes. The interview data collection took place from 11/2020 – 01/2021. In total, 12 interviews have been realized. The interviews were recorded, transcribed verbatim and anonymized (Flick, 2013). The primary data gathered through the interviews was triangulated through secondary data retrieved from company websites, management reports and press releases (Yin, 2014). The software program "MaxQDA", which is particularly designed for qualitative data analysis, was utilized to store, analyze and visualize the data.

Various approaches for qualitative data analysis exist (Kuckartz, 2016; Mayring, 2015). An important aspect of

qualitative data analysis is the formation of categories, which can be derived deductive and inductive. While deductive category formation defines the structure of categories based on existing literature before analyzing the data, inductive category formation allows to derive categories through analyzing and abstracting the data iteratively. Therefore, categories are retrieved from the data itself (Mayring, 2015). Within this study, we followed the qualitative content analysis according to Kuckartz (2016). To be precise, the content structuring qualitative analysis that consists of seven phases. We structured the data and applied an inductive-deductive category formation (Kuckartz, 2016; Strike & Rerup, 2016).

Initially, we inductively derived general case insights (e.g. year of foundation, number of employees). A detailed overview including the category, codes, code descriptions and exemplary quotes is depicted in Appendix 5. Furthermore, we enriched this data with the finding generated from the supplemental method (section 4.2.2), following the results point of interface, as described previously. As we aimed at identifying CSFs for DIUs to fulfill their objectives, we analyzed the aggregated data in regard to the objectives that are pursued by each case based on the objectives that were defined within section 2.3. Thus, we applied a deductive approach, which is illustrated in Appendix 6.

To answer RQ1 ("What are CSFs for DIUs to fulfill their objectives?"), the underlying data was coded iteratively while applying an inductive approach. After identifying first order codes, explicit CSFs were derived (depicted as "sub codes" in Appendix 7). Second, we defined categories of CSFs (depicted as "codes" in Appendix 7). Both categories of CSFs and explicit CSFs were derived on a generic level and not directly related to specific DIU objectives. An exemplary overview of the data structure is depicted in Figure 4, including first order codes, second order concepts (explicit CSF) and aggregated themes (categories of CSFs).

The underlying CSF method primarily focuses on identifying information and actions that are crucial to achieve the expected objectives and has been widely applied by practitioners (Bullen & Rockart, 1981; Rockart, 1979). An important benefit of the CSF method is, that implicit CSFs can be made explicit and consequently be addressed appropriately. The CSF method is based on interviews, which target at identifying explicit CSFs (Bullen & Rockart, 1981). Furthermore, the CSF method can be adjusted to the specific research purpose (Bullen & Rockart, 1981; Holotiuk & Beimborn, 2017; Rockart, 1979). Thus, the conducted semi-structured interviews were a suitable approach to identify CSFs for DIUs to fulfill their objectives. In order to derive a more robust set of CSFs, we exclusively considered CSFs that were identified among at least 15% of the cases (Sproull, 2002), meaning at least in two of the sample cases.

To answer RQ2 ("Which KPIs are or should be used by DIUs to measure their performance?"), we applied an inductive approach as well. After identifying first order codes, contextual information for the application of KPIs at DIUs was derived (e.g. challenges and benefits of establishing KPIs at DIUs). A detailed overview that includes information regarding the coding approach is provided in Appendix 8.

Subsequently, specific KPIs were identified (exemplary depicted as "sub codes" in Appendix 9) and aggregated into clusters (exemplary depicted as "codes" in Appendix 9). Both clusters and individual KPIs were directly related to specific DIU objectives as suggested by literature (section 3.3). Similar to the overview of the data structure provided in Figure 4, an exemplary overview of the data structure relevant to KPIs is depicted in Figure 5.

The underlying method for deriving specific KPIs follows the PEMS development approach by Bourne et al. (2000) which is depicted in Appendix 10. We exclusively focused on the first phase, system design, that consists of identifying key objectives and designing measures. Consecutive phases, for example the implementation of measures, would go beyond the scope of this research project.

After having defined the core component of the mixed-method research design comprehensively, it is crucial to introduce the supplementary survey.

4.2.2. Supplemental component: Survey

The core component was complemented with a supplementary survey to identify the DIU type of each case. The supplemental component followed less rigorous scientific guidelines.

Within this study, a survey was conducted as supplementary, quantitative component to identify the DIU type of each case. While Barthel et al., 2020 derived ideal DIU types based on the objective and scope as well as the setting and design of DIUs, we exclusively focus on identifying the DIU type dependent on the specific objective and scope. Information regarding setting and design was primarily used to complement the findings. Hence, we primarily used closed-ended questions that were closely aligned with the typology of DIUs (section 2.2.2 & 2.2.3). The questionnaire consisted of ten questions and was divided into four parts: After providing a short introduction of the purpose of the survey (part one), two general open-ended questions with regards to the background of the participant and the DIU were asked (part two). Consequently, part three consisted of three closed-ended questions that aimed at gathering data in regard to the objective and scope of the DIU. Concluding, part four focused on identifying the specific setting and design of each case based on five closed-ended questions including the response option "other", in case the DIU design differs from the dimensions provided by Barthel et al., 2020. An overview of the questionnaire design is provided in Appendix 11.

The sample of the supplemental component does not necessarily need to be the different from the one used within the core component (Morse, 2010). Therefore, we utilized the same sample for both components. Following the concept of simultaneous mixed-method research design, the survey was distributed individually to the interview partners directly after the interviews. We used a cross-sectional survey design. To conduct the online survey and collect the data, we used the online tool provided by "SurveyMonkey". Survey methodology usually follows rigorous scientific guidelines, for example

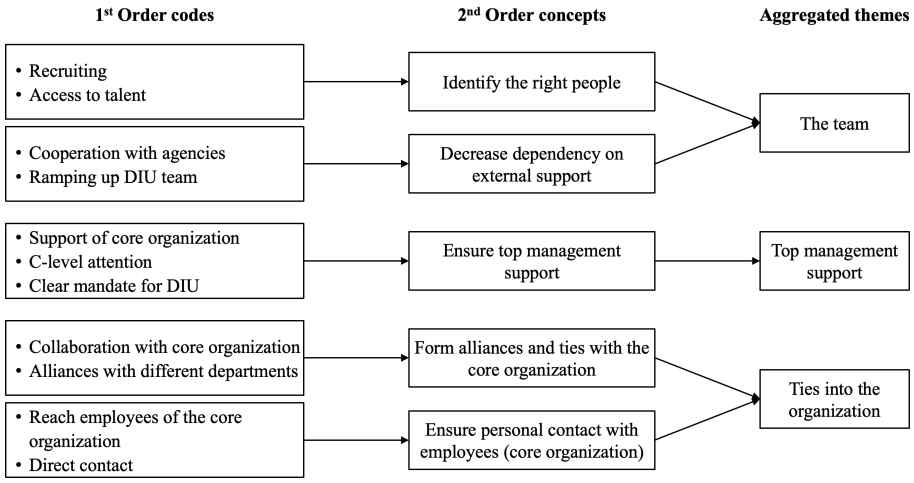

Figure 4: Exemplary data structure CSFs

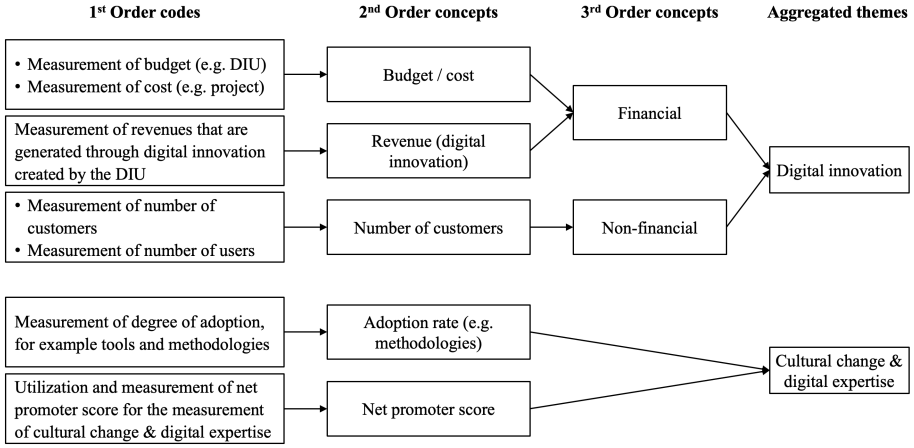

Figure 5: Exemplary data structure KPIs

regard sampling, data collection and analysis (Groves et al., 2009; Laaksonen, 2018; Passmore et al., 2002). However, supplemental components in mixed-method research designs can be incomplete due to multifaceted reasons (Morse & Niehaus, 2016). Within this study, we utilized those less rigorous requirements in regard to sample selection and sample size, as we exclusively focused on the sample of the core component. We analyzed the data individually for each case, instead of applying quantitative descriptive statistics. Thus, the requirements from a scientific research point of view were fulfilled.

To summarize, we developed a comprehensive understanding of the applied methodology. Thus, we set the foundation for presenting the results of this research project.

5. Results

A comprehensive understanding of the results derived within this research project is crucial for its contribution to the existing research gap and its implications for practice. Initially, we merge the findings of the core and supplementary component by introducing the identified DIU types within the sample together with general, case specific information. After defining the objectives that are pursued by the sample cases, we outline the identified CSFs for DIUs to fulfill their objectives. Afterwards, we provide contextual information for applying KPIs at DIUs before concluding with the introduction of KPIs that are or should be used by DIUs to measure their performance.

5.1. DIU types

In total, three DIU types were identified which highlights the diversity of the sample. However, the analyzed DIUs show high degrees of individuality in regard to their development over time, specific activities as well as setting and design.

Based on the results of the conducted survey, the type of each case was derived dependent on the specific objective and scope. Whereas no case was identified as internal facilitator, five cases (Case A-E) were classified as external enhancers and two cases (Case F & G) as external creators. Due to their balanced innovation orientation, Cases H & I were categorized as hybrid types. A summary of the classification is depicted in Table 12.

Table 12: Identified DIU types

	Objective and scope		
Case	Innovation Orientation	Market Focus of Innovation	DIU Type
A	Purely External	Existing Business Areas	External enhancer
B	Primarily External	Existing Business Areas	External enhancer
C	Primarily External	Existing Business Areas	External enhancer
D	Balanced, Primarily External	Existing Business Areas	External enhancer
E	Primarily External	Existing Business Areas, Novel Business Areas	External enhancer
F	Primarily External	Novel Business Areas	External creator
G	Primarily External, Purely External	Existing Business Areas, Novel Business Areas	External creator
H	Balanced	Existing Business Areas	Hybrid
I	Balanced	Novel Business Areas	Hybrid

Note. In case responses of multiple interview partners within one case were inconsistent, the data was triangulated with the results from the semi-structured interview to improve consistence.

Following the logic of the results point of interface within mixed-method research design, the results of the supplementary component were integrated into the results of core component. In the following, general information for each case is provided. This includes data gathered through the interviews (e.g. year of foundation, development over time, exemplary activities) as well as the case specific setup within the organizational dimensions embedding, collaboration (i.e. external cooperation, internal ties) and projects (i.e. project selection, location).

Case A (external enhancer): Throughout its existence, Case A went through several transformations of its activities and strategy. Initially, the DIU focused on transferring deep tech knowledge into the core organization. With 26 employees, Case A realizes venture capital activities and company building for the core organization as well as for external clients (Case A, Interview One). As depicted in Appendix 12, Case A is set up as separate legal entity and its internal ties are best described by regular liaison. External cooperation is seen as standard working mode. Whereas projects are conducted on- and offsite, the projects are mainly ordered and not selected autonomously.

Case B (external enhancer): Established in 2018, Case B has developed towards a DIU with around 150 employees (located in several countries) and is set up as separate business area and legal entity. Initially, Case B was seen as starting point for the digital transformation of the core organization but evolved its focus towards company building (Case B, Interview One). With irregular external cooperation and regular liaison to the core organization, projects are ordered and selected autonomously as well as located on- and offsite (Appendix 13).

Case C (external enhancer): Case C was established as co-innovation lab in 2017 and allows employees from the core organization to become intrapreneurs and work on innovation beyond existing products of the core organization. The responsibilities of its innovation activities are split up between two teams. Whereas the first team (around nine team members) is responsible for ideation, the second team (around nine team members) proceeds with incubation including launch & scale within the established innovation process (Case C, Interview One & Two). As depicted in Appendix 14, Case C is embedded as line organization with regular liaison. Whereas external cooperation is seen as standard working mode for ideation, the incubation and launch & scale team cooperates only irregularly with externals. Projects are ordered and selected autonomously and normally conducted at the facilities of the DIU.

Case D (external enhancer): With around 12 employees, Case D is set up as digital transformation unit that focuses on customer-centric digital initiatives, leveraging innovation created by startups within the core organization and developing towards a more data-driven organization (Case D, Interview One). Embedded as executive department with external cooperation as standard working mode, projects are ordered and selected autonomously as well as conducted on- and offsite. Regarding its internal ties to the core organization, Interviewee One described the relationship as regular liaison, whereas Interviewee Two sees the DIU as core organization integrated (Appendix 15).

Case E (external enhancer): Established in 2018, Case E initially focused on defining strategic priorities in the context of digitalization for the core organization. However, Case E is currently developing towards a more execution-focused DIU. In total, Case E has around 22 employees which are divided into several teams that focus on strategy, project management and creating digital innovation (Case E, Interview One & Two). The graphical overview of the organizational setup depicted in Appendix 16 reveals a discrepancy between the responses of Interviewee One and Two. An example is the embedding of the DIU as executive department and separate legal entity, respectively.

Case F (external creator): Case F (around 10 employees) has a clear focus on supporting its members, which are estab-

lished companies, to validate ideas at an early stage (Case F, Interview One). In contrast to several other cases, Case F only covers idea generation, idea selection and innovation development within the innovation process. Being setup as separate legal entity, Case F utilizes external cooperation as standard working mode. It collaborates regularly with the core organization and project selection as well as location are mixed (Appendix 17).

Case G (external creator): Case G was established in 2018 focusing on scouting and developing new digital business models. Cost reductions within the core organization did not only result in a reduced team size from 22 employees to around 10 employees, but also in the termination of its accelerator activities (Case G, Interview One & Two). Case G mainly focuses on innovation within novel business areas. However, existing business areas are also covered. Similar to Case E, there is a discrepancy in regard to the understanding of the setting and design of Case G between Interviewee One and Two (Appendix 18).

Case H (hybrid type): Established in 2017 as cross functional unit, Case H has become a DIU with around 190 employees that have various backgrounds, such as data science, marketing and e-commerce. With an equal focus on internal and external innovation, Case H was classified as hybrid type. Starting as a pure e-commerce unit, Case H has realized several lighthouse projects that aim at advancing digitalization across the entire value chain of the core organization (Case H, Interview One). As depicted in Appendix 19, Case H is embedded as executive department and core organization integrated. External cooperation is seen as standard working mode. Whereas projects are mainly conducted onsite, the projects are partly ordered by core organization and partly selected by the DIU autonomously.

Case I (hybrid type): Case I was established in 2015 as a corporate startup and focuses almost exclusively on e-commerce activities (Case I, Interview One). Due to its purpose and the balanced innovation orientation, Case I is best classified as hybrid type using external cooperation as standard working mode. Embedded as separate legal entity and core organization integrated, the projects of Case I are selected autonomously and ordered by the core organization as well as mainly conducted onsite (Appendix 20).

After having established a general understanding of the sample, it is important to comprehensively understand which objectives are pursued by each of the sample cases.

5.2. DIU objectives

While most DIUs within the sample define digital innovation as the primary objective, other objectives (e.g. cultural change) are perceived as secondary outcomes. However, all DIU objectives that were introduced in section 2.3 are addressed by the sample (primary or secondary).

Based on the insights generated from the conducted expert interviews, the objectives of each Case (A-I) were identified. A graphical overview is provided in Table 13. We distinguish between primary objectives (marked as x) and secondary objectives (marked as (x)). The table shows that especially the development of digital innovation is pursued as primary objective. Almost all DIUs address the digital innovation ecosystem, cultural change, digital expertise and organizational design change. However, these objectives are oftentimes perceived as secondary outcomes, that occur as by-outcomes when pursuing primary objectives (Case A-I, Interview One & Two).

Each DIU distinguishes itself from others with regards to organizational dimensions. Due to the high degrees of individualism, also in regard to the particular interpretation and implementation of objectives, an overview of each pursued objective is provided. As cultural change and digital expertise are oftentimes seen as secondary objectives and pursued through similar activities (section 2.3, Appendix 3), the findings related to these objectives were aggregated.

Digital innovation: Case A addresses the development of digital innovation through building companies, starting with incubation and targeting at raising external funding as validation and market proof. Whereas Case A primarily focuses on creating digital business value for the core organization, projects with external organizational clients are conducted on a regular basis in order to generate revenue and gain market experience (Case A, Interview One). Similar to Case A, Case B aims at building companies (Case B, Interview One). Case C addresses digital innovation through developing innovations that go beyond physical products (e.g. services, digital tools, business model innovation) in order to contribute to the digital transformation of the core organization (Case C, Interview One & Two). Case D focuses on the digital transformation of the core organization, conducting digital initiatives, that are realized in an agile, customer-centric and business problem-oriented way (Case D, Interview One). By building new services around the core product portfolio, Case E targets at augmenting the existing offering of the core organization as well as increasing its revenue. To realize this objective, Case E applies user-centric methodologies like design thinking, involves various stakeholders from the core organization and utilizes data to create a better understanding of its customers (Case E, Interview One & Two). Case F distinguishes itself from the other cases, as the DIU primarily supports its corporate members in validating early-stage ideas in standardized ways. By doing so, agile methodologies, such as design thinking are applied (Case F, Interview One). Similar to Case A and B, Case G targets at building companies. Case G has a clear focus on creating digital business through scouting, developing, validating and scaling new, standalone digital services (Case G, Interview One & Two). The key objective of Case H (hybrid type) is to digitally transform the different business areas of the core organization. In addition to establishing e-commerce activities, this includes digital innovation projects across the entire value chain (Case H, Interview One). Case I also differs from the other cases in regard to its innovation activities. As depicted in Table 13, the development of digital innovation is not seen as primary objective. Case I focuses on the establishment and development of the e-commerce business for the core organization

Table 13: DIU objectives addressed by sample cases

DIU Objectives	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
Digital innovation	x	x	x	x	x	x	x	x	(x)	9
Cultural change	(x)	(x)	(x)	x	(x)	(x)	(x)	x	(x)	9
Digital expertise	(x)	(x)	(x)	x	(x)	(x)	(x)	x	(x)	9
Organizational design change	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	(x)	9
Digital innovation ecosystem	x	(x)		x	x	x	(x)	x		7

Note. x = primary objective, (x) = secondary objective, *Count indicates how often each objective was mentioned as primary or secondary objective by cases.

(Case I, Interview One).

Cultural change & digital expertise: At Case A, cultural change and digital expertise are advertised actively towards the core organization. However, these objectives are rather pursued passively through projects that are conducted interdisciplinary with employees from the organization and DIU employees. This results in fostering digital culture and expertise. Hence, these are not primary objectives, but rather beneficial side effects and secondary outcomes (Case A, Interview One). Similar objective structures were identified within the Cases B, C, E-G, I. Cases B, E, F, H, I additionally conduct workshops and trainings for employees from the core organization that address topics like agile methodologies. In contrast, Case D has defined these objectives as primary. Through becoming more data driven, employees should be empowered to make better business decisions. Therefore, a change of mindset is fostered that also impacts the way of tackling specific business problems (Case D, Interview One). This cultural shift and mindset change is also pursued by Case H and fostered through innovation events with external speakers (Case H, Interview One).

Organizational design change: Similar to cultural change and digital expertise, organizational design change is seen as secondary objective by most DIUs. Although, organizational design change was not named explicitly by any case, the explanations in regard to main outcomes and objectives of the DIUs indicate, that organizational design change is pursued implicitly. Case C for example, has split up the responsibilities of the innovation process between two teams. Hence, digital innovation can be handed over in a standardized way for further development, fast integration and growth (Case C, Interview One & Two).

Digital innovation ecosystem: Participating in digital innovation ecosystems or establishing new ones, is seen as one primary objective by the majority of the cases. For example, Case A utilized the digital ecosystem to raise external funding for the ventures that were built by the DIU (Case A, Interview One). Case D leverages the startup ecosystem based on a strong open innovation and platform approach, that allows to integrate innovative startup solutions into the core organization (Case D, Interview One). At Case E, the digital ecosystem (e.g. startups, academic player, innovation networks) is utilized for identifying new technologies and collaboration opportunities (Case E, Interview One & Two). For Case F, which particularly aims at establishing a digital ecosystem for its members, ecosystem activities include knowledge exchange, the utilization of local ecosystems for identifying digital talent and the education of its members in regard to digital expertise (Case F, Interview One). Similar, Case H participates in the digital ecosystem to get access to digital experts that support the DIU in establishing digital expertise within the core organization (e.g. keynote speeches, Case H, Interview One). Case B and G see ecosystem activities as secondary outcome (Case B, G, Interview One & Two). Only Case C and I, do not see the digital ecosystem as part of their objectives at all (Case C, I, Interview One & Two).

Following the case study research approach (section 4.1), we aimed at a diverse sample of DIUs, that addresses all objectives introduced in section 2.3. As we aimed at deriving CSFs for DIUs to fulfill their objectives and at identifying KPIs that are or should be used by DIUs to measure their performance, creating a comprehensive understanding of the objectives pursued within the sample is an important and necessary step to in regard to the robustness and generalization of this study. The results show that all objectives are covered by the sample, either directly or indirectly as primary and secondary objectives. Thus, we have set the basis for presenting the results in regard to CSFs and KPIs.

5.3. Critical success factors

In the course of this study, we derived nine important categories of CSFs that consist of 16 explicit CSFs in total.

To answer RQ1 ("What are CSFs for DIUs to fulfill their objectives?"), several categories of CSFs have been identified. Table 14 shows the aggregated results. Different categories of CSFs are depicted in a descending order (dependent on the number of expert mentions).

In total, ten categories have been derived, consisting of 16 CSFs. However, "incentives" was addressed by one case only. Therefore, it was not identified in at least 15% of the cases

Table 14: Categories of CSFs

Categories of CSFs	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
The team	x	x	x		x	x	x	x	x	8
Top management support	x	x		x	x		x	x	x	7
Ties into the core organization	x	x	x	x	x		x			6
Acceptance & trust	x		x	x	x	x	x			6
Methodology		x	x		x	x	x	x		6
Distance & playground	x	x	x	x	x		x			6
Impact	x	x	x		x		x		x	6
Unfair advantage	x	x					x			3
Communication					x			x		2
Incentives		x								1

Note. *Count indicates number of cases that mentioned specific category of CSFs.

(section 4.2.1) and will not be explained further. The same logic was applied to explicit CSFs. As no clear differences between different types of DIUs were observable, CSFs were derived across DIU types consistently.

To summarize the results with regards to RQ1 ("What are CSFs for DIUs to fulfill their objectives?"), an overview of categories of CSFs including explicit CSFs is provided in Table 15.

Based on the categories identified, the underlying explicit CSFs are explained in the following, starting with the team, as mentioned most frequently.

The team: In regard to the team, three CSFs have been identified. First, it is important to identify the right people with relevant experience that are willing to join a corporate DIU (1). This also includes identifying the right team members from the core organization. Relevant experience may include a previous employment in a startup or comparable entrepreneurial experience. This can also be a challenge for DIUs, since aforementioned talent often strives towards founding own startups rather than working for a corporate (Case A-C, E, Interview One & Two). Another CSF is to hire the right digital talent in order to decrease the dependency on external support (2). Being dependent on external support would be too expensive and not sustainable long-term (Case E, H, Interview One & Two). Hence, it is crucial to set up a diverse team with the right mix of skills (3). This includes areas like technology (e.g. data scientists, developers), design (e.g. UX designers), marketing & sales (e.g. e-commerce and marketing experts). Thus, DIUs become more independent (Case A, E, H, Interview One & Two).

Top management support: Almost all cases referred to top management support (CEO, board & senior management) (4) as CSF. The reasons for this are multifaceted: First, the risk of a CEO change, which could result in the termination of initiatives set up by the former CEO. This is oftentimes the case for special, cost intensive initiatives like DIUs (Case A, Interview One). Furthermore, it is important to have a clear mandate from the board that empowers the DIU to work towards its objectives, which is oftentimes associated with (monetary) resources (Case E, Interview One & Two). The top management support also impacts the acceptance and understanding for the DIU's activities across the entire core organization (Case D, Interview One & Two).

Ties into the core organization: Another important category are the ties into the core organization which is closely related to top management support. Although top management is crucial for the success of DIUs, close ties into the core organization are seen as almost as important. Therefore, forming alliances & ties with the core organization (e.g. IT, HR, legal, finance) (5) is seen as CSF for DIUs to achieve their objectives. For example, an alliance with the corporate IT is beneficial for handing over digital innovations created by the DIU during the late phases of the innovation process and during early phases to understand the tech stack of the core organization. Alliances with other departments, such as HR and legal, help the DIU to speed up its operations and to become more efficient. Furthermore, it is important to ensure the personal contact to employees across the entire organization (6). Similar to forming alliances, the DIU benefits from such relationships with regards to operations and innovation activities through leveraging core organization resources. For example, the reach of the core organization into different regions can help to scale digital innovations (Case A-E, G, Interview One & Two).

Acceptance & trust: Closely related to ties into the core organization, gaining acceptance & trust from the core organization (7) is another CSF for DIUs. Some cases recommend working on innovation close to the core first, in order to prove the benefits of digital innovation. Thus, the DIU can increase its acceptance & trust and use resulting autonomy to shift further towards novel business areas (Case A, C-G, Interview One & Two).

Table 15: Categories of CSFs including explicit CSFs

Categories of CSF	Explicit CSFs
The team	Identify the right people with relevant experience that are willing to join a corporate DIU (1)
	Decrease the dependency on external support (2)
	Set up diverse team with the right mix of skills (3)
Top management support	Ensure top management support (CEO, board & senior management) (4)
Ties into the core organization	Form alliances and ties with the core organization (e.g. IT, HR, legal, finance) (5)
	Ensure the personal contact to employees across the entire organization (6)
Acceptance & trust	Gain acceptance & trust from the core organization (7)
Methodology	Select appropriate methodologies according to objectives (8)
	Define responsibilities within the innovation process (9)
	Be fast (10)
Distance & playground	Define suitable distance to the core organization (11)
	Create playground for the DIU and its employees (12)
Impact	Create impact on the core organization (13)
	Select the right topics (14)
Unfair advantage	Utilize the “unfair advantage” (15)
Communication	Establish a clear and effective communication concept (16)

Methodology: Due to the strong focus on digital innovation, it is critical to select appropriate methodologies according to the objectives (8), for example, design thinking. It is important to validate each idea based on specific criteria. Similar to traditional R&D, the cost of pivoting increase throughout the innovation process. This CSF is also closely related to the team, which applies these methodologies in their daily work life. Another CSF within methodology is to define the responsibilities within the innovation process (9). It is fundamental to coordinate the transfer of digital innovation from the DIU to the core organization, including the stage within the innovation process, the department that takes over the project and what exactly will be delivered to the core organization (Case B-D, E-H, Interview One & Two). Furthermore, it is crucial to be fast (10). Otherwise, there is the risk that the management loses interest in specific projects. This CSF might be highly dependent on CSF (3), setting up a diverse team with the right mix of skills (Case A, B, H, Interview One).

Distance & playground: Closely related to methodology, the category distance & playground consists of two CSFs. First, define a suitable distance to the core organization (11), which is important to lose the boundaries of the core organization and to speed up operations. With an increasing distance, DIUs are able to operate more autonomously and agile which might have a positive impact on the outcome (Case A, B, E, G, Interview One & Two). Distance to the core organization is related to another CSF, creating a playground for the DIU and its employees (12). This includes the empowerment of the team, allowing to experiment and to fail, the willingness to take risks and agility (Case A-E, Interview One & Two).

Impact: This category consists of the CSFs create impact on the core organization (13) and select the right topics (14). Creating impact on the core organization includes aligning the activities of the DIU with the strategy of the core organization and creating digital innovation that creates business impact with a relevant size (e.g. revenue increase, cost savings). This is not only critical for the cases that focus on existing business (i.e. external enhancer), but also for the external creators. Furthermore, it is important to focus on scalability and a well-diversified digital innovation portfolio that is self-sustaining (Case A, E, G, I, Interview One and Two). The second CSF within impact, select the right topics (14) is closely related to CSF (13). It includes the identification of relevant opportunity fields and problems. Furthermore, it is important to not only focus on “moonshot” topics, that are of high risk, but also on topics that are close to the core business. Thus, the DIU is able to gain visibility which might result in an improved acceptance within the core organization (Case A-C, G, Interview One & Two).

Unfair advantage: Another CSF for DIUs is to utilize the “unfair advantage” (15). Compared to startups, DIUs are usually slower with regards to operations and innovation activities. However, DIUs can use their unfair advantage (i.e. being part of the core organization) over startups. This includes, for example, access to existing sales structures and resources like knowledge and customers (Case A, B, G, Interview One & Two).

Communication: The last category of CSFs is related to communication. It is critical to establish a clear and effective communication concept (16) to communicate activities and success stories to relevant stakeholders, for example through hosting events and publishing intranet articles. Oftentimes, this also has an educational effect which results in an increased awareness for the DIU within the core organization (Case E, H, Interview One & Two).

The majority of CSFs seems to address the key objective of

DIUs, digital innovation. More detailed analysis with regards to the CSFs that focus on other objectives would go beyond the scope of this research project. As a next step, we take a closer look at the results of the semi-structured interviews in order to address RQ2 ("Which KPIs are or should be used by DIUs to measure their performance?").

5.4. Performance measurement of DIUs

Initially, we provide contextual information about the use of KPIs at DIUs (e.g. challenges and benefits of establishing KPIs at DIUs). Subsequently we introduce different sets of KPIs that are or should be applied at DIUs to measure their performance. In addition, we highlight KPIs that are reported to the core organization and conclude with a short set of KPIs that could be applied to measure the impact of the DIU on the digital transformation of the core organization.

5.4.1. Contextual information: Key performance indicators

So far, none of the cases has utilized an established PEMS (e.g. balanced scorecard approach) to measure its performance. While there are several challenges in regard to establishing KPIs at DIUs (e.g. identification of suitable KPIs), the key benefit is to improve transparency. Furthermore, the KPIs applied with regards to digital innovation usually change and develop alongside the innovation process. The majority of the cases recommends the use of a specific set of KPIs across multiple projects. However, each project usually includes individual KPIs as well.

A detailed overview of the identified contextual information that is relevant for the purpose of this study is provided in the following.

PEMS

Interestingly none of the cases has established an existing PEMS, such as the balanced scorecard approach. While there are first approaches of setting up PEMS, they mainly consist of individual KPIs that do not follow the structure of any established PEMS. The reasons for this are manifold: Most DIUs were founded only a few years ago. Hence, performance measurement was oftentimes addressed only recently. In this context, the DIUs mainly focused on identifying suitable KPIs that can be used to measure their activities and performance (Case A-I, Interview One & Two). Establishing a PEMS like the balanced scorecard is related to high efforts, that would go beyond the requirements for performance measurement as of today (Case C, D, G, Interview One & Two). Furthermore, several cases do not see a good fit between the highly individual activities of their DIUs and the applicability of a standardized PEMS (Case D, G, H, Interview One & Two).

Challenges and benefits of establishing KPIs

In total, five challenges and one major benefit of establishing KPIs at DIUs were identified among the sample. A short overview is provided in Table 16.

Challenges

Identification of suitable KPIs: The key challenge of establishing KPIs mentioned by most cases is the identification of suitable KPIs (Case A-C, E-H, Interview One & Two). As employees might work towards achieving specific KPIs that are related to their compensation, DIUs need to ensure that KPIs actually represent their objectives. Furthermore, projects usually include a high degree of individuality. Hence, identifying KPIs that are applicable for various projects poses a challenge (Case B, Interview One). The complexity and nature of digital innovation further complicates the identification of suitable KPIs (Case A-C, E. Interview One & Two). As DIUs also aim at fostering cultural change within the core organization, purely financial measures would not sufficiently address this objective. However, the identification of KPIs that measure cultural change and digital expertise is challenging (Case E, F, Interview One & Two).

Applicability of traditional KPIs: Another important challenge many DIUs are facing is the applicability of traditional KPIs, which are used for performance measurement within the core organization. Examples for these traditional, oftentimes financial KPIs are ROI and earnings before interest and taxes (EBIT). Core organizations incorporated such KPIs to measure their success. Consequently, DIUs are oftentimes expected to use similar KPIs. However, these KPIs are hardly applicable for the objectives and areas of activities pursued within DIUs (Case C-E, G, Interview One & Two).

Incentives related to KPIs: The establishment of incentives that are attached to KPIs is another challenge DIUs are facing as it is complex to identify the right KPIs which consider that digital innovation might take several years before business impacts are actually realized. Hence, DIUs need to appropriately establish incentives that motive employees to work towards the right KPIs (Case B, D, E, G, Interview One & Two).

Focus on reporting: It is important to keep the tracking and reporting of KPIs rather light, in order for DIUs to be able to focus on their actual objectives (Case C, D, F, Interview One & Two).

Data collection: As many of the KPIs that are applied at DIUs differ from the ones at the core organization, there is oftentimes no system for automated tracking in place. Therefore, collecting related and relevant high-quality data is oftentimes demanding for DIUs (Case G-H, Interview One & Two).

While multiple challenges of establishing KPIs at DIUs were identified, one multifaced key benefit was derived among the sample.

Benefits

Transparency: The key benefit of establishing KPIs identified among all cases is transparency. However, transparency is multifaced and includes several elements: First, KPIs allow showing the value of the DIU to the core organization to justify its existence. Second, KPIs help making the outcomes of the DIU more tangible, observable and comparable over time. Third, KPIs are absolutely required for managing and steering the DIU not only as a whole, but on team and individual level (Case A-I, Interview One & Two).

Journey of KPIs

Another contextual information is the "journey of KPIs"

Table 16: Challenges and benefits of establishing KPIs at DIUs

Challenges & benefits	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
Challenges										
Identification of suitable KPIs	x	x	x		x	x	x	x		7
Applicability of traditional KPIs			x	x	x	x	x			5
Establishment of incentives		x		x	x	x	x			5
Focus on reporting			x	x		x				3
Data collection							x	x		2
Benefits										
Transparency	x	x	x	x	x	x	x	x	x	9

Note. x = challenge or benefit identified.

which was identified among the majority of the cases. Journey of KPIs means, that the KPIs applied to measure the objective digital innovation might change and develop alongside the innovation process. While non-financial and qualitative KPIs should be prioritized during early phases of the process (i.e. discovery, development), the applied KPIs should partly develop towards traditional, financial KPIs when moving towards later phases of the process (i.e. diffusion, impact). Some cases even recommend having specific KPIs for each process stage (Case A, C, D, F-H, Interview One & Two).

Cross-project applicability of KPIs

Concluding, the interviews revealed another interesting contextual information concerning the cross-project applicability of KPIs. Due to the high degree of individuality across the conducted projects, it is important to apply customized KPIs for each initiative. However, having a set of common KPIs to foster comparability and to improve the efficiency of performance measurement within the DIU is key (Case A, C, D, F-H, Interview One & Two).

After having introduced relevant contextual information in regard to key performance indicators, we have laid the foundation for answering RQ2 ("Which KPIs are or should be used by DIUs to measure their performance?").

5.4.2. Key performance indicators

In total, 38 KPIs were identified that are or should be used by DIUs to measure their performance. The set was split up into objective related subsets, KPIs that are reported to the core organization and complemented by KPIs that are or should be applied to measure the impact of the DIU on the digital transformation of the core organization.

For measuring the objective digital innovation, 26 KPIs were identified. These can be further clustered into financial (7 KPIs), customer-related (9 KPIs) and other KPIs (10 KPIs). In accordance with section 5.2, KPIs related to cultural change and digital expertise were aggregated (10 KPIs). While no KPI could be identified for the objective organizational design change, two KPIs were derived in regard to digital innovation ecosystem. An overview including all subclusters and the count of each KPI, meaning the number of cases that mentioned a specific KPI, is depicted in Table 17. The high share of KPIs related to digital innovation indicates the importance of the objective within the sample (section 5.2). The KPIs are listed in descending order dependent on their count. In case of the same count, alphabetical sorting was applied.

While an overview of the most important findings is given in the following, Appendix 21 provides a short explanation of each of the identified KPIs.

Digital innovation

Financial: Each of the seven KPIs identified in this cluster is applied by at least two cases within the sample. There are three KPIs included that measure different types of revenue. To be precise, revenues generated through digital innovations created by the DIU, revenues created through services the DIU offers to the core organization and occasionally to external clients and revenues that result from establishing the e-commerce business of the core organization. Another widely applied KPI is the input-related measure budget / cost of the DIU. As many DIUs also create digital innovation that aim at improving processes, the achieved efficiency gains get measured through cost savings. Concluding, several DIUs use ROI to measure their digital innovation activities from a financial point of view (Case A-I, Interview One & Two).

Non-financial – customer: A sub-cluster of non-financial KPIs that are related to customers was identified. While each KPI is explained in Appendix 21, we want to highlight three KPIs, that are widely used among the sample cases: Number of customers, customer / user satisfaction and net promoter score which is closely related to customer satisfaction. Compared to the majority of financial KPIs, customer-related measures are suitable for earlier phases of the innovation process (Case A-I, Interview One & Two).

Non-financial – other: Complementary, the remaining KPIs that were derived to measure the objective digital in-

Table 17: Objective related KPIs of DIUs

KPIs to measure specific objectives	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
Objective: Digital innovation										
Financial										
Budget / cost		x	x	x	x	x	x	x	x	8
Revenue (digital innovation)	x	x	x		x	x	x	x		7
Cost savings	x			x	x	x	x	x		6
Revenue (offered services)	x					x	x	x		4
ROI			x		x	x				3
Ratio digital / traditional business				x				x		2
Revenue (e-commerce)								x	x	2
Non-financial: Customer										
Number of customers	x	x	x	x	x		x	x		7
Customer / user satisfaction	x		x		x	x		x	x	6
Net promoter score	x	x	x		x				x	5
Churn rate		x					x			2
Customer engagement				x	x					2
Customer acquisition cost							x			1
Customer centricity			x							1
Customer lifetime value							x			1
Number of interviews						x				1
Non-financial: Other										
Number of projects per stage		x		x	x	x	x	x		6
Total number of projects / tests				x	x		x	x		4
Time to market					x	x		x	x	4
Number of ideas evaluated	x						x	x		3
Share of digital transactions			x					x		2
Number of successful projects		x						x		2
Business model readiness			x							1
Interaction rate			x							1
Learning velocity			x							1
Stability			x							1
Objective: Cultural change & digital expertise										
Adoption rate (e.g. methodologies)				x	x					2
Net promoter score						x	x			2
Number of collaborations					x	x				2
Number of workshops		x				x				2
Employee satisfaction						x				1
Hours of training		x								1
Number of digital trends scouted					x					1
Number of exchanges						x				1
Number of workshop participants		x								1
Social media traction				x						1
Objective: Digital innovation ecosystem										
Number of collaborations					x					1
Number of exchanges						x				1

novation were aggregated within the sub-cluster “other”. The KPIs most frequently used are the number of projects per stage, total number of projects / tests, time to market and number of ideas evaluated. Similar to customer-related measures, these KPIs are suitable for early phases of the innovation process and could even be applied within the first

stage (i.e. discovery, Case A-I, Interview One & Two).

Cultural change & digital expertise

Compared to the KPIs identified for the objective digital innovation, the KPIs applied in regard to cultural change and digital expertise are utilized by fewer DIUs. This might be related to the findings of section 5.2, which shows that most DIUs within the sample define cultural change and digital expertise as secondary objectives. The KPIs used by at least two DIUs are adoption rate (e.g. methodologies), net promoter score, number of collaborations as well as number of workshops (Case B, D-G, Interview One & Two).

Digital innovation ecosystem

With regards to digital innovation ecosystem, the KPIs number of collaborations (e.g. collaborations with startups) and number of exchanges (e.g. exchanges with partners within the digital innovation ecosystem) were identified (Case E-F, Interview One & Two).

In addition, we identified objective related KPIs that are or should be reported by the DIU to the main organization. An overview that follows the same order logic as Table 17 is depicted in Table 18.

The KPIs used by DIUs to measure their objectives (Table 17), also set the basis for the reporting to the core organization. However, not all KPIs that are measured are consequently reported. Furthermore, the count of KPIs, meaning the number of cases that report a specific KPI, is lower for several KPIs compared to the count depicted in Table 17 (e.g. cost savings, number of customers, number of projects per stage). Especially financial and customer related KPIs (e.g. revenue (digital innovation), customer / user satisfaction) seem to be of high importance in regard to reporting. Interestingly the average number of KPIs reported is 6.3 KPIs per case while the average number of measured KPIs per case is 10.4. With 14 KPIs in total, Case E established the most comprehensive set of KPIs that are or should be reported among the sample cases (Case A-I, Interview One & Two).

Concluding, we derived a short set of KPIs that are or should be applied by DIUs to measure their impact on the digital transformation of the core organization (Table 19). While most of these KPIs are only applied by individual DIUs, the KPIs ratio digital / traditional business and net promoter score are applied by multiple DIUs. Similar to the explanations provided for the KPIs that are used to measure specific objectives, a short overview including explanations for this set of KPIs is provided in Appendix 22 (Case A-F, H, Interview One & Two).

Thus, we answered RQ2 ("Which KPIs are or should be used by DIUs to measure their performance?") through deriving several sets of KPIs, that enable DIUs to measure specific objectives, including reported KPIs and metrics to measure the impact of the DIU on the digital transformation of the core organization.

6. Discussion

Following RQ1 ("What are CSFs for DIUs to fulfill their objectives?"), we identified nine re-levant categories of CSFs, which consist of 16 explicit CSFs. We answered RQ2 ("Which KPIs are or should be used by DIUs to measure their performance?") by deriving 38 KPIs that were clustered into objective related subsets (e.g. KPIs to measure digital innovation). Additionally, we identified KPIs that are or should reported to the core organization as well as KPIs to measure the impact of the DIU on the digital transformation of the core organization. Thus, our results address the existing research gap in the field of DIUs and performance measurement.

By answering both research questions and merging our results with existing literature, we aim at deriving a framework for the measurement of success of DIUs. Therefore, we initially discuss our results in association with existing research, following the same content structure as section 5. At the end of each section (section 6.1.1 - 6.1.5), we derive relevant steps for the framework. Subsequently, the framework for the measurement of success of DIUs, which is the key outcome of this study, is presented. Concluding, implications for practice and theory, limitations as well as ideas for future research are introduced.

6.1. Framework development

By discussing and merging our findings with existing literature, six guiding steps that set the foundation for the framework were derived. These steps address various aspects of DIUs, such as different DIU types and objectives, CSFs and relevant KPIs.

6.1.1. DIU types

Using the typology of DIUs derived by Barthel et al. (2020) to identify the type of each sample case, we identified five external enhancers, two external creators and two hybrid types. However, no case was classified as internal facilitator. This indicates that DIUs with an external innovation orientation might be prevalent. We followed Barthel et al. (2020) and exclusively focused on the objective and scope for identifying the DIU type. In addition, we gathered relevant information in regard to the setting and design of each case (Appendix 12 – 20) through conducting the supplemental survey.

The results revealed two major discrepancies: First, differences in regard to the responses of multiple survey participants within one case were identified (e.g. Case D, Appendix 15), for example in regard to the dimensions internal ties and project selection, showing that the setting and design of DIUs can be perceived differently among its employees. Second, the specific setting and design of several cases does not correspond to the setup of ideal types recommended by Barthel et al. (2020) for achieving the specific objectives. However, these design patterns of ideal types "appear to fit the different innovation objectives" (Barthel et al., 2020, p. 12). Thus, we derived two initial steps for the framework based on literature and our findings:

Table 18: Objective related KPIs of DIUs reported to the core organization

KPIs to measure specific objectives	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
Objective: Digital innovation										
Financial										
Revenue (digital innovation)	x	x	x		x		x	x		6
Budget / cost		x	x		x				x	4
Revenue (offered services)	x					x	x			3
Cost savings	x				x					2
Ratio digital / traditional business				x				x		2
Revenue (e-commerce)								x	x	2
ROI			x		x					2
Non-financial: Customer										
Customer / user satisfaction			x	x	x	x			x	5
Number of customers			x		x		x	x		4
Net promoter score			x		x				x	3
Customer centricity			x							1
Customer engagement					x					1
Non-financial: Other										
Non-financial: Other										
Time to market					x			x	x	3
Total number of projects / tests				x	x			x		3
Number of projects per stage					x			x		2
Share of digital transactions			x					x		2
Business model readiness			x							1
Interaction rate			x							1
Learning velocity			x							1
Number of successful projects								x		1
Stability			x							1
Objective: Cultural change & digital expertise										
Adoption rate (e.g. methodologies)					x					1
Hours of training		x								1
Number of collaborations					x					1
Number of digital trends scouted					x					1
Number of workshop participants		x								1
Number of workshops		x								1
Objective: Digital innovation ecosystem										
Number of exchanges						x				1

Step 1: Define the objective & scope of the DIU in regard to digital innovation.

Step 2: Dependent on the objective & scope, consider the setting & design of ideal DIU types for establishing a new DIU and for comparison in case the DIU was already established.

6.1.2. DIU objectives

By analyzing existing literature, five objectives pursued by DIUs were identified (i.e. digital innovation (primary objective), cultural change, digital expertise, organizational design change, digital innovation ecosystem). As we aim at considering objective related KPIs within the framework, it was important to understand which DIU objectives are actually addressed by the sample cases, to improve the applicability and generalizability of the framework.

In accordance with existing literature, digital innovation is seen as primary objective among the majority of the sample cases. Cultural change, digital expertise and organizational design change are oftentimes perceived as secondary objectives, that occur as by-outcomes when pursuing main objectives. In addition, several cases defined participating in or creating digital innovation ecosystems a primary objective as well.

To sum up, all objectives identified within literature have

Table 19: KPIs to measure impact on digital transformation

KPIs to measure impact on digital transformation	DIU type and case									Count*
	External enhancer					External creator		Hybrid		
	A	B	C	D	E	F	G	H	I	
Ratio digital / traditional business		x	x	x	x			x		5
Net promoter score		x			x	x				3
Acceptance rate					x					1
Cost savings	x									1
Employee retention					x					1
Employee satisfaction						x				1
Number of successful projects			x							1
Revenue (digital innovation)	x									1
Revenue safeguarded					x					1

been confirmed as primary or secondary objective by the sample cases. Therefore, the sample represents a sufficient basis for answering RQ1 and RQ2. As the objectives pursued within the DIU are crucial in regard to defining suitable KPIs (Chapter 3), we included an objective based step to the framework:

Step 3: Define which objectives are pursued at the DIU that go beyond digital innovation.

6.1.3. Critical success factors

We identified 16 CSFs for DIUs to fulfill their objectives and clustered these into categories of CSFs answering RQ1. While existing contributions by practitioners mainly cover recommendations for DIUs that lack in theoretical foundation, literature only provides important factors for DIUs. However, CSFs have been widely addressed in other research areas (e.g. project management) and occasionally also in related fields to DIUs (e.g. digital business strategy). The common approach observed within literature, is the aggregation of CSFs into clusters derived from the underling concept. Hence, we followed this approach and adapted the overview of CSFs provided in Table 15 through utilizing the structure of the typology provided by Barthel et al. (2020). Dependent on the respective issue addressed within the individual CSFs, each explicit CSFs was assigned to the categories objective and scope and setting and design. An overview is provided in Table 20.

The identified CSFs partly overlap with the factors identified by practitioners and academics (e.g. top management support, Table 2). However, the majority of CSFs have not been derived previously. Thus, we addressed the existing research gap and identified CSFs for DIUs to fulfill their objectives. CSFs were included into the framework through the following step:

Step 4: Consider the explicit CSFs for DIUs to fulfill their objectives within the categories objective & scope and setting & design.

6.1.4. Contextual information: Key performance indicators

Existing literature already highlighted the importance of PEMS for innovation activities. Several attempts of adopting established approaches, such as the balanced scorecard, to measure innovation exist. One key takeaway is the importance of linking KPIs to specific objectives (section 3.2). Furthermore, several important requirements for PEMS in DIUs (section 3.2.2) as well as challenges of measuring digital innovation have been discussed in detail (section 3.3.2). We contribute to the existing discussion by deriving contextual information in regard to the application of KPIs at DIUs. We outlined, that none of the cases has utilized an established PEMS (e.g. balanced scorecard) to measure its performance so far. Furthermore, we identified challenges (e.g. identification of suitable KPIs) and a multifold key benefit (transparency) of establishing KPIs at DIUs. In addition, we introduced the "journey of KPIs", which entails the development of digital innovation KPIs alongside the innovation process. These findings are in accordance with the innovation performance measurement framework provided by Dewangan and Godse (2014) (Table 9) and selected requirements for PEMS in DIUs (Table 5, Table 6, Table 7, Tabl 8). As the requirements derived by Haskamp et al. (2021) set a profound basis for establishing PEMS at DIUs and can be applied as guidelines for selecting specific KPIs to measure the success of DIUs, we added the following step to the framework:

Step 5: Consider the requirements for PEMS in DIUs.

6.1.5. Key performance indicators

By deriving a profound set of 38 KPIs that were clustered into objective related subsets, we answered RQ2. An aggregated overview of the identified KPIs is provided in Table 21.

In addition, we identified KPIs that are reported to the core organization and KPIs that are or should be used to measure the impact of the DIU on the digital transformation of the core organization (Table 22). The derived KPIs partly overlap with the selected innovation metrics identified by Chan et al. (2008) (Table 10) but are more comprehensive

Table 20: Adapted overview of explicit CSFs: Assignment to categories of DIU typology

Category	Explicit CSFs
What? Objective & Scope	Select appropriate methodologies according to objectives. Define responsibilities within the innovation process. Be fast. Create playground for the DIU and its employees. Create impact on the core organization. Select the right topics. Utilize the “unfair advantage”.
How? Setting & Design	Identify the right people with relevant experience that are willing to join a corporate DIU. Decrease the dependency on external support. Set up diverse team with the right mix of skills. Ensure top management support (CEO, board & senior management). Form alliances and ties with the core organization (e.g. IT, HR, legal, finance). Ensure the personal contact to employees across the entire organization. Gain acceptance & trust from the core organization. Define suitable distance to the core organization. Establish a clear and effective communication concept.

Table 21: Objective related KPIs

Objective: Digital Innovation		
Financial		
Budget / cost	Revenue (offered services)	
Revenue (digital innovation)	ROI	Revenue (e-commerce)
Cost savings	Ratio digital / traditional business	
Non-financial: Customer		
Number of customers	Churn rate	Customer centricity
Customer / user satisfaction	Customer engagement	Customer lifetime value
Net promoter score	Customer acquisition cost	Number of interviews
Non-financial: Other		
Number of projects per stage	Share of digital transactions	
Total number of projects / tests	Number of successful projects	Learning velocity
Time to market	Business model readiness	Stability
Number of ideas evaluated	Interaction rate	
Objective: Cultural Change & Digital Expertise		
Adoption rate (e.g. methodologies)	Number of workshops	Number of exchanges
Net promoter score	Employee satisfaction	Number of workshop participants
Number of collaborations	Hours of training	Social media traction
	Number of digital trends scouted	
Objective: Digital Innovation Ecosystem		
Number of collaborations		
Number of exchanges		

(e.g. subsets of KPIs) and particularly applicable to DIUs. In accordance with literature, the KPIs were directly related to objectives (section 3.3.1) and clustered into different subsets (section 3.3.2). With regards to the objective organizational design change, no specific KPI was identified. The reason might be, that this objective was classified secondary by all sample cases.

The KPIs derived in this study contribute to the existing research gap of performance measurement at DIUs and can be utilized as a starting point for establishing PEMS in DIUs. Literature suggests assigning KPIs to specific stages within the innovation process (section 3.3.2, Table 9), which might be considered when selecting and applying KPIs. Based on literature and our findings, we derived the last step of the framework:

Step 6: Select an appropriate number of objective related KPIs dependent on the specific objectives of the DIU (under consideration of the requirements for PEMS in DIUs intro-

Table 22: KPIs to measure impact of DIU on digital transformation

KPIs		
Ratio digital / traditional business	Cost savings	Number of successful projects
Net promoter score	Employee retention	Revenue (digital innovation)
Acceptance rate	Employee satisfaction	Revenue safeguarded

duced in Step 5). Define which of the selected KPIs are reported to the main organization. If necessary, complement the selected KPIs with an additional set of KPIs to measure the impact of the DIU on the digital transformation of the core organization.

6.2. Framework for the measurement of success of DIUs

By aggregating and enriching the derived steps with relevant insights, the practical framework for the measurement of success of DIUs was derived. The six guiding steps within the framework address various aspects of DIUs, including the DIU type (step 1 & 2), DIU objectives (step 3), CSFs (step 4), requirements for PEMS in DIUs (step 5) and KPIs to measure the performance of DIUs (step 6). The main outcome of this research project, the practical framework for the measurement of success of DIUs including all steps, is depicted in Figure 6. In addition, we provide a more comprehensive version of the framework, which was particularly designed for practical application, in Appendix 23.

To make sure that all success related aspects of DIUs derived and aggregated within this study are taken into account, each of the six guiding steps should be considered consecutively, starting with step one. When applying the framework, the different steps can be prioritized to different degrees, depending on specific needs and inefficiencies of the existing performance measurement. Thus, the framework sets the foundation for establishing and improving performance and success measurement at DIUs in a practical and flexible way.

6.3. Implications, limitations and future research

The comprehensive framework derived within this study comes along with several implications for practice: First, the framework can be applied for various DIU types. Second, it can be utilized when establishing new DIUs and adjusting existing ones, as it includes important information in regard to the setting and design of ideal types. Third, the framework helps to assess which CSFs have been realized within the DIU already and which further CSFs should be addressed. Fourth, the framework allows to align existing performance measurement with the recommendations for PEMS in DIUs. Last, the identified KPIs set a profound basis for selecting an appropriate set of KPIs to measure the performance of DIUs. To sum up, the framework sets the foundation to measure the success of DIUs in a practical way, through guiding DIU employees, responsible for success and performance measurement, in regard to establishing or improving the success measurement of their DIU. It helps to address existing challenges DIUs are facing and to increase transparency, for the DIU itself and for the core organization.

Moreover, we contribute to the existing discussion around performance measurement of DIUs by answering both research questions and deriving the framework. Hence, this study has multiple implications for theory. By using the typology of DIUs provided by Barthel et al. (2020), we were able to identify the type of each case within our sample. The objectives of DIUs derived by Raabe et al. (2021) set the foundation to identify the objectives of the sample cases. No further objectives were identified, showing the comprehensiveness of the set of objectives. The theoretically sound identification and clustering of explicit CSFs for DIUs enriched the existing contributions of practitioners and academia. By outlining contextual information in regard to the application of KPIs at DIUs, we contributed further interesting insights with regards to performance measurement of DIUs, which can be considered along the requirements of PEMS in DIUs derived by Haskamp et al. (2021). Existing literature in regard to innovation performance measurement was utilized to identify KPIs that are or should be applied by DIUs to measure their performance. Therefore, we contribute to the theory surrounding performance measurement of digital innovation.

Although we followed the guidelines of the underlying research methodologies rigorously, our findings are not without limitations. We investigated a small sample that consisted of nine cases that differ in company size and industry. However, the sample is geographically limited to Germany and Switzerland. In addition, we were only able to conduct multiple interviews for three cases. The data was gathered and analyzed by one researcher. Future research could investigate a larger sample with cases from several regions and industries, through conducting in depth case studies with multiple researchers and interviews per case to improve generalizability, reliability and reduce interviewer bias.

We exclusively conducted interviews with upper management DIU employees, who have a profound understanding of the success measurement within their DIU. Interview partners from core organizations that are directly involved in the reporting process of DIUs might provide further interesting insights in regard to success measurement of DIUs. As no case was identified as type internal facilitator within the sample, future research could particularly address success measurement of this DIU type. In addition, the derived framework could be applied in future studies to investigate its applicability in real world settings and to identify potential shortcomings. It would be interesting to see how the identified CSFs are actually realized within DIUs and how

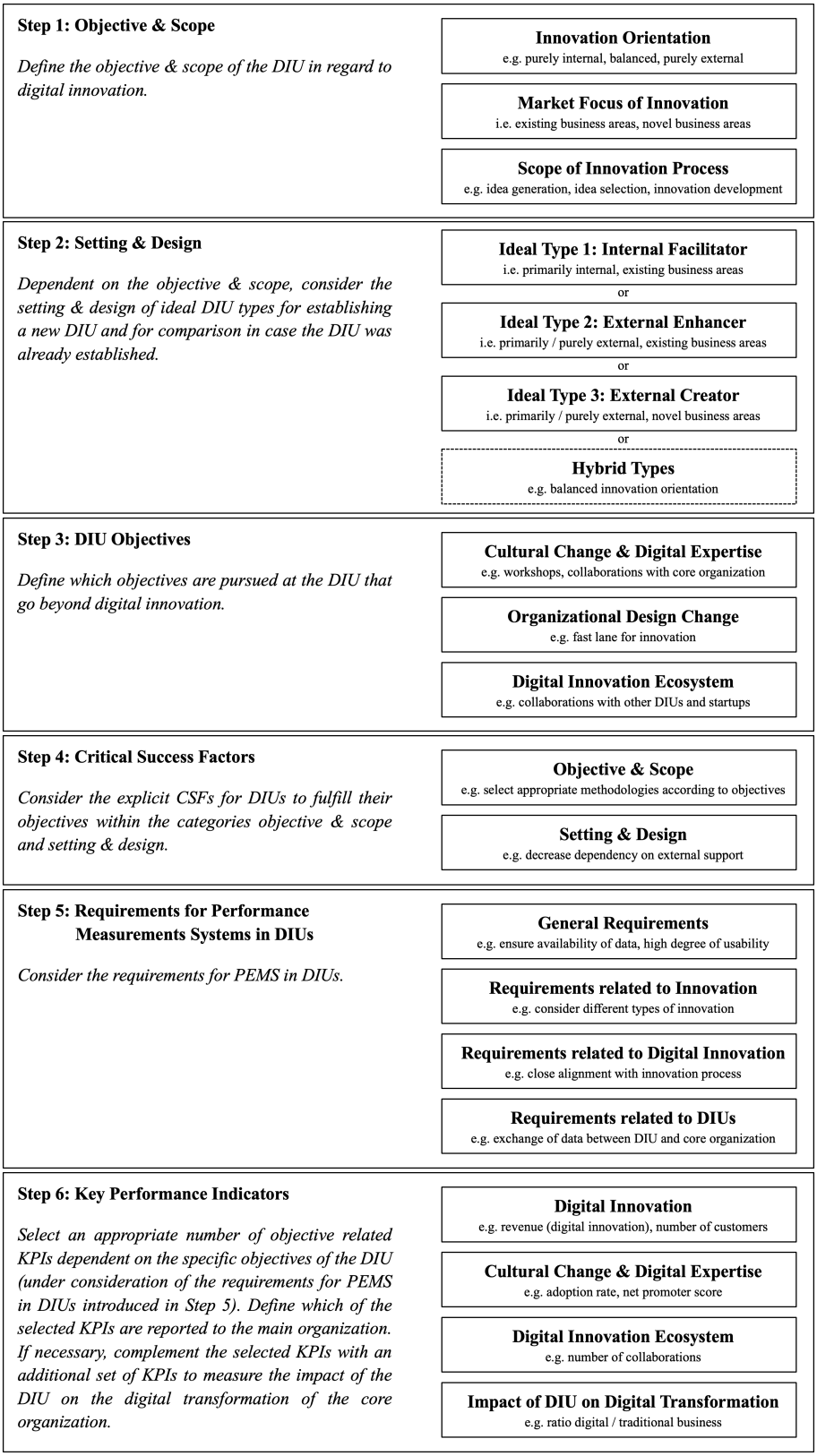

Figure 6: Framework for the measurement of success of DIUs

their implementation impacts the success of DIUs. Similar, future research could analyze how the derived KPIs are implemented within DIUs. Moreover, a subset of KPIs could be applied to measure the success of DIUs, which would enable

performance comparison across multiple DIUs.

Within this study, we only captured the current status of the cases. However, the results from the interviews revealed, that DIUs constantly develop over time, which might also impact performance measurement of DIUs. Future research could investigate the same sample at a later point in time to investigate, if and how CSFs and KPIs have developed over time.

7. Conclusion

This research project deals with digital innovation in corporations. It contributes to DIU and performance measurement research through deriving a practical framework for the measurement of success of DIUs.

Based on the applied case study research design and the mixed-method approach consisting of semi-structured interviews as core component, we answered both research questions in a profound way. We derived 16 CSFs for DIUs to fulfill their objectives. These were assigned to the dimensions of the typology of DIUs (RQ1). Furthermore, we identified 38 KPIs that are or should be used by DIUs to measure their performance and clustered these into objective related subsets. We identified KPIs that are or should reported to the core organization and supplemented the objective related metrics by KPIs that can be used to measure the impact of the DIU on the digital transformation of the core organization (RQ2).

Moreover, we retrieved contextual information in regard to the use of KPIs at DIUs. The results generated through the core component were complemented with data retrieved from the supplementary survey which was utilized to identify the type of each case. Hence, we contributed to the ongoing scientific discussions around different types of DIUs.

Through merging existing literature with the results of this study, a comprehensive framework consisting of six guiding steps was derived that addresses various aspects of DIUs, such as different DIU types, objectives, CSFs and relevant KPIs. Among multiple implications for practice and theory, the framework sets the foundation for establishing and improving performance and success measurement at DIUs in a practical way.

In conclusion, this study is among the first scientific contributions that address the topic success measurement of DIUs. The identified CSFs and KPIs as well as the derived framework are important contributions to this research field, which is facing an emerging interest by practitioners and academia. It does not only provide multiple implications for practice, but also builds the basis for various future research projects that can validate and extend the findings provided within this thesis.

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