Electronic Markets (2024) 34:16
https://doi.org/10.1007/s12525-024-00703-5

RESEARCH PAPER

Designing incentive systems for participation in digital ecosystems—An integrated framework

Cristina Mihale-Wilson[1] · **K. Valerie Carl**[1]

Received: 15 February 2023 / Accepted: 12 February 2024

Abstract

Digital ecosystems are a highly relevant phenomenon in contemporary practice, offering unprecedented value creation opportunities for both companies and consumers. However, the success of these ecosystems hinges on their ability to establish the appropriate incentive systems that attract and engage diverse actors. Following the notion that setting "the right" incentives is essential for forming and growing digital ecosystems, this article presents an integrated framework that supports scholars and practitioners *in identifying and orchestrating incentives into powerful incentive systems that encourage active participation and engagement*. This framework emphasizes the importance of understanding how individuals and groups are motivated to engage in the ecosystem to incentivize them effectively. To demonstrate its applicability and value, we show its application in the context of an emergent digital ecosystem within the Smart Living domain.

Keywords Incentive system design · Digital ecosystem participation · Company incentives · Consumer incentives · Incentive orchestration

JEL classification 03/039

Introduction

In today's highly competitive business environment, digital ecosystems (DEs) are a pathway to success and growth (Subramaniam et al., 2019). As digital counterparts of natural ecosystems, digital ecosystems are self-organizing, robust, and scalable environments where various species (i.e., hardware, software, platforms, consumers, and companies) interact with each other to solve complex problems (Hein et al., 2020; Teece, 2018). DEs can also be described as dynamic multi-player environments where value co-creation relies heavily on exchanging data and services between different actors (Hein et al., 2020; Wang, 2021). Such actors might include technology and platform providers, operators of digital artifacts, vendors of technical devices, and consumers (Bonina et al., 2021; B. Tan et al., 2015; F. Tan et al., 2016).

In this paper, we introduce a framework designed to facilitate the successful formation of DEs. After all, DEs do not just emerge. Instead, they are the results of one or various key actors' efforts (usually one or more companies) that team up to create more value than they could on their own (Jacobides et al., 2018). As practice shows, efforts and success to develop digital ecosystems vary significantly. Within this literature, scholars document that one crucial success factor for DEs lies in finding the suitable set of incentives—i.e., incentives and incentives systems—to ensure that ecosystem participation and user enrollment are self-perpetuating (Jacobides, 2019; Lettner et al., 2022; Valdez-De-Leon, 2019).

Incentives are the motivation or reason for someone to take a particular action. *Incentive systems*, however, are a structured and coordinated set of incentives that work together to drive a specific behavior or set of behaviors over time (Deci et al., 1999). In the context of DEs, incentive systems encompass various stimuli, mechanisms, and rewards designed to motivate a target group to join and actively use

Responsible Editor: Ulrike E. Lechner.

✉ Cristina Mihale-Wilson
mihale-wilson@wiwi.uni-frankfurt.de

K. Valerie Carl
kcarl@wiwi.uni-frankfurt.de

[1] Information Systems and Information Management, Goethe University Frankfurt, Theodor-W.-Adorno-Platz 4, 60323 Frankfurt Am Main, Germany

Published online: 28 February 2024

and engage in activities within the ecosystem. Although prior literature emphasizes the importance of setting the "right" incentives for ensuring participation and engagement within the ecosystem (e.g., Adner, 2017; L. Chen et al., 2022; Valdez-De-Leon, 2019), it remains silent on how to identify what really incentivizes various actor groups and how to orchestrate potentially conflicting or complementary incentives into a set of stimuli able to maximally scale DE participation (Ojala & Lyytinen, 2022; Parker et al., 2017; Pellizzoni et al., 2019). Surprisingly, although both activities are non-trivial and critical for achieving effective participation and engagement within digital ecosystems, they remain chronically under-researched. Our work builds on prior related literature (e.g., L. Chen et al., 2022; Kretschmer et al., 2022; Ojala & Lyytinen, 2022) and introduces a framework demonstrating the process of *identifying and integrating incentives into a cohesive system designed to attract both organizations and consumers to an emergent DE.*

Consequently, our work makes two valuable contributions to the scholarly literature on the topic. Firstly, our work thoroughly compiles goals and needs crucial for identifying matching incentives to encourage targeted groups to join a DE. This compilation serves as a foundation for discerning DE incentives. Current literature tends to emphasize various incentives like financial rewards, recognition, status, and access to resources (L. Chen et al., 2022; Jacobides et al., 2018), without consistently highlighting the importance of aligning these incentives to goals for optimal motivation. While prior literature offers some examples of stimuli, there is room in the current research landscape for a more structured and comprehensive compilation of needs and goals that can enhance the effectiveness of incentives on their recipients.

Our work offers insights into orchestrating incentives for various actor groups, ensuring a cohesive incentive system. While certain incentives might resonate with specific groups, integrating them into a larger DE framework can sometimes dilute their efficacy. By strategically coordinating these stimuli and considering their potential interactions, we aim to optimize the desired DE participation outcomes, focusing on the collective impact of combined stimuli on their target audience. To date, most studies treat incentives as isolated entities, overlooking potential conflicts or synergies between them. In our work, we account for the fact that stimuli might influence each other's effects (i.e., can be complementary, conflicting, or unrelated) and thus lead to less optimal outcomes in terms of participation.

In the subsequent sections of this article, we introduce an integrated framework designed to help orchestrate incentives for enhancing participation in DEs. We begin with a discussion on the theoretical underpinnings behind our proposed framework, followed by an overview of our methodology and the key elements of the framework. After presenting the main concepts and elements of the framework, we illustrate its application in the context of an emergent DE in the Smart Living domain. Finally, we conclude with a discussion of the advantages and limitations of the proposed framework, as well as potential paths for future research.

Theoretical background

This work relates to various literature streams but particularly to digital ecosystems, incentive system design, organizational strategic management, and consumer technology adoption. In this section, we discuss theories and prior work from the relevant individual streams of literature. We start by elucidating on the digital ecosystems and ecosystem design.

Digital ecosystems and ecosystem design

The information systems (IS) and organization studies (OS) disciplines present various definitions and types of "digital ecosystems" (Bonina et al., 2021; Hein et al., 2020; Isckia et al., 2018; Nambisan et al., 2019; Wang, 2021). Digital innovation ecosystems (Wang, 2021), Internet of things (IoT) ecosystems (Leminen et al., 2012), and platform ecosystems (Parker et al., 2017; Schreieck et al., 2016) are only a few exemplary types of ecosystems mentioned by prior research. These ecosystems, while similar in that ecosystems, represent a community collaborating toward a shared objective (Hein et al., 2020) and exhibit structural and operational differences. Innovation ecosystems, for instance, refer to a community that fosters and facilitates new and disruptive technologies (Wang, 2021). In comparison, the Internet of things (IoT) ecosystems revolve around smart sensors and devices that share data to perform a wide range of (automated) tasks (Mihale-Wilson et al., 2019). Another prominent type of ecosystem mentioned in the literature—platform ecosystems—refers to a community of participants who form around a platform (Parker et al., 2017; Schreieck et al., 2016). In contrast to these ecosystem examples, in this work, we understand DEs in more broad terms—i.e., as *dynamic multi-agent environments where agnostic but interconnected species (i.e., technology, digital services, products and platforms, organizations, individual consumers) work loosely together to achieve individual and shared goals* (Barykin et al., 2020; Jacobides et al., 2018; Valdez-De-Leon, 2019). This distinction between the various types of ecosystems is particularly important since it reveals differences in scope, emergence, and the set of potentially suitable incentives (Rochet & Tirole, 2003). For a better understanding, we elaborate on the structural differences between platform ecosystems and DEs.

In the context of platform ecosystems, the cornerstone of the ecosystem is the platform itself or a few interconnected platforms. However, the platform(s) is (are) a crucial piece for the value creation process, and the community builds around the platform owner(s) (Hein et al., 2020). This(these) platform(s) facilitate interactions between various participants, often bridging providers and consumers. The platform owner has the power to set the rules of governance for all interactions between actors and benefits from the transactions linked to their platform (Hein et al., 2020). The platform owner drives the platform ecosystem's inception and keeps a relatively high degree of control as the platform ecosystem evolves and matures. In fact, the platform owner plays a central role in shaping the evolution of the platform ecosystem by curating the product and service assortment as well as the participating providers (Gawer & Cusumano, 2014).

By contrast, in the context of a broader DE concept, the foundational elements of the ecosystem encompass multiple species (e.g., digital tools, platforms, technologies, services, organizations, and consumers) that coexist and benefit from one another (Jacobides et al., 2018). The community builds modularly around delivering novel value or creating new opportunities that can be platform- or technology-agnostic. Modularity refers to the fact that once the ecosystem has formed, no single dominant or governing entity regulates collaborations and ties between actors (Jacobides et al., 2018). Instead, within DEs, participants operate independently and interact with each other based on their own goals and objectives. Although collaboration between actors in DEs is more loose, dynamic, and uncontrollable than in platform ecosystems, the formation of these collaborations and by extension the formation of a DE can be purposefully initiated (Barykin et al., 2020).

In this work, we refer to the strategic establishment of the necessary cornerstones to form an ecosystem as *DE design*. The *DE designers* are the companies striving for the formation of the DE. Hence, the formation of an ecosystem starts with the DE designers' vision and ambition to push for establishing not only a technical infrastructure on which the DE can form but also suitable rules for governing the interactions between the actors in the DE (Floetgen et al., 2022; Hein et al., 2020). The technical infrastructure and suitable governance are equally important for DE's success (L. Chen et al., 2022; Teece, 2017). Because DEs rely heavily on autonomous agents that contribute to the ecosystems' value propositions, it is crucial to implement governance mechanisms that enable and coordinate the interactions between actors (e.g., the flow of resources) without losing the advantages of decentralized decisions (L. Chen et al., 2022; Teece, 2017). From an organizational perspective, governance mechanisms can be classified into incentive and control mechanisms (L. Chen et al., 2022). Control mechanisms rely on coercion to ensure that the actors in DEs behave in ways that align with the goals of the DE (e.g., monitoring, sanctions, and penalties for non-compliance). In contrast, incentives rely on motivation and refer to stimuli or benefits offered to actor groups to encourage them to participate in and contribute to the ecosystem voluntarily (L. Chen et al., 2022).

Incentives and their recipients

By definition, an *incentive* refers to the stimuli or benefit that motivates individuals or entities to take specific actions or behave in a certain way. For incentives to effectively influence their targets, they must resonate with the target's motivations and self-interest (Adner, 2017; Weber, 2006). Such stimuli spark action by catering to a particular need or objective of the targeted group, whether a consumer or a company. If these groups discern that the incentive aligns with their objectives—essentially, that it resonates with their core goals—they will respond positively (Weber, 2006). On the flip side, a misaligned incentive will not produce the desired outcome. This underscores the idea that incentives are designed to sway entities with agency and defined aspirations. Put simply, the beneficiaries of incentives must have the capacity for intent, ambition, and awareness to identify and pursue specific goals.

In terms of agency, we note that entities like organizations, consumers, and regulatory bodies possess agency in a digital ecosystem, making choices based on their objectives. In contrast, species of a more technological nature (e.g., technology infrastructure, digital services, platforms) lack agency, meaning they operate without conscious and intentional decision-making capacity. Acknowledging this distinction, we deduce that only those with agency within the digital ecosystem (i.e., organizations, consumers, and regulatory bodies) can indeed be influenced by incentives. While incentives must be strategically aligned with these agents' goals and behaviors, they must be tailored to the distinct nature of the ecosystem in question. As we will briefly discuss in the following, structural differences between various types of ecosystems (e.g., platform ecosystems versus digital ecosystems in the broader sense) require broadly different incentives.

In essence, platform ecosystems promote a degree of centralization (because they revolve around one (or a few) primary platform(s)) (Gawer & Cusumano, 2014), whereas digital ecosystems emphasize decentralization, modularity, and broad interconnectivity (Jacobides et al., 2018). Consequently, the incentives for participation in these two environments will be tailored to these unique ecosystem characteristics and will differ in scale and focus, nature of engagement, or potential benefits. In terms of scale and focus, platform ecosystem incentives are designed to

encourage the development of products and services for the focal platform(s) (e.g., through platform-specific developer tools and sharing models) (Gawer & Cusumano, 2014). In contrast, digital ecosystem incentives aim to grow the entire ecosystem (e.g., by educating developers about multiple tools and technologies in the ecosystem). Regarding the nature of engagement, in platform ecosystems, incentives primarily focus on facilitating transactions and direct interactions with the platform (e.g., by providing sellers with analytics tools or discounted transaction fees) (Rietveld et al., 2019). On the contrary, in digital ecosystems, incentives focus more on collaboration (Camarinha-Matos & Abreu, 2007), knowledge sharing (Cresswell et al., 2021), and developing complementary products and services that are agnostic to one technology or platform (Briscoe et al., 2011). Accordingly, in digital ecosystems, the incentives seek to form and establish communities (Immonen et al., 2014), promote interoperability among different platforms, or establish standards that help different ecosystem components work together seamlessly (Hodapp & Hanelt, 2022). Regarding potential benefits and monetization strategies, incentives in platform ecosystems are transactional and will include reduced fees, access to premium features, or specific revenue-sharing agreements. Platform ecosystems also often have a built-in monetization model (e.g., commission-based, subscription fees) with the platform ecosystem provider being a central beneficiary of the platforms' transactions (Rochet & Tirole, 2003). In contrast, since digital ecosystems are more modular, with no entity exerting too much control (Jacobides et al., 2018), DEs exhibit multiple monetization tactics that are likely to vary across different tools and services. Additionally, incentives in the digital ecosystem are more geared toward long-term objectives and encompass strategic initiatives, partnerships, or investments that enhance the ecosystem's overall infrastructure, knowledge base, or collaborative potential. Recognizing these distinctions is crucial when determining the optimal incentives to encourage participation in either platform ecosystems or DEs. Furthermore, it is essential to appreciate that individual incentives are components of broader *incentive systems* which combine and reconcile various incentives into a structure that aligns the interests of various DE groups (Davis, 1993; Kretschmer et al., 2022).

Incentive systems

The design of incentive systems involves considering factors such as the target audience, desired outcomes, and the overall objectives of the system (Kopalle et al., 2020; Kretschmer et al., 2022; Y. Sun et al., 2022; Valdez-De-Leon, 2019). This is necessary for mainly two reasons: Firstly, incentives are not isolated entities that never influence each other. Secondly, incentive systems are not static, one-size-fits-all solutions.

Incentives are not isolated entities

Depending on the target audience, incentives might be independent of each other, complementary, or even contradictory (Adner, 2017; Kretschmer et al., 2022). Complementary incentives are those that align and reinforce each other, while contradictory incentives represent conflicting or opposing ones that can lead to conflicting behaviors between actor groups. In the digital economy, a classic example of conflicting incentives can be observed between tech companies and consumers around data privacy. On the one hand, consumers desire and often demand products and services that prioritize their privacy, wishing to safeguard their personal information and limit data collection (Carl et al., 2023; Mihale-Wilson et al., 2021). This incentive is especially strong due to increasing awareness about data breaches and misuse. On the other hand, many tech companies are incentivized to collect as much user data as possible. This data not only informs their product development and enhances user experience but also becomes a significant revenue source when monetized, either through targeted advertising or by selling to third parties (Mihale-Wilson et al., 2021). Such conflicting incentives can pose challenges in achieving a harmonious digital ecosystem, as they push the entities involved in different directions—consumers toward heightened data protection and businesses toward expansive data usage.

Viewing an incentive system as the aggregate of all the incentives intentionally put forth to influence the behavior of various groups and prompt a specific desired action, it is essential to distinguish between conflicting goals and conflicting incentives. While divergent goals between actor groups can foster innovation and yield new value propositions, conflicting incentives—those that induce behaviors that neutralize each other or collectively lead to undesired outcomes for the ecosystem's overall participation—should be approached with caution.

Incentive systems are not static

The dynamic nature of DEs (Adner, 2017) implies that incentive systems are not static, one-size-fits-all solutions. Rather, incentive systems must be flexible and able to evolve with the DE to fit the ecosystems' current life cycle phase (Panico & Cennamo, 2022). Under the premise that DEs do not just "appear" but develop and evolve over time, literature on DEs distinguishes four life cycle phases: *inception*, *growth*, *maturity*, and *renewal* (Isckia et al., 2018; Teece, 2018). Each life cycle phase is linked

to slightly different challenges, the incentive system needs to be aligned with (Panico & Cennamo, 2022). During *inception*, for instance, participants must imagine and understand the new opportunities that the DE affords and view the new ecosystem as appealing (Isckia et al., 2018). Hence, at this initial stage, DE designers might want to focus on attracting industry leaders and early adopters (Khanagha et al., 2022) who can then serve as advocates, demonstrating the DE's innovativeness and potential to other organizations. During *growth*, attracting outsiders and broadening the user base are vital to achieving a critical mass of active participants (Isckia et al., 2018; Teece, 2017). Hence, during the growth stage, DE designers' focus might be on the exponential growth of the DE's participant base (Sebastian et al., 2020). Once the ecosystem possesses the critical mass to unlock its full potential, the DE reaches *maturity*, and participants are now starting to explore business opportunities within other ecosystems (Isckia et al., 2018; Teece, 2017). If DE designers do not counter the transition of ecosystem partners and value to competing ecosystems, the DE will shrink and eventually disappear. Hence, during this post-maturity phase, DE designers might seek ways to *rejuvenate* the ecosystem (Isckia et al., 2018; Teece, 2017). Therefore, at this juncture, DE designers might seek to attract new and highly innovative actors that can help the ecosystem penetrate other industries or find new and innovative ways for value creation. Given the varying strategic emphases that accompany each stage of an ecosystem's life cycle, it becomes imperative to re-align incentives within the system when deemed necessary (X. Sun & Zhang, 2021).

To sum up, designing incentive systems for DE participation requires designers to comprehensively understand the expectations, goals, and needs of the target audience (actor groups) when joining and participating in the DE. Furthermore, designers must have access to suitable strategies and mechanisms that allow them to orchestrate incentives into an incentive system—i.e., one able to attract companies and consumers alike to join and participate in the ecosystem. It is important to note that companies join and participate in DEs primarily by playing an active role on the supply side of the ecosystem (e.g., by co-developing products and services). In contrast, consumers are typically on the demand side of the ecosystem (e.g., by adopting and using the products and services provided in the ecosystem) (Hein et al., 2020). Thus, we can draw on the literature stream on organizational strategic management to structure and explore companies' expectations and goals when deciding to join DE. To understand consumers' needs and goals when adopting and using the products and services provided in the ecosystem, we can draw on the technology adoption literature. Below, we discuss both streams of literature in more detail.

Organizational strategic management literature

In our case, the organizational strategic management literature provides a framework to analyze how companies plan and make strategic decisions, such as the decision to join a DE. Companies often join DEs to achieve specific business goals, such as expanding market reach or leveraging new technologies for innovation. The organizational strategic management literature provides the necessary insights and tools to identify these goals and how they align with the broader strategic objectives of the company. As previously noted, the decision to participate in DEs, akin to other strategic company choices, depends on the anticipated value from the ecosystem. However, just as quantifying the value and impact of IT in organizations is complex, so is assessing the precise benefits of DE participation. Delving deeper into this argument, existing literature indicates that technology and IS investments can yield tangible and intangible returns, which might only manifest in the mid- to long-term. Directly correlating these investments with organizational profits remains difficult, both in retrospective and, even more so, in predictive evaluations (Rosati et al., 2017; Tallon & Kraemer, 2007; Tallon et al., 2020). Committing to a digital ecosystem can parallel IT investment decisions, for instance, in terms of risks, long-term commitment, and potential need for alignment with the organization's broader strategic goals. Also, similar to IT investment decisions, the choice to enter a DE potentially yields tangible and intangible results, whose realization may vary over time, making their upfront quantification notably challenging.

Motivated by the challenge of capturing less tangible benefits such as improved customer service (Volberda et al., 2021) or new collaborations and complementarities that would not form outside the DE (Jacobides, 2019), scholars (e.g., Martinsons et al., 1999; Milis & Mercken, 2004; Shen et al., 2022) suggest using the well-established balanced scorecard (BSC). Originally developed by Kaplan and Norton (1992), the BSC aims to complement the financial perspective on business performance with the non-financial perspective. Applied to technology projects and decisions, the BSC is also useful for developing metrics reflecting the tangible and intangible benefits of technology implementations (Martinsons et al., 1999; Shen et al., 2022). Because "the metrics used in a balanced scorecard framework are aligned to the company's strategy and business aims"(Milis & Mercken, 2004, p. 94), the BSC model allows managers to adopt a comprehensive view on technology investments while also serving as a map for navigating the strategic goals of the company (Milis & Mercken, 2004). In particular, the BSC allows organizations to measure their intangible assets, such as customer relationships, innovative products, services, technology, knowledge, and the organizational structures that provide a company with a competitive advantage

(R. S. Kaplan & Norton, 1992, 2001). Accordingly, the BSC has practical relevance for strategy and focuses on financial and non-financial aspects, short-term and long-term strategy, and internal and external business measures (Wu, 2012).

Specifically, the BSC takes on four perspectives: a *financial perspective*, a *customer (or market) perspective*, an *internal process perspective*, and a *learning and growth perspective*. Following Kaplan and Norton (1992, 2001), from a financial perspective, companies focus on their economic and financial health (e.g., profitability and value creation of the organization) (Fischer & Himme, 2017; Kliestik et al. 2020). From a customer perspective, companies seek to understand their market performance regarding their customer relationships (e.g., customer satisfaction, retention, churn) and market share (Kamalaldin et al., 2020; Krizanova et al., 2019). From an internal process perspective, companies seek to understand the efficiency and effectiveness of their operations and processes (H. Chen et al., 2021). Ultimately, the learning and growth perspective encompasses factors crucial for fostering continuous learning, improvement, and adaptability within the company—e.g., employee training and development, knowledge management, innovativeness, and organizational culture (Kimiloglu et al., 2017).

We use the BSC model as a structured blueprint for exploring companies' goals and expectations when deciding to join DE. To now turn to the consumers' side and delve into the goals of this group when deciding to join a DE (specifically, to use the offerings of the DE rather than alternative options), we draw on the technology adoption literature. Consulting the technology adoption literature, particularly its theories, is fitting, as these theories have traditionally examined the factors influencing individuals' decisions to accept or reject new technologies and products.

Technology adoption literature

Research on technology adoption is one of the most mature streams in IS literature (Ho et al., 2020). It entails theories concerning individuals' pre- and post-adoption behaviors (Mishra et al., 2023). While pre-adoption theories focus on explaining individuals' intentions to adopt, post-adoption behaviors focus on what drives usage continuance. Given that we seek to explore and structure both—consumers' needs and goals when initially joining the DE but also their needs and goals in relation to continuous participation in DE (i.e., continuous use of the ecosystem products and services)—our work relates to both streams of literature within this corpus of research. Within the *technology pre-adoption literature*, we mainly refer to two of the well-established adoption models: Davis' (1989) technology adoption model (TAM) and Venkatesh et al.'s (2003) unified theory of acceptance and use of technology (UTAUT). According to TAM, technology acceptance is mainly driven by individuals' attitudes toward the technology, which in turn is shaped by the individuals' perception of the technology's usefulness (PU) and ease of use (PEoU) (Davis, 1989; Venkatesh et al., 2003). PU describes to which degree individuals think a particular technology can fulfill predefined goals. PEoU reflects individuals' perception of how effortless a technology's usage might be (Davis, 1989; Venkatesh et al., 2003). TAM has served as a foundation for various other research models for technology adoption. The UTAUT, for instance, posits that technology acceptance and use are determined by four constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). While performance expectancy refers to individuals' beliefs that using the target technology will advance their goals (i.e., it is equivalent to PU), effort expectancy represents the same as PEoU. However, social influences (also referred to as "subjective norms" (Brown et al., 2010)) relate to individuals' beliefs that adopting technology will enhance their status within a relevant peer group (Maruping et al., 2017). Extant literature corroborates the link between important actors and individuals' technology adoption intention (Brown et al., 2010). This link is compelling for novices (i.e., individuals with no prior experience with the target technology) and within the work-related context when important external others (e.g., supervisors, colleagues) can exert some sort of pressure on the potential adoption candidate (Maruping et al., 2017). Finally, facilitating conditions refer to objective factors that make technology use possible. Such factors include technical and organizational support (Venkatesh et al., 2003).

Within the *technology post-adoption literature*, our work relates to Bhattacherjee's (2001) expectation-confirmation model (ECM) and Liao et al.'s technology continuance theory (TCT). In both models, individuals' continued technology use is strongly driven by consumers' satisfaction with the technology, which again depends on factors such as PU and PEoU (Liao et al., 2009). With PU and PEoU influencing both the technology pre- and post-adoption, while other factors might influence only consumers' satisfaction with the technology (post-adoption), we suggest distinguishing between "*first-tier*" *drivers of adoption and use* (e.g., PU, PEoU) and additional "*second-tier*" *drivers of continuous use* (i.e., any factors that can increase satisfaction in the post-adoption phase).

We combine the previously discussed streams of literature to develop a framework for designing incentive systems for DE participation. Based on the literature on digital ecosystems and ecosystem design, please remember that DEs are dynamic multi-agent environments where diverse but interconnected species—ranging from technology, digital services, products, and platforms to organizations and individual consumers—operate in a loosely coupled manner. Their interaction dynamics aim to realize unique and collective

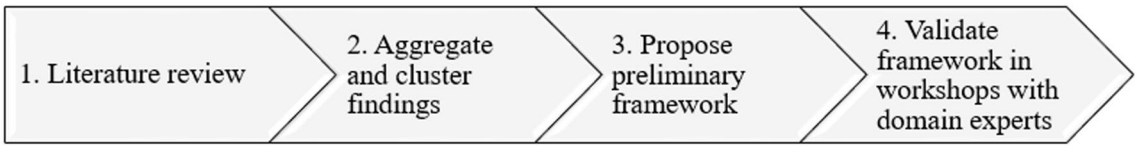

Fig. 1 Methodological approach to the framework development

goals, reflecting the intricate and often symbiotic relationships within these digital realms. The literature on incentives provides the foundational rationale for our framework. Incentives are stimuli crafted to motivate specific actions or behaviors. These incentives work only with entities that possess the necessary agency and conscious decision-making ability to be swayed toward a particular behavior. In the context of DEs, not all entities have the necessary agency; our study recognizes that besides regulatory or governmental bodies, only the consumer and organizational species possess agency. Building on this, we delve into incentive systems literature, emphasizing that incentives do not operate in isolation. They are components of intricate systems where individual incentives interact and potentially influence each other. An effective incentive system, therefore, necessitates a careful orchestration of these incentives, ensuring that their collective influence yields the most desirable outcomes in terms of ecosystem participation. Yet it is important to acknowledge that organizations and consumers are two different species that are driven by a different set of goals. From the realm of organizational strategic management, we adopt insights from the BSC model. Given its structured approach to exploring and articulating corporate objectives and aspirations, the BSC model serves as our guiding blueprint for exploring companies' goals and expectations when deciding to join DE. Lastly, our framework is also informed by the technology adoption literature, which is pivotal because technology acceptance theories shed light on the nuances that drive individuals' decisions around embracing the offerings of the DE over alternative offerings.

By blending the insights from all these research dimensions, our framework aims to offer a comprehensive, nuanced, and actionable guide for devising effective incentive systems tailored for the DE landscape. Having laid out this foundation, let us transition into the structured process through which we developed the framework.

Methodology for developing the framework

For the development of the framework, we follow various scholars' insights on theorizing and developing (integrated) IS frameworks (e.g., Baird & Maruping, 2021; Burton-Jones & Volkoff, 2017; Hassan et al., 2022; Maxwell, 2012; Miles & Huberman, 1994). Specifically, we design our framework in a multi-step approach (see Fig. 1). First, we conducted comprehensive literature reviews (step 1, Fig. 1): Initially, we performed a systematic literature review approach employing a keyword-driven search (consumers: "digital AND (preferenc* OR nee*)"; companies: "compan* AND "strategic goals"""). For consumers, we focused on the best-ranked publications in IS research (VHB A+, A, and B), and for companies, we conducted a broader search, capturing the online library EBSCO. The search led to 1032 (consumers) and 1336 (companies) results. In the first step of assessing the title and abstract, we retained 112 (consumers) and 386 (companies) publications. Facing high exclusion rates in both steps of the paper analysis due to the required transferability of results to the context of DEs, we received 10 relevant publications for consumers and 9 for companies. Thus, we performed more explorative further searches employing multiple backward and forward search steps as well as more explorative search on received goals and needs and regularly updated the search, leading to a total of 34 publications regarding consumers' needs and 32 covering companies' goals. To sum up, the aim of this literature review was to capture the current state of related work on (i) companies' expectations and goals concerning DE participation, (ii) consumers' expectations and needs concerning DE participation, and (iii) potential set of strategies and mechanisms to orchestrate individual incentives into incentive systems. The literature reviews capture the current state of related work and allow us, in a second step, to aggregate knowledge from prior research efforts into one comprehensive framework (Baird & Maruping, 2021; Okoli & Schabram, 2010). We follow the established propositions by Kitchenham et al. (2009), which ensure that synthesizing the extracted research findings informs and guides practitioners in a structured and comprehensive manner (Kitchenham et al., 2009; Snyder, 2019). Besides, the literature reviews also serve as a basis to further aggregate and cluster previous research based on predefined criteria, informing the conceptualization of a (new) theory construct (Paré et al., 2015; Snyder, 2019).

In a second step, the insights from prior literature were aggregated and synthesized through a DE-specific lens (step 2, Fig. 1), however interacting with the first step (literature review) to adapt the process accordingly. The

DE-specific lens enables us to account for idiosyncratic characteristics of DEs, such as the collaborative value creation in a coopetitive environment[1] (Lettner et al., 2022), particularly for DEs. For instance, in DEs, value creation occurs through collaboration (i.e., via common business practices, interoperability between products and services, shared data spaces, and knowledge transfer). Hence, the organizational goals concerning DE participation might not include only goals such as improving the company cost structure (R. S. Kaplan et al. 2004; Wu, 2012) but also goals such as creating new value (i.e., products and services) that otherwise would not be possible to develop. At the same time, organizational goals that might be important in other contexts (e.g., financial transparency (S. Lee et al., 2021)) might play no significant role in the context of DE participation.

We compiled a preliminary framework based on the aggregated insights from prior literature (step 3, Fig. 1). To this end, we use the BSC to structure and document companies' expectations and goals concerning DE participation. Analogously, we structure and document consumers' expectations and goals concerning DE participation by distinguishing between first-tier (must-have expectations and goals to join and continuously participate in the DE) and second-tier factors (optional factors that can increase consumers' satisfaction with the offerings of the DE and thus support continuous participation).

The preliminary version of the framework was validated in two workshops with domain experts working on a joint research project (step 4, Fig. 1). The research project aims to design and develop the necessary components for a DE in the Smart Living domain. The workshops were conducted with six domain experts with different backgrounds and research foci: Three participants represented the R&D departments of leading global suppliers of smart home, mobility, and consumer goods technology. One participant represented the association of electric and consumer goods. Another participant represented an SME supplying smart home solutions. Finally, two participants work for research entities researching digital (services and consumption) ecosystems. In the first workshop, the experts discussed and chose the most relevant companies' organizational goals in relation to DE participation. In the second workshop, the discussion revolved around the most critical consumer needs concerning DE participation. Both workshops resulted in a curated list of company goals and consumer needs most relevant concerning DE participation. Finally, we combined all findings in one framework to design DE participation incentive systems.

[1] Coopetition is a business strategy in which companies work together to achieve a common goal while still competing against each other. This approach combines the benefits of cooperation and competition, allowing companies to share resources and knowledge while striving to be the best in their industry.

Framework for designing incentive systems for DEs

Figure 2 visualizes the proposed design framework. It consists of three building blocks (i.e., identify incentives, combine incentives into a system, and incentive system realignment) and three key elements (i.e., (i) company goals, (ii) consumer needs, and (iii) orchestration mechanisms). Subsequently, we discuss each building block individually, as they indicate how to use our framework.

First building block: Identify incentives

The first building block of the framework suggests *identifying the incentives* for each of the targeted actor groups—i.e., in our context, companies and consumers—by analyzing these actors' expectations, goals, and needs when joining and participating in DEs. Only once designers document companies' and consumers' needs and expectations in relation to DE participation can they derive incentives that will be effective for each of the individual target groups. For these activities, designers can use a range of methods: Expert interviews and Delphi studies, for instance, are suitable for documenting companies' goals and potentially deriving applicable incentives for companies. Analogously, expert interviews, focus groups, or consumer surveys are helpful to gather consumers' needs and derive suitable incentives for this group. To support these activities, our framework offers concrete support by providing a comprehensive set of goals and needs that companies and consumers have concerning their DE participation decisions.

As mentioned in the previous section (the "Methodology" section for developing the framework), these company and consumer goals were derived from prior literature. We first present the *(i) company goals* along the four perspectives proposed by the BSC. *From a financial perspective*, companies focus on economic and financial status. There are various ways to increase the value of a company through strategic actions. Common measures are, for example, the development of a new business field, the acquisition of a company, or a strategic realignment. Short-term profits should be subordinated to long-term successes (Rappaport, 2006). Thereby, investors closely monitor revenue, profitability, and expected cash flows (R. S. Kaplan & Norton, 1992). Additionally, investors also monitor the decisions about adopting new technological developments.

In general, DE participation can directly or indirectly improve various key financial performance indicators. For instance, DEs require a certain degree of homogeneity

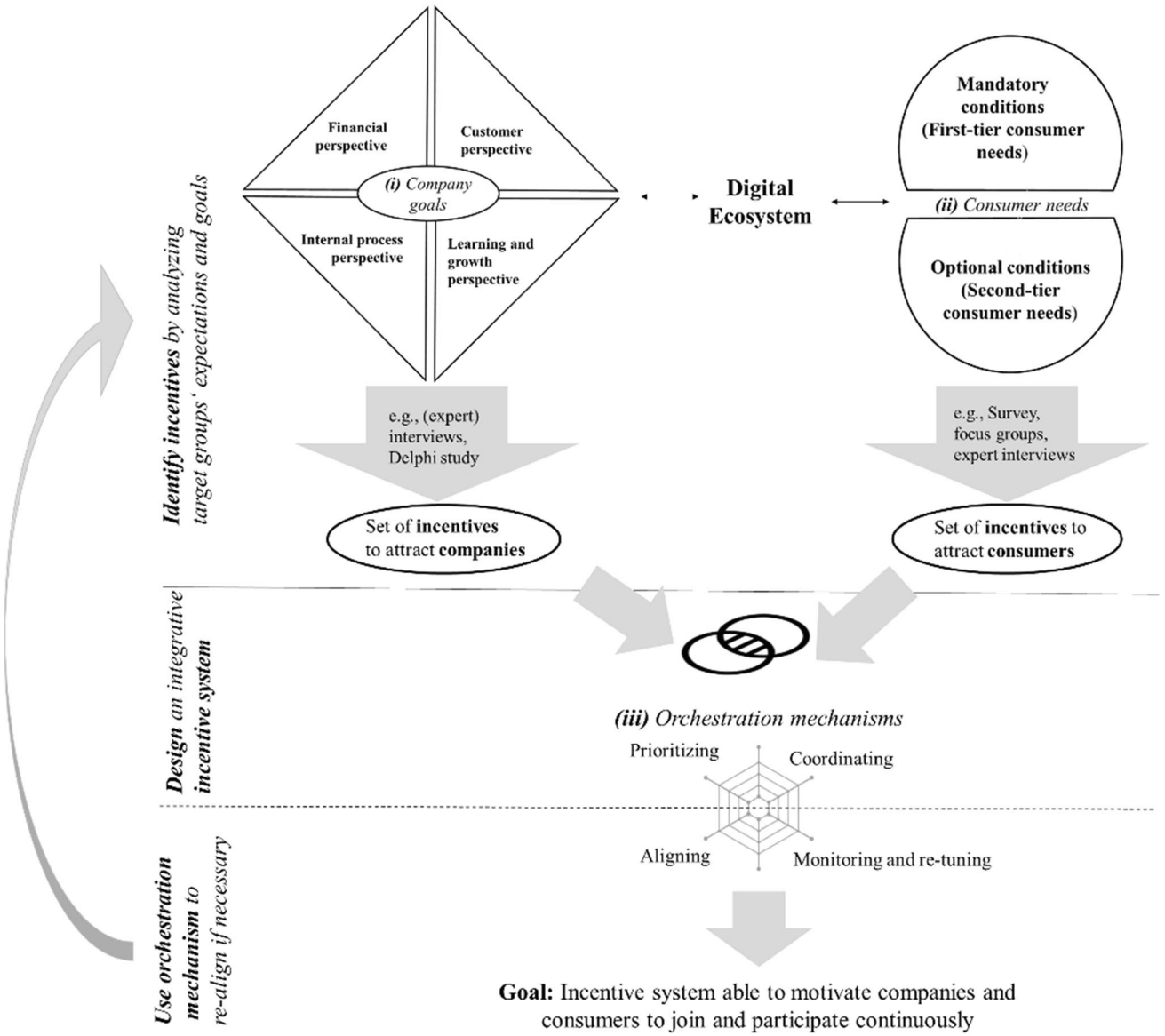

Fig. 2 Integrated framework for designing incentive systems for DE participation

regarding common technical standards (Wareham et al., 2014). This technical homogeneity creates cost reductions and risk-sharing opportunities when developing new products and services (Gawer & Cusumano, 2014). Furthermore, because various technology components and other assets can be exchanged and used across DE partners, DEs also open new opportunities for asset usage (Subramaniam et al., 2019). Such assets include data, IT infrastructure, algorithms, and other software components. While some of these assets (e.g., data) might find only limited application in the organization they originate from, such assets can be important for other ecosystem partners (Schneider & Kokshagina, 2021). If the ecosystem disposes of the necessary mechanisms to remunerate the provision of assets to other DE partners, assets that were not previously used can offer new sources of revenue. Cost reductions, risk sharing, and better asset usage can improve various key financial performance indicators such as profit margin or returns on investment (Gamayuni, 2015; Romanova et al., 2021). Simultaneously, by developing and distributing novel products and services that would not have been possible without collaboration within the DE, companies can increase their turnover and market value (Redjeki & Affandi, 2021; S. Zhang et al., 2019).

From a customer perspective, companies are concerned about gaining new and retaining existing customers. Although customers have always been important to companies, nowadays, in the digitalized world, they are even

more powerful and essential than ever (S. M. Lee & Lee, 2020; Mihardjo et al., 2019). As digitization is pervasive in everyday life and switching to competing products and services is easier than ever (Leimeister et al., 2014), gaining and retaining new customers for a company are necessary for success. DEs support this essential condition in various ways. For instance, DE participants can collaborate to enjoy synergy effects for various organizational functions (Subramaniam et al., 2019). While a collaborative development of products and services to create better value for the customer is obvious, companies in a DE can also leverage ecosystem-wide shared resources and assets (e.g., shared data spaces, algorithms, components, and knowledge). By sharing such infrastructural elements and assets, participating companies can improve other key areas such as marketing, user experience, and process optimization (Helo et al., 2021). For instance, by building a shared ecosystem data space, various positive trickle-down effects might occur: First, a DE's shared data space enables companies to capture and extract new intelligence on customer needs and preferences (Subramaniam et al., 2019) that otherwise would remain concealed. Second, additional customer insights can strengthen organizations' agility[2] and the capability to satisfy consumers' needs. Third, through a better product and service fit with consumer needs, organizations can gain new customers or increase the satisfaction and loyalty of existing customers (H. Sun et al., 2020).

From an internal process perspective, DE participation can bring a range of benefits that improve the operational inner workings of companies. Similar to shared technological standards that ensure interoperability between the components provided by different DE partners, DE participation can require that various internal processes across DE participants are standardized or harmonized (Aulkemeier et al., 2019; Helo et al., 2021). Although implementing changes to extant processes represents an investment on the side of the DE partners, it can have significant benefits for the overall performance of the ecosystem. After all, by standardizing or harmonizing processes and forcing various partners to adopt specific ecosystem processes, outputs of the joint work between DE partners are standardized enough to ensure a high quality of solutions and applications (Wareham et al., 2014). Additionally, with aligned internal processes across participants, the flow and sharing of resources (e.g., data assets, knowledge) between DE participants is optimal and can have various benefits (L. Chen et al., 2022): For instance, the flow of diverse domain expertise across DE participants might enable some companies to adopt technological innovations faster than otherwise (Gupta et al., 2019). Similarly, through the governance entity of the DE, which sets the rules of the game for all participants in terms of legal (e.g., data protection, data security) and social responsibilities[3] of business activities, DEs ensure that all companies within the ecosystem comply with the current rules (L. Chen et al., 2022). While these advantages might not be of enormous importance for bigger organizations, they could significantly benefit smaller and middle-sized enterprises (SMEs). For SMEs, process standardization or harmonization across DE partners enables them to profit from key organizational functions (e.g., distribution channels, marketing) and other synergy effects.

Typically, synergy effects allow companies to generate more value than they would have alone (Yu & Wong, 2014). Such synergy effects occur from resource sharing or resource integration (Y. Xu et al., 2023). In an ecosystem, SMEs can enjoy synergy effects, for instance, from sharing resources such as legal, financing, or technological skills (Wasiuzzaman, 2019). Smaller companies cannot usually afford (a large) legal department. However, within a collaborative digital ecosystem, SMEs could set up a joint legal department with several other participating SMEs and start-ups. Such setups and collaborations between ecosystem participants can improve the cost and asset structure (Wasiuzzaman, 2019). Suppose ecosystem participants can share assets and follow the main notion of the sharing economy (i.e., use instead of own), in that case, ecosystem participants can also enjoy a better cost and asset structure. In addition, aligned processes across partners can also mean increased synergy effects that yield increased productivity. After all, aligned business and technical processes and standards ensure that combining various application components, modules, and solutions into one intelligent offering is technically and operationally possible without compromising on quality (Hein et al., 2019).

Ultimately, *from a learning and growth perspective*, companies focus on creating sustainable growth (Masli et al., 2011). As competition between companies increases, technological advancements put companies additionally under stress while consumer needs shift. Hence, it is more essential than ever that companies become learning entities (Garvin et al., 2008). The goal is to enable a company's employees to cultivate innovations (Quezada et al., 2019), promote open discussions, and develop a holistic and systematic way of thinking. The result of this process is a company that can react faster and better to unexpected changes than its competitors.

[2] Agility shows how well an organization can forecast and react to market changes (O.-K. Lee et al., 2015).

[3] Social responsibilities refer to newly emerging social standards in dealing with, e.g., customers in the digital world.

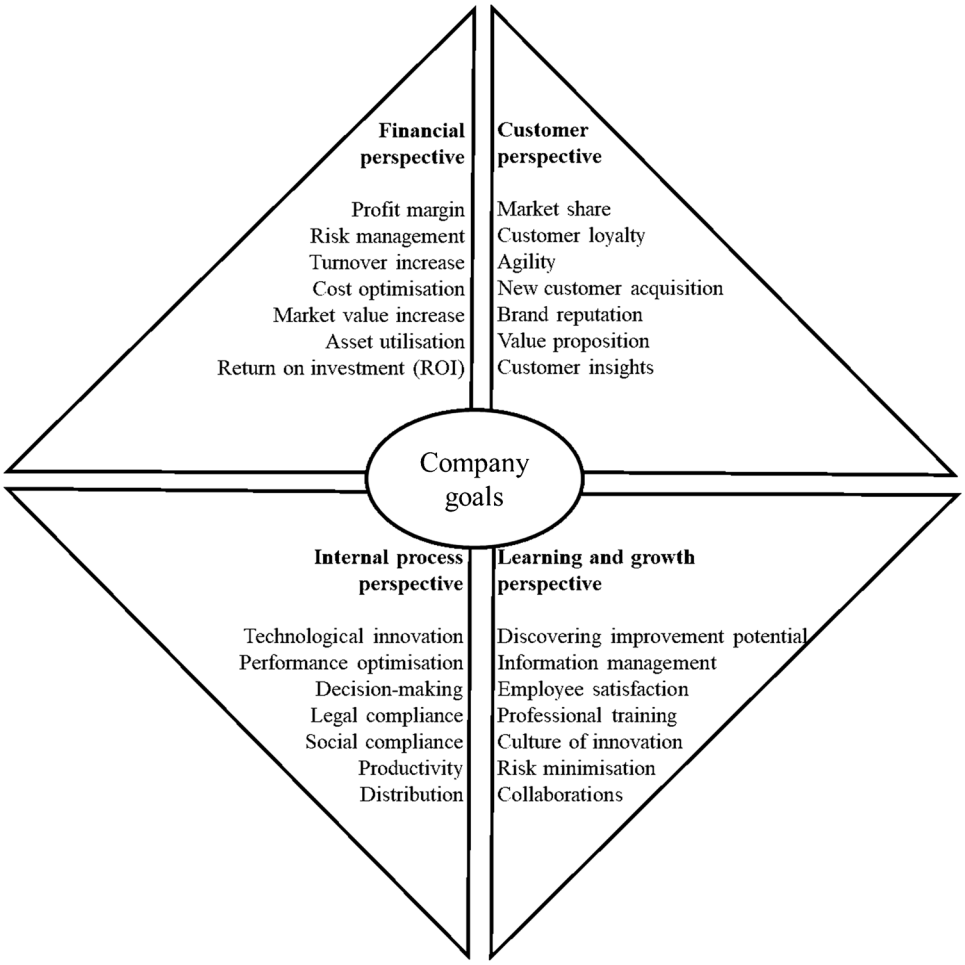

Fig. 3 Company goals concerning DE participation (structured based on BSC)

The extant body of literature has repeatedly recognized the importance of innovation and knowledge for sustainable growth (Vaz and Nijkamp, 2009). Hereby, knowledge refers not only to the available intelligence within a company but also to a company's ability to assimilate and use the knowledge from external sources. Although the importance of the internal versus the external knowledge source might vary with company size and industry, both knowledge types are essential for sustainable growth (Vaz and Nijkamp, 2009). For SMEs, for instance, the external source of knowledge in the form of lessons learned from similar companies and endeavors can help companies minimize risk (Manica et al., 2017; Vaz and Nijkamp, 2009). Similarly, intel on the failure of others can help companies discover the changes and potential for improvement needed to avert failure (Liang, 2015). In contrast, internal knowledge can help companies improve their products and services and develop new and innovative ones. While such internal knowledge can be honed through professional training (Cao et al., 2015; Liang, 2015), it can only be retained in the company through increased employee satisfaction (Liang, 2015; Quezada et al., 2019; Wu, 2012) and low personnel turnover (Wu, 2012). DE participation is an excellent opportunity for companies to tap into external knowledge sources and profit from lessons learned by other partners (Weissenberger-Eibl & Hampel, 2021). Similarly, it can offer a great opportunity to build new internal knowledge and skills, offer employees new challenges, and foster a culture of innovation (Volberda et al., 2021). Figure 3 summarizes company goals relevant to DE participation.

Besides companies' goals concerning DE participation, the second important element in our framework is *(ii) consumers' expectations and needs when joining DEs*. Analogous to organizations, particularly companies' goals concerning DEs, individuals can also display many needs and preferences when deciding to use DE-based offerings over single-provider products and services. Such needs and preferences can be related to the function of products and services the DE enables or other DE-specific benefits—e.g., whether the DE empowers individuals to be both consumers and value contributors within the ecosystem (Lettner et al., 2022; Valdez-De-Leon, 2019). Although successful DEs need to generate value for their users and produce offerings that match consumers' needs (Valdez-De-Leon, 2019), our

understanding of consumers' needs and expectations when joining DEs remains very sparse.

Traditionally, researchers and practitioners elicit and analyze consumer needs and preferences to inform the design and marketing of (digital) products and services (Chapman et al., 2008). Marketers, for instance, conduct preference studies mainly for articulating commercialization-related goals (Chapman et al., 2008). Design engineers exploit consumer preferences to create and develop consumer-orientated products. In the human–computer interaction (HCI) discipline, consumer needs and preferences ensure good usability of products and services (Chapman et al., 2008). Although various fields leverage intelligence on customer needs and preferences to achieve different goals, they have in common that customer needs are investigated concerning features of specific products and services. Because in this framework, we are interested in a higher abstraction level—i.e., DE participation—consumer needs result from the inherent properties and benefits of digital ecosystems.

DEs are complex structures in which value creation is dynamic and possible only through the collaboration of several partners and species (Subramaniam, 2020). In this context, the partners within the DE are interdependent. Partners share resources, particularly data, which is essential in value creation (Hein et al., 2020). In a DE, partners can build intelligent services and create new products and solutions by using and combining components and products developed by another partner (Hein et al., 2020). Furthermore, partners can use the data generated by the devices and systems provided by one partner to improve and develop their offerings further (Schneider & Kokshagina, 2021).

On the bright side, within this dynamic and complex environment, DE partners can create personalized and context-aware products and services that fit consumers' needs better than ever (Hein et al., 2019). Furthermore, through collaboration and recombining various DE components and resources, the DE allows companies to implement and issue new products and services faster and cheaper than before (Hein et al., 2019, 2020). Besides, because DEs require a certain degree of homogeneity in terms of technical standards (Wareham et al., 2014), offerings within a DE are typically interoperable and (re)combinable, leading to new products and services (Hein et al., 2020). An additional advantage of DEs is their ability to engage users in the (co-) creation of new DE offerings (Sussan & Acs, 2017). On the downside, however, the complex and dynamic environment of DEs can exacerbate challenges that a digitalized, highly recombinant, and interconnected world can bring. For instance, due to the importance of data in the value creation process, DEs can exacerbate extant privacy and opacity challenges (Mihale-Wilson et al., 2022). Moreover, when it comes to the collection and processing of data, companies and consumers have conflicting interests (Royakkers et al., 2018). While companies see data as a critical production factor and seek to amass as much data as possible, consumers would like to be informed and in control of what happens to their data (Carl et al., 2023; Mihale-Wilson et al., 2021).

The importance of data privacy and security is a widely discussed and multi-faceted research topic in IS research (e.g., Acquisti & Grossklags, 2005; Adjerid et al., 2018; Bélanger & Crossler, 2011; Hann et al., 2007; Park et al., 2018). Its importance is also reflected in various data privacy and security regulations and directives such as the European General Data Protection Regulation or the OECD Guidelines for Protection of Privacy and Transborder Flows of Personal Data (Mihale-Wilson et al., 2021). According to the OECD (2013) guidelines, for instance, privacy and data security should consider eight main principles: (1) data collection should be limited, (2) collected and stored data quality should be high (e.g., accurate and up-to-date data), (3) purpose specification for data collection, (4) limited data use to consented purposes, (5) appropriate security safeguards for storage and processing, (6) openness or transparency about data processing practices, (7) individual participation should be possible to correct or add and delete data, and (8) accountability for all collected and processed data. Implicitly, sound practice principles for data security and privacy emphasize the importance of transparency within the DE.

Research on transparency in complex networks suggests that companies can pursue transparency at different strategic and operational levels. For instance, transparency can occur by disclosing information about their pricing strategies (e.g., Granados & Gupta, 2013) or data processing and monetization practices (Mihale-Wilson et al., 2019; Turilli & Floridi, 2009). Companies can also implement transparency of their processes and governance structures by using certifications—a widely adopted institution-based mechanism to increase consumers' trust (Carl & Mihale-Wilson, 2020). Finally, transparency can also mean making the data flow within networks traceable and accountable (Mihale-Wilson, 2021). After all, as DE offerings become more complex and surge from recombining various components and resources of the DE, it becomes increasingly complicated to track and understand data flows and how data is processed (Mihale-Wilson et al., 2022; Royakkers et al., 2018). As such, it also becomes almost impossible to trace and handle product safety and liability responsibilities, enforce customer rights, and settle disputes (Carl et al., 2023; Mihale-Wilson et al., 2022).

In general, product safety describes the degree of potential risks and injuries due to the handling and use of products (Mihale-Wilson et al., 2021). At the same time, liability relates to the actions of product or service providers in the event of injury (Daughety & Reinganum, 1995;

Mihale-Wilson et al., 2021). While it is feasible in the physical world to identify the source of most injuries, in the interconnected and recombinant world of DEs, finding the definite cause of injuries can be impossible. Additionally, since consumers of digital offerings may suffer physical and psychological harm that is not necessarily visible at first glance, product safety and liability in DEs are much more complicated than in the analog world (Carl et al., 2023; Mihale-Wilson et al., 2021).

Notably, the opaque nature of DEs can cover the use and flow of data, the recombination of software components, and the overall availability of offerings within the DE (Mihale-Wilson et al., 2022). Through the recombination of components, data, and solutions, DEs enable the development of many offerings (Hein et al., 2020). Suppose the number of available offerings becomes unmanageable. In that case, successful DEs require ways and tools (e.g., a recommendation engine) to help users choose the online offerings that best suit their needs (Schneider & Kokshagina, 2021). Therefore, such tools and mechanisms need to be trustworthy and inclusive. Trustworthiness refers to matching offerings with consumer needs and preferences while putting customers' economic needs first. Inclusivity refers to DE offerings being accessible and usable for different consumer segments (Mihale-Wilson et al., 2021).

The need for trustworthiness stems from companies and consumers having conflicting economic interests. This tension between consumers and companies has been observed and analyzed in many contexts, such as regarding interoperability of technical standards (e.g., Lewis, 2013), pricing strategies (e.g., Weisstein et al., 2013), and recommendation systems (e.g., Xiao & Benbasat, 2011). Despite the various foci and research questions that existing studies investigate, they ultimately indicate that protecting consumers' economic interests can pay off in the long run (Weisstein et al., 2013).

The requirement of inclusivity stems from the documented fact that inequalities in access or knowledge on how to use technology can have adverse human, social, and financial capital disadvantages for various groups (e.g., Agarwal et al., 2009; Hsieh et al., 2011; Park et al., 2018). Therefore, it is essential to distinguish between accessibility and technology literacy issues. While accessibility refers to whether DE offerings are accessible to everyone, technology literacy refers to the fact that participation in DEs will also require—to some extent—the knowledge needed to use technology (Park et al., 2018) effectively. Only if consumers possess the knowledge to use various DE offerings, they will succeed in leveraging the value added of these offerings and thus continue to use them actively (Mihale-Wilson et al., 2021). Following this logic, to ensure participation on the consumer side, successful DEs need to bestow consumers with the knowledge needed to benefit from the DE's offerings.

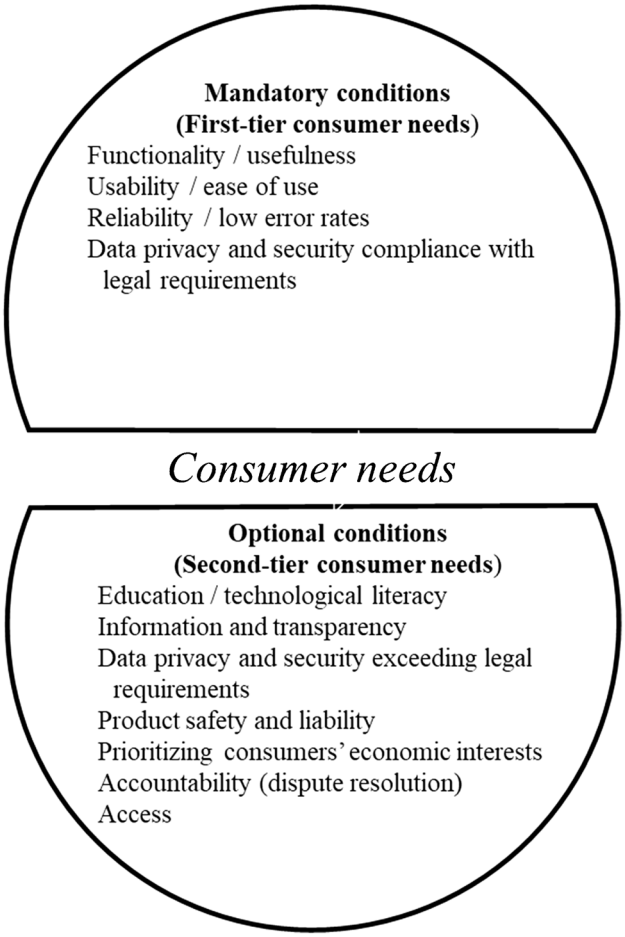

Fig. 4 Consumer needs concerning DE participation

To conclude, we note that digital consumers nowadays "expect to be very well informed, spoiled, and empowered" (Granados & Gupta, 2013, p. 637). Against this background, customer needs concerning DE participation entail functional and usability-related requirements and mechanisms for transparency, consumer empowerment, inclusion, and accountability. Some individual needs are more likely to be linked to mandatory conditions that must be met to participate in DE at all (Subramaniam, 2020). In contrast, others might not be prohibitive and influence the chances of participation only partially (see Fig. 4). With that in mind, we draw on the insights discussed in the theoretical background section and classify functionality (e.g., perceived usefulness, reliability) and usability-related needs (e.g., perceived ease of use, required data privacy, and security levels) as "first-tier" mandatory conditions for participation. In contrast, we can classify individual needs linked to consumer empowerment,

Table 1 Orchestration mechanisms, exemplary practices, and employable methods

Orchestration mechanism (exemplary sources)	Practices	Example suitable methods to leverage mechanism
Prioritizing (e.g., Jahantigh et al., 2018; Treiber et al., 2023; Verma et al., 2022)	Identify target companies and consumer groups	Life cycle analysis, DE growth strategy analysis, expert interviews
	Incentives for companies	Interviews with companies, expert workshops, expert interviews
	Incentives for consumers	Surveys with prospective users, expert workshops, expert interviews, focus groups
Coordinating (e.g., Gkeredakis & Constantinides, 2019; Meyerhoff Nielsen & Jordanoski, 2020)	Brokering between contradicting company and consumer incentives	Expert workshops, expert interviews
	Facilitating complementary company and consumer incentives	Expert workshops, expert interviews
Aligning (e.g., Makkonen et al., 2022; Martin et al., 2019; Murthy & Madhok, 2021)	Strategic alignment of stimuli (incentive) with company goals and consumer needs	Expert workshops, expert interviews
Monitoring and re-tuning (e.g., Martin et al., 2019; Panico & Cennamo, 2022)	Monitor whether targeted companies and groups are participating	Statistics, expert interviews
	Identify areas of improvement and re-tuning of incentive system if necessary	Expert workshops, expert interviews

inclusion, and accountability (e.g., transparency, consumers' economic interests, data security, and privacy exceeding legal requirements) as "second-tier" conditions for DE participation.

Second building block: Combine incentives into a system

Incentive systems combine and reconcile various incentives into a structure that aligns the interests and behaviors of different actor groups of the ecosystem (Davis et al., 1992; Kretschmer et al., 2022). This is essential since the individual incentives between actor groups or within an actor group might be independent of each other, complementary, or even contradictory (Adner, 2017). Thus, to maximize the incentive system's effect on its target audience, designers need to "orchestrate" incentives in an incentive system. In other words, they need to carefully pick, combine, and coordinate the various incentives within a cohesive and integrated set (i.e., "incentive system") that work together to achieve their set goal. Orchestration ensures that the incentives are strategically aligned, properly balanced, and effectively deployed to maximize their impact and achieve the intended objectives of the incentive system (Panico & Cennamo, 2022). Again, to support this process, our framework proposes four *(iii) orchestration mechanisms* for incentives: *prioritizing* (Jahantigh et al., 2018; Treiber et al., 2023; Verma et al., 2022), *coordinating* (Gkeredakis & Constantinides, 2019; Meyerhoff Nielsen & Jordanoski, 2020), *aligning* (Makkonen et al., 2022; Martin et al., 2019; Murthy & Madhok, 2021), and *monitoring and re-tuning* (Martin et al., 2019; Panico & Cennamo, 2022). Analogous to companies' and consumers' expectations and goals related to DE participation, the orchestrating mechanisms from the framework were derived from prior literature.

Prioritizing accounts for the heterogeneity and multitude of options (in our case, incentives) that need to be considered (Jahantigh et al., 2018). Further, it accounts for the evolving life cycle of the DE and the fact that various stages of the ecosystem require different emphases (Panico & Cennamo, 2022; X. Sun & Zhang, 2021)—i.e., for instance, certain companies and consumer segments may become the focal points for incentives at different times. Besides, prioritizing also refers to prioritizing the company goals (Jahantigh et al., 2018) and consumer needs (Mihale-Wilson et al., 2019; Shah et al., 2006) following the preferences of the targeted groups. The *coordination mechanism* accounts for the fact that the various company goals and consumer needs are likely interdependent (e.g., contradictory or complementary) (Gkeredakis & Constantinides, 2019). Because contradiction between goals and needs requires a trade-off that will render the incentive system less effective (Q. Zhang & Sun, 2023), finding ways to reconcile and broker between contradicting company goals and consumer needs is essential. In contrast, logic dictates that incentive designers must create strategies that meet individual goals and synergize with others, generating the necessary momentum to draw a broad spectrum of companies and consumers to the digital ecosystem. The *aligning mechanism* is a prerequisite to ensure the maximally desirable participation outcome (Makkonen et al., 2022). After all, incentives can only trigger a desired action if they concur with the incentive recipient's specific need or goal (i.e., consumer or company) (Adner, 2017; Weber, 2006). If the incentive does not fit with the intended recipient's goals, the incentive will not be effective and will not lead to the desired behavior (Adner, 2017; Weber,

2006). Ultimately, the *monitoring and re-tuning mechanism* ensures that the incentives system continues to be effective over time. Since DEs are dynamic environments that evolve, incentive systems must be monitored and re-tuned whenever necessary (Panico & Cennamo, 2022).

Table 1 provides an overview of the discussed orchestration mechanisms and names exemplary methods that can be used to leverage each respective mechanism. For instance, to prioritize incentives for companies (i.e., identify top priority incentives), designers can conduct interviews with companies appertaining to the targeted companies group. Then, if the top priority company and consumer incentives are contradictory, designers can broker between these incentives based on the input from expert workshops and expert interviews.

Third building block: Incentive system realignment

Following the arguments presented earlier, incentive systems cannot be static and should evolve with the changing conditions of each DE life cycle. As discussed previously, depending on whether the DE is in its inception, growth, maturity, or renewal phase (Isckia et al., 2018), the incentive system must address the respective life cycle challenges. During the inception phase, for instance, DE designers might want to attract industry leaders and early adopters. At later stages, such as the growth phase, DE designers' focus might be on the exponential growth of DE's participant base. Similarly, once the first-tier consumer needs are satisfied, incentive systems should consider the second-tier needs most important for the biggest group of consumers that the DE intends to appeal to. Accordingly, it is essential to monitor the goals of the incentive system and, if necessary, re-tune the system to be effective and continuously attract the DE actors it seeks to attract (Panico & Cennamo, 2022). To this end, designers can employ the previously stated orchestration mechanisms to both monitor and re-tune existing incentive systems. We detail the process of this "realignment" within the system in the Use Case section of this study, where we provide a comprehensive guide on the practical application and expected outcomes of such strategic adjustments.

Case study: Applying the framework to a DE in Smart Living

To highlight the practical usefulness of our proposed framework, we present its application in a real-world scenario: an emerging digital ecosystem in the Smart Living space. This illustration is underpinned by expert interviews and a survey conducted to assess the robustness and relevance of the framework. Before delving further into the case study, it is pivotal to elaborate on the concept of Smart Living.

Advancements in fundamental technologies, such as cloud computing, artificial intelligence, or the Internet of things, gain ever-increasing traction and abet a new generation of digital products and services (Hosseinian-Far et al., 2018; Mihale-Wilson et al., 2022). Along with these advancements, scholars and practitioners expect a significantly growing importance of the Smart Living domain in the upcoming years (Makkonen et al., 2022; Murthy & Madhok, 2021). In essence, the Smart Living concept refers to weaving technology into our daily lives to improve convenience, efficiency, sustainability, and the overall quality of life (Hosseinian-Far et al., 2018; Jiménez et al., 2014). Among others, Smart Living envisions more convenience and higher quality of life by streamlining and automating various tasks to make routine activities more efficient (Bauer et al., 2020). With various daily activities being automated, consumers might have less stress and more free time to do whatever they love (Mihale-Wilson et al., 2017). Besides automation of tasks, Smart Living also envisions that smart services and systems can support consumers to lead healthier (e.g., through monitoring and recommending dietary and sports activities) and more sustainable lifestyles (e.g., through optimized energy consumption and waste reduction) (Bauer et al., 2020; Cimmino et al., 2014; Liu et al., 2019). Although desirable from a welfare and well-being point of view, the materialization of the Smart Living promise requires a high level of interoperability and cooperation between actors (Jiménez et al., 2014).

To achieve the cooperation and interoperability needed to materialize the Smart Living concept, European governments have started various initiatives (e.g., the German program SmartLivingNext[4]) that aim to create DEs that can merge the currently fragmented market and its respective actors. Because Smart Living DEs are only starting to form, such ecosystems are in their inception phase. Thus, their main focus is to attract as many actors (on the supply and demand side) as possible. We can use the proposed framework to identify and orchestrate the most promising incentives for attracting and engaging companies and consumers into a Smart Living DE. The first step in applying the framework is identifying incentives for companies and consumers by analyzing their expectations and goals when joining a Smart Living DE.

Identify incentives for companies and consumers

We use the set of company goals and consumer needs provided by the framework to identify incentives for companies and consumers. These need to be first prioritized according

[4] https://www.bmwk.de/Redaktion/EN/Pressemitteilungen/2023/01/20230103-smartlivingnext-call-for-funding-published.html

Table 2 Overview of interviewed companies concerning their goals with DE participation

Industry	
Home automation	8
Consulting	4
Mechanical engineering	3
Real estate/housing	1
Solution providers (software)	4
Insurance	2
Electrical engineering	2
Other	3

We constructed the sample to capture a wide variety of companies regarding company size, life cycle, and ownership structure to capture a comprehensive assessment of companies' goals independent of company types. The interviews were conducted online and lasted 40 min on average. The interview guide comprised the companies' goals compiled in Fig. 5 (left side). Specifically, the interviewees were asked to rate (1) the importance of the four BSC perspectives (finance, customer, internal process, and learning and growth) and (2) the respective goals by their importance when deciding to participate in a Smart Living DE.

Table 3 Ranking companies' goals concerning the participation in a Smart Living DE

Rank	1st	2nd	3rd	4th
	Customer perspective	**Learning and growth perspective**	**Financial perspective**	**Internal process perspective**
1	*Value proposition*	*Collaborations*	Turnover increase	Technological innovation
2	*Customer loyalty*	*Culture of innovation*	Market value increase	Performance optimization
3	*Brand reputation*	*Discovering improvement potential*	Cost optimization	Decision-making
4	Customer insights	Information management	Profit margin	Legal compliance
5	New customer acquisition	Professional training	Risk management	Productivity
6	Market share	Risk minimization	Return on investment (ROI)	Distribution
7	Agility	Employee satisfaction	Asset utilization	Social compliance

Note: Rank 1 indicates that the item is most important, and rank 7 indicates that the item is least important

to their importance for the consumers and companies' target groups. In our example, to reduce complexity and showcase the framework's application, we first seek to find the most important goals of the first and second most important dimensions of the BSC and the top 3 consumer needs, thus incentives. Due to the broad nature of the assessed company goals and consumer needs, such a prioritization of goals is pivotal for applying the framework. The plethora of goals and needs will be challenging to satisfy simultaneously, indicating the suitability of an initial focus on the most critical needs and goals while possibly being broadened over time.

To get a feeling on (i) companies' rating of the various company goals proposed by the framework, we conducted structured interviews with 27 companies related to the housing or home automation industry. Table 2 indicates the industry of the interviewed companies. Furthermore, we note that 15 interview partners represented large companies, 10 represented SMEs, 1 represented a start-up, and another a public entity related to the housing industry.

The conducted interviews with companies reveal that when deciding on participation in a Smart Living DE, companies are most interested in the customer perspective, followed by the learning and growth perspective. For instance, the Senior Manager for Strategic Innovation at a home automation company, responsible for strategic partnerships and ecosystems, states, "Yes, I think I would first rank that we already take the customer perspective in the first place, because that should always be the starting point, i.e., also the starting point for action. Learning and growth is then perhaps already two that we also want to grow in the market." The financial perspective ranks third, revealing a key insight about the Smart Living market: Although customer and growth-related goals might, in the end, also reflect positively in financial key performance indicators, companies seek to participate in a Smart Living DE first and foremost to improve customer- and

growth-related goals. In this context, the Managing Director of Technology overseeing the development and production of intercom systems and building communication company explains, "we would like the financial perspective to be at one, but that will then come downstream, and we are working to keep it that way."

From a customer perspective, companies seek to join the Smart Living ecosystem to improve their value proposition, customer loyalty, or brand reputation. From a learning and growth perspective, the interviewed companies value the new collaboration opportunities such a DE brings. Companies also seek to establish a strong culture of innovation and learn from others to discover their potential for improvement. Table 3 shows the rank of the respective perspectives and the goal importance within those perspectives. Rank 1 shows that the respective goal is, on average, voted to be the most essential and rank 7 the least important when deciding to join a Smart Living DE. Importantly, the ranks do not reflect the topic's overall importance in other managerial contexts. Case in point, "employee satisfaction" ranks seven, while "collaboration" ranks first within the learning and growth perspective. This indicates that although improving employee satisfaction and new collaboration are essential goals in the overall context of any company, the management does not expect that joining a Smart Living DE will considerably improve its employees' satisfaction. Instead, it expects that joining a Smart Living DE will enable numerous opportunities for collaborations that otherwise would not have been possible.

To maintain a manageable level of complexity, we will concentrate on the highest-ranked company goals from both the consumers' and learning and growth perspectives (as highlighted with a grey background in Table 3). From these company goals, corresponding incentives can be derived.

From the consumer perspective, companies seek to improve their value proposition, customer loyalty, and brand reputation. In discussions with domain experts, we determined that matching incentives to address companies' goal of improving their value proposition within the DE are setting *interoperability standards* between the components (tools, services, and other products within the DE); defining common *data exchange protocols* to effortlessly share and evaluate consumer data across different digital touchpoints in the DE; *unified user profiles* that allow organizations to have a unified view of a customer's interactions across the digital ecosystem can help in tailoring their offerings more effectively; establish a *community* for open source collaboration, research and development collaborations, and best practice sharing. To address companies' goal for improved customer loyalty, potential incentives are again *data exchange protocols* to improve holistic data-driven personalization of products and services; establishing a *customer community* where they can provide feedback and experiences; ensure *interoperability and seamless integration* between the products or services from different entities in the ecosystem; promoting a *research and development community* where shared value propositions are encouraged and materialized jointly; set joint standards for *quality assurance and testing*, to make sure that the user experience across different products and services are seamless and of high quality. To target companies' goal to improve their brand image, potential incentives encompass establishing *joint Corporate Digital Responsibility standards*—i.e., a set of best practices and guidelines about the responsibilities of the organizations when developing digital products and acting in the DE; providing a *customer dialogue platform* that bundles consumer concerns and feedback; establishing a *provider community* to share best practices related to brand image, sustainability commitments, and customer education initiatives; providing a *conflict resolution mechanism* that demonstrates a commitment to fairness and thus can elevate a brand's image; issue *transparency reports standards* that highlight the brand's commitments, achievements, challenges, and plans within the ecosystem.

From a learning and growth perspective, companies seek to improve collaborations, establish a culture of innovation, and discover improvement potential. Incentives that could target this company goal encompass *establishing a community* with shared research and development initiatives, best practices, open innovation challenges, and joint venture initiatives; providing *collaborative digital tools* between the entities on the supply side of the ecosystem; *shared prototyping labs* for collaborative idea prototyping and testing; *shared knowledge management and learning platforms* for idea and value proposition documentation, best practices and prototyping. At this stage, we note that although the listed examples of enabling collaborations might not be exhaustive, they depict stimuli aligned with companies' goals to achieve collaborations and hone their culture of innovation. For completeness and better understanding, we note that a non-aligned incentive would be one that does not speak to the respective goal of improving collaborations. More specifically, an example of a non-aligned incentive would be establishing a B2C marketplace where users can book smart services the Smart Living DE provides. Because a B2C marketplace serves as a distribution channel for ecosystem services, setting up such a marketplace does not generate better and more diverse collaborations between the companies in the ecosystem, nor does it help to develop companies' innovation culture.

Keeping in mind that alignment of the incentives with the respective entity's needs and goals is essential, we now turn to the investigation of (ii) consumer needs. To this end, we first prioritize the second-tier goals listed in Fig. 4. The rationale for focusing only on second-tier needs is that first-tier consumer needs (such as good functionality, easy to use,

Table 4 Demographic characteristics of the study participants surveyed with regard to their needs concerning DE participation

Demographics		
Gender	Male	55.51%
	Female	44.49%
Age	< 18	0.15%
	18–24	3.32%
	25–34	14.03%
	35–44	21.42%
	45–54	22.17%
	55–64	15.08%
	65–74	19.16%
	> 75	4.68%
Education	Less than secondary school certificate	14.48%
	Secondary school certificate	34.69%
	High school diploma	20.51%
	Bachelor	8.60%
	Master/diploma or higher	21.72%

the importance of the attributes queried. Because the topic of DE might be abstract and unknown to individuals, we designed and implemented a BWS study to create a ranking of the consumers' secondary needs concerning ubiquitous and interoperable Smart Living solutions in the form of a virtual digital assistant that assists their user in all kinds of daily tasks.

Table 5 illustrates the importance of second-tier consumer needs when individuals decide to consume and engage with a Smart Living DE. First, it shows that data safety and security exceeding legal requirements are the most important factors when choosing to consume products and services in a Smart Living DE. Second, individuals attach great importance to product safety and liability, followed by transparency and technological literacy (needs with a grey background in Table 5).

Again, based on domain experts' opinions, we can derive incentives matching the top-ranked consumer needs. For instance, to cater to consumers' desire for data privacy beyond the legal requirements and information transparency following incentives might apply, establish *clear data governance*—i.e., explicit policies about how data is stored, used, shared, and eventually deleted, providing users clarity on their data lifecycle; *end-to-end encryption* when data is transferred; establish the *data minimization principle* where products and services and gather only the vital data; *data anonymization* when storing and processing data; usage of *open source security standards* that are tested by the open community for vulnerabilities; regular *3rd party security audits* and *certifications* that testify that the ecosystem's data privacy and security measures are up-to-date; transparent data breaches and usage reports. Ultimately, it is pivotal to contribute to *consumers' education* regarding DE's privacy and security measures and how to optimally use the

Table 5 Ranking of second-tier individual needs in a Smart Living DE

Rank	Optional conditions (second-tier consumer needs)
1	*Data privacy and security exceeding legal requirements*
2	*Product safety and liability*
3	*Information and transparency*
4	Education/technological literacy
5	Access
6	Prioritizing consumers' economic interest
7	Accountability (dispute resolution)

Note: Rank 1 indicates that the item is most important, rank 7 indicates that the item is least important

reliability, and compliance with the current data security and privacy regulations) represent so-called "deal breakers" that are non-negotiable. Accordingly, it makes more sense to focus on those second-tier optional consumer needs, which can make a difference and sway consumers toward purchasing DE offerings instead of alternative ones.

To identify the top 3 s-tier consumer needs, we conducted a best–worst scaling (BWS) study with 663 German individuals between 17 and 87 years old (Table 4). Best–worst scaling is an established method to elicit individuals' preferences for various attributes of products and services (Hinz et al. 2015). However, the method can also be applied to elicit consumer preferences and needs in various contexts. In BWS, participants are asked to choose their most and least preferred attribute from a varying set of attributes (Hinz et al. 2015). In the end, the results of the BWS represent

ecosystem tools and mechanisms to ensure their preferred data privacy and security level.

Regarding consumers' need for product safety and liability, it is essential to erase confusion on who is accountable for any harm caused by using ecosystem offerings. As mentioned previously, the opaque and interdependent nature of DEs makes it challenging to attribute harm to a particular component. This, in turn, can lead to disputes about who should be held accountable and discourage innovation in the digital space. Additionally, due to the dynamic nature of the DE, offerings might be developed and deployed without being able to conduct long-term studies on potentially adverse side effects. To cater to consumers' need for clear and comprehensive product safety and liability while encouraging innovation within the ecosystem, DE designers might want to assess *joint liability* via *an ecosystem-wide entity*. This could be operationalized in the form of an *insurance mechanism* that takes effect in case some damage happens. Besides the joint liability, other suitable incentives to address consumers' need for safety and liability include building a *community for collaborative security measures* (where the community shares information about potential threats and collaborates on solutions); *clear liability agreements* among participants; (i.e., each entity's liability is clearly defined); *3rd party certifications and audits*; *distributed trust mechanisms that ensure the traceability and accountability* when components from different providers are jointly providing a service. Again, it is ultimately also essential to ensure the *education of the consumer* in terms of safety. In this vein, it is pivotal to disseminate information and educational resources on safety practices within the *ecosystem communities*, ensuring that all entities are aware of best practices and potential threats.

The identified incentives are now combinable into a system that synergistically amplifies their individual effects, fostering a collaborative, innovative, and continuously improving environment within the digital ecosystem.

Combine incentives into a system

To find the set of incentives that is, on aggregate, most effective (i.e., it has the maximal desired effect on the target audience), we analyze the relationships between the various incentives. To this end, we employ different orchestration mechanisms used in Table 1 and assess whether incentives are independent, competing, and complementary to each other. Figure 5 visualizes these relationships. For instance, the incentives *clear data governance*, *end-to-end encryption*, and *data exchange protocols* are complementary. They all address different facets of data management and security, especially in the context of data privacy. While clear data governance sets the "rules" for managing data, end-to-end encryption provides the "tools" to ensure data remains confidential. On the other hand, data exchange protocols ensure smooth and standardized data transitions across systems. Together, they provide a comprehensive approach to data privacy. This way, the three incentives complement each other and cater to both (i) consumers' need for data privacy beyond the legal requirements and (ii) organizations' need to effortlessly share and evaluate consumer data across different digital touchpoints in the DE. In stark contrast, the incentives *data minimization principle and data anonymization* and *unified user profiles* are conflicting incentives. Data minimization and anonymization again cater to consumers' need for privacy-friendly offerings. The unified user profiles target organizations' wish to improve their value proposition through richer data and the knowledge it holds about the customers. These incentives are fundamentally conflicting since data minimization encourages collecting the least amount of data necessary, while unified user profiles require a comprehensive collection of data for a complete view of the user. Similarly, data anonymization and unified user profiles are totally opposite. While anonymization seeks to obscure consumers' identities, the purpose of unified profiles is to provide individualized insights on the user. Anonymizing a unified profile significantly limits its usefulness.

Based on the relationships between the incentives mapped out in Fig. 5, we can design an incentive system that harmonizes conflicting incentives and accommodates both independent and complementary ones. Figure 6 depicts the incentive system derived for our specific example. In our case, the incentive system encompasses four DE components: providing a toolbox, establishing a community, ensuring a joint DE-wide liability and dispute resolution and a Personal Data Space. The ecosystem-wide toolbox should offer services and tools (such as knowledge-sharing platforms and prototyping labs) but also standards for the DE collaboration on all levels (such as interoperability standards on a technology level and transparency report standards on a managerial level). Further, DE designers need to invest efforts to form a vivid community that actively communicates and collaborates (for instance, within the framework of visionary forums, regular community events on cutting-edge technologies, best practices for research and development, or matchmaking events to facilitate collaborations between companies with different skill sets and assets).

The third element in the incentive system is a DE-wide joint liability and dispute resolution. Knowing that there is a joint liability structure assures consumers that they have avenues for redress if things go wrong. The mere existence of such a system signals that organizations in the ecosystem are confident enough in their offerings to share the risk. Additionally, when every player in the ecosystem shares responsibility, it fosters a culture of accountability and quality assurance, thereby boosting the overall credibility of the ecosystem. Ultimately, the last element of the incentive

Fig. 5 Exemplary identification of independent, competing, and complementary incentives for top three company goals (see Table 3) and consumer needs (see Table 5)

system is establishing a Personal Data Space (PDS)—a digital environment (e.g., a platform) that enables individuals to view, manage, buy, sell, and trade personal data. The concept behind a Personal Data Space is to empower consumers to check and monitor but also monetize their data if they choose to do so. Personal data space can also be essential in making data flows transparent and fair.

Incentive system realignment

Once in place, the effectiveness of the incentive system needs to be monitored and, if necessary, re-tuned to attract the groups of companies and consumers it was set up for. In particular, as the DE evolves and participants interact, DE designers might seek to appeal to companies and individuals who still need to join the ecosystem. As mentioned previously, incentive systems are not intended to be static approaches but recursively developed and adapted over time. Only this way we can ensure that the proposed incentive system (in its current version) will match the development of the DE itself. Accordingly, monitoring loops and refinement cycles should be implemented in the DE. To this end, the incentive system needs to be expanded with additional stimuli that address company goals and consumer needs that have not been considered yet.

Continuing with our example, when the initial version of the incentive system (see Fig. 6) accomplishes its objectives and secures the participation of the intended user groups and companies within the ecosystem, its ability to attract further companies and users to the DE will gradually diminish.

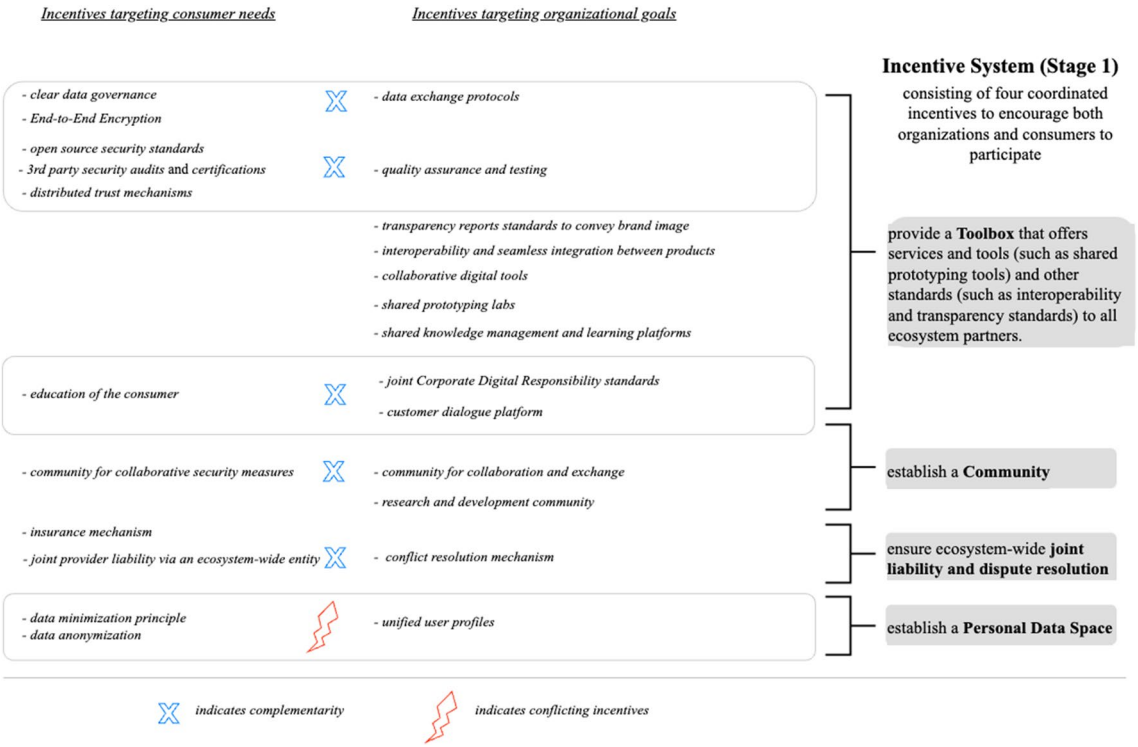

Fig. 6 Exemplary developed incentive system that addresses top three company goals (see Table 3) and consumer needs (see Table 5)

Then, it is necessary to expand and readjust the initial version of the incentive system to accommodate the requirements of additional companies and user groups and try to bind these additional entities to the DE. From a consumer perspective, our research revealed that beyond the top three consumer needs data privacy, product safety, and information transparency, consumers value technology education to improve their *technology literacy* (see Table 5). Recognizing the significance of this finding and seeking to attract further consumers to the ecosystem, it is appropriate to expand upon the original version of our incentive system by integrating incentives specifically tailored to address consumers' wish for enhanced technology literacy. These consumer-directed incentives would play a pivotal role in not only meeting consumer demands but also in fostering a more informed and empowered consumer base. Such incentives encompass the provision of ecosystem-based online learning courses, an expansion of the ecosystem community to accommodate user forums. Other incentives might be the provision of user-focused tech support services or the implementation of credits for user engagement in the ecosystem's community.

On the company side, our interviews revealed that another crucial strategic corporate objective in digital ecosystem participation (see Table 3) is gaining access to consumer insights. Consumer insights empower businesses with invaluable information about consumer behavior, preferences, and trends. Armed with this knowledge, companies can make informed decisions, refine their product offerings, and tailor their marketing strategies to better resonate with their target audience. While such insights remain indispensable for being able to compete within a market, in reality, due to limited access to the necessary data, companies cannot always independently generate the key consumer insights they need. Given the strategic importance of consumer insights, enhancing the original version of the incentive system should logically prioritize addressing this need. To address companies' desire for (better) consumer insights, ecosystem designers can consider implementing a range of incentives: For one, there is the *provision of advanced analytics tools* for mining, analyzing, and interpreting consumer data more effectively. Another incentive that targets the goal of improved consumer insights could be the provision of *data-sharing agreements* (for non-sensitive data) between companies participating in the DE. These agreements should promote mutually beneficial data sharing that profits all involved partners. Further incentives involve the provision of *consumer-feedback mechanisms* (e.g., customer-feedback platforms, online surveys), improved *access to third-party data brokers* through DE participation, and *interoperability standards for data exchanges* within the ecosystem. Also possible is the provision of generally valid *customer insights* that could serve a wide range of ecosystem participants or establishing a *community for collaborative research initiatives* that enable the participating entities to extract the key

consumer insights they need. Ultimately, a further viable alternative to serve companies' need for (better) customer insights is by providing an ecosystem-wide *customer insights intelligence service* through an entity owned by the ecosystem itself. In contrast to providing only generally valid consumer insights, this intelligence entity would provide ecosystem participants with customer insights tailored to their specific industry or business area (i.e., insights on customer segments within their business area, aggregate-level customer profiling relevant to the specific business a company is active in). However, a pivotal element of this approach would involve establishing an intelligence entity with the responsibility of centralizing and overseeing all ecosystem data. This centralization is crucial to guarantee that individual ecosystem participants are granted access only to their own data and not that of other participants, thus safeguarding data privacy and security.

In light of all these considerations, we can proceed to expand the original incentive system (see Fig. 6) to accommodate the consumer need for improved technology literacy and companies' wish for better consumer insights and thus ultimately increase ecosystem participation. However, to do so, we first need to align and assess the compatibility of the above-discussed incentives with each other with the incentives that form the original version of the incentive system. The idea is to achieve an expansion of the original incentive system to attract new players into the ecosystem without losing those who are already part of the ecosystem.

In practice, aligning and assessing the compatibility of the new incentives require a thorough analysis of conflicts or synergies among consumer and company goals and legacy and new incentives. In our specific case, for instance, the analysis reveals that providing advanced analytics tools contradicts the primary goal of data minimization. After all, advanced analytics tools often require and thrive on having a wealth of data to analyze and derive meaningful insights from. Without an extensive database to perform their functions effectively, analytics tools cannot provide the intelligence they are supposed to offer. Thus, when ecosystem participants are provided with advanced analytics tools, they might be inclined to request and access more consumer data than is strictly required for their immediate needs. Accordingly, the provision of ecosystem-wide advanced analytics tools can create a tension between the desire for enhanced data-driven insights and the principle of data minimization. As more data is gathered and processed than may be strictly necessary, individual privacy and data security are potentially compromised. To reconcile these conflicting goals, we need to combine only incentives that can strike a balance between data utility and minimization. One fruitful avenue to address this challenge is to strengthen the Personal Data Space envisioned in the original incentive system (incentive system stage 1). Within the Personal Data Space, consumers can control the access to their data and thus decide deliberately and—if they wish—on a case-by-case basis whether they sell their data, make it available free of charge, or not at all. In combination with a well-designed Personal Data Space, the provision of *advanced analytics tools* is, in this case, a feasible option to support companies in their endeavor toward (better) consumer insights. Thereby, the design of the Personal Data Space plays a pivotal role in encouraging users to willingly contribute their data to the ecosystem. Without a substantial amount of consumer data, the utility of the ecosystem's data analysis tools is highly constrained.

This scenario bears resemblance to the concept of *data-sharing agreements* within the diverse companies comprising the DE. Here, the idea is to ensure the exchange of consumer data between the DE companies, enabling DE participants to extract the consumer insights they require. However, even with the implementation of data minimization principles and the Personal Data Space, the mere existence of *data-sharing agreements or interoperability standards for data exchanges* may not necessarily result in an abundance of improved consumer insights. The crux lies in whether consumers are willing to share or sell their data for analytical purposes.

Another potentially fruitful avenue to reconcile consumers' and companies' interests concerning data collection is the provision of the *consumer insights ecosystem-wide intelligence service* that offers companies the necessary insights without divulging individual consumer data to individual companies. It presents a harmonious solution without conflicting with other incentives within the system, as companies within the ecosystem are supposed to gather only the minimal necessary data required to provide their respective products and services. When aggregated, the minimalistic data sources collected by each ecosystem participant through their products and services can evolve into a valuable asset for extracting consumer insights. In this manner, implementing the consumer insights intelligence service aligns with the interests of both companies and consumers. It can offer companies the desired customer insights while upholding the critical principle of data minimization and preserving consumer privacy.

Given the importance of consumers' willingness to share or sell their data for better insights, both of the aforementioned incentives (i.e., the Personal Data Space and consumer insights intelligence service) should be implemented alongside one or more consumer technology literacy campaigns. Such campaigns enable ecosystem designers to address consumers' need for enhanced technology literacy while fostering greater acceptance and willingness among individuals to share their data for ecosystem-related purposes. In essence, the technology literacy campaigns should offer educational materials explaining the ecosystems'

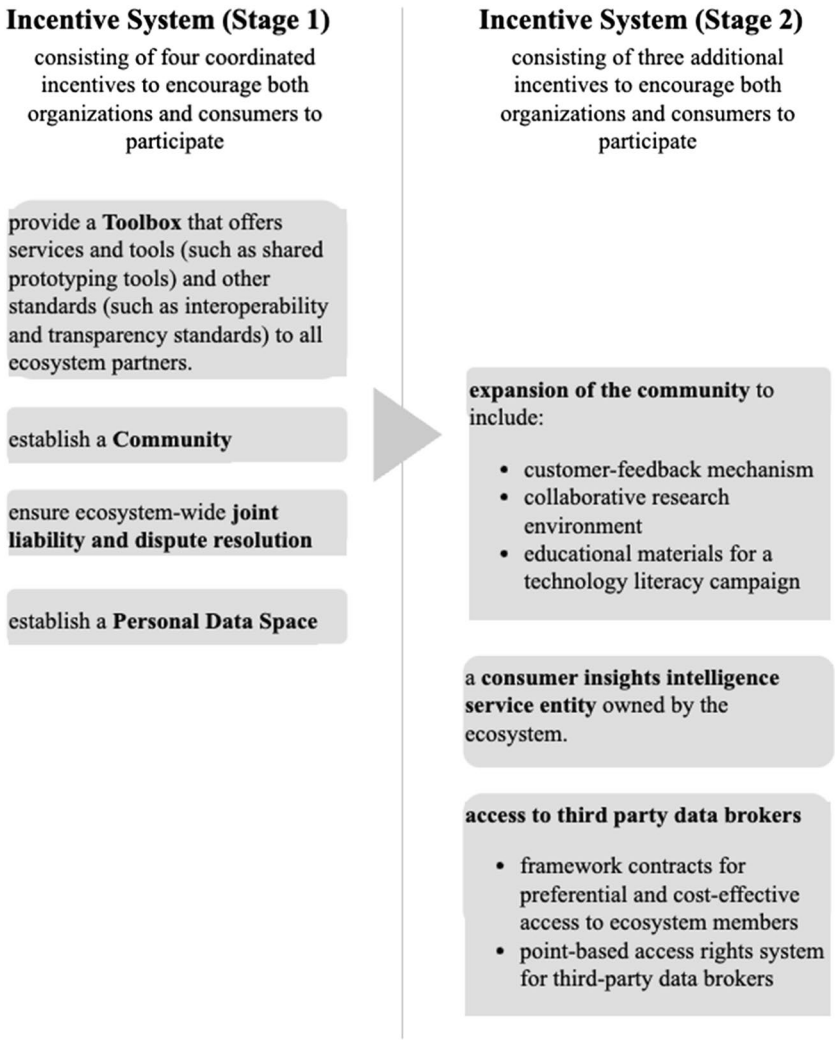

Fig. 7 Realigned (extended) incentive system (based on the incentive system stage 1)

products and services' functionality, the underlying technologies, and the role of data for the personalization and utility of the ecosystems' products and services. In this sense, such campaigns should present detailed information about how the customer insights services are compiled, the specific data sources they utilize, and the potential benefits of these insights for the customers themselves, along with explanations of the measures in place to safeguard consumers' data safety and privacy.

As discussed previously, besides the Personal Data Space and the provision of consumer insights intelligence service, ecosystem designers can facilitate the generation of relevant customer insights by implementing *consumer-feedback mechanisms* or *a community for collaborative research initiatives* among companies. The customer-feedback mechanism will most likely have two beneficial outcomes. For one, it will increase consumers' involvement in the ecosystem and thus their loyalty to the ecosystems' products and services. At the same time, it will also provide insights into the focal topics that should be addressed during the technology literacy campaign(s). Such a customer-feedback mechanism will also work well with the customer dialogue platforms in the initial version of the incentive system. Likewise, establishing a community for collaborative research initiatives is complementary to the already envisioned efforts of the community in the first version of the incentive system. Thus, these two incentives could extend the initial version of the incentive system without any expected complications.

Finally, *access to third-party data brokers* stands out as another promising avenue for enabling companies to gain the consumer insights they require. This incentive is relatively autonomous from the initial version of the incentive system. Thus, it could expand the initial version of the incentive system through implementing a range of approaches. One viable option is establishing framework contracts or other agreements that grant ecosystem members preferential and cost-effective access to third-party brokers. Another option is that the ecosystem itself buys access rights to third-party brokers and distributes these access rights based on a points-based system. In this scenario, every ecosystem member accrues

points based on their level of participation, contribution, or engagement within the ecosystem. These points could then be redeemed for access to third-party data brokers, which ensures that access is tied to active involvement within the ecosystem. This approach maintains fairness within the ecosystem, as it is not favoring any specific member over others.

To sum up, a suitable extension of the original version of the incentive system (see Fig. 7) should encompass the following additional incentives: a *consumer insights intelligence service entity*, *access to third-party data brokers*, and a *community expansion*. The community expansion should include a customer-feedback mechanism, a collaborative research environment for consumer insights, and educational materials for the technology literacy campaign.

Discussion

This article draws upon existing literature on digital platforms and platform ecosystems (e.g., L. Chen et al., 2022; Kretschmer et al., 2022; Kuang et al., 2019; Ojala & Lyytinen, 2022; X. Sun & Zhang, 2021) to propose an integrated framework for identifying and orchestrating incentives into incentive systems that attract and engage two species of the DE: consumers and companies. The framework outlines the key components for designing these systems, emphasizing interconnections like the alignment of company and consumer needs. It proposes methods to harmonize intertwined incentives, ensuring cohesive incentives across ecosystem actors.

We understand incentive systems as a set of incentives that have a maximum effect on the target audience and lead them toward the desired behavior. Against this background, the complexity of designing incentive systems stems from two factors: First, incentives in the context of DEs are much different from "organizational incentives" (L. Chen et al., 2022). Whereas organizational incentives are typically regarded as a structural attribute of an organization, in the context of DEs, they are key governance mechanisms to ensure ecosystems' success (L. Chen et al., 2022; X. Sun & Zhang, 2021). They also differ in terms of their operational focus, goals, and the nature of stakeholder engagement. Organizational incentives are primarily designed to enhance employee performance, ensure that employee actions align with the company's strategic objectives, foster employee loyalty, and increase retention (Saleem, 2011). On the contrary, DE incentives have a broader reach as they foster collaboration and symbiosis among various loosely connected stakeholders with independent and sometimes competing interests. Furthermore, DE incentives are crafted to encourage active participation, facilitate cooperation, and drive collective value creation within the ecosystem (Adner, 2017; L. Chen et al., 2022; Valdez-De-Leon, 2019).

DE incentives are pivotal governance mechanisms because they orchestrate the complex interplay between autonomous yet interdependent actors. The primary focus of these incentive systems extends beyond merely attracting and maintaining participants; it is about strategically guiding the ecosystem toward sustainable growth. These incentives are meticulously designed not just for resolving conflicts or aligning diverse, often competing interests within the ecosystem. Rather, their pivotal role lies in effectively integrating valuable actors into the ecosystem. By harmonizing these varied interests, the incentives facilitate cooperative and mutually beneficial interactions among all players in the ecosystem.

In DEs, participants jointly contribute to the ecosystem's success by creating technologies, services, or products that other ecosystem participants can recombine to generate new interconnected and complementary products and services. While these interconnected products and services offer their user superior value than traditional products, they typically do not materialize in coopetitive environments, where companies operate independently. Effective harmonization of interests within the DE promotes collaboration and cooperation among the participants. This, in turn, leads to the co-creation of value and an expanded market presence, driving sustainable growth through two main channels: On the consumer side, enabling co-created value enhances user satisfaction and fosters high customer loyalty. This, in turn, activates a second growth channel—the continued engagement of companies within the ecosystem. From a company perspective, in a stable environment with promising collaboration opportunities, businesses are more likely to remain engaged and committed for the long haul, which is vital for the perpetual growth of the ecosystem.

In contrast to organizational incentives, DE incentives are structured to ensure the cohesive functioning and strategic progression of the broader digital ecosystem. This way, incentives in DEs are instrumental in the governance of the ecosystem—i.e., creating conditions that enable and coordinate the interactions between actors (e.g., the flow of resources) without losing the advantages of decentralized decisions (L. Chen et al., 2022; Teece, 2017).

Due to the complexity of developing incentive systems for DE participation, we draw on various models and insights from the organizational strategic management literature and technology adoption literature to comprehensively explore companies' and consumers' needs. For instance, we adapted the BSC, which is typically a general management tool, to the context of DEs to specify and elaborate appropriate business goals and incentives from various strategic perspectives within a company. In addition, we also synthesized and applied several technology adoption models

concerning DEs. This way, designers can identify, filter, and evaluate various consumer needs. Furthermore, combining several technology adoption models, the framework captures the pre- and post-adoption phases of technology adoption. Albeit the framework's multiple building blocks and elements might feel overwhelming at first sight, the exemplary application of the framework corroborates the appropriateness of implementing such a comprehensive approach to designing and orchestrating incentive systems.

Contributions to theory and practice

Altogether, our work presents various contributions to theory and practice. For theory, this work contributes first and foremost to the corpus of literature on DEs and, in particular, DE design and governance mechanisms. Extant literature has called out the importance of stakeholder participation for the success of a DE (e.g., Evans, 2003; Hagiu & Rothman, 2016; Schreieck et al., 2016), as well as the need for identifying the incentive structures necessary for attracting and binding the stakeholders required for the ecosystem to thrive (e.g., Adner, 2017). However, to our knowledge, there is no systematic research on designing incentive systems for (digital) ecosystems. This research extends the current body of literature while providing actionable insights for practice. Besides, our work contributes to the growing literature on the design and characteristics of DEs (Jacobides et al., 2018; Wang, 2021). Currently, the framework is only dedicated to the companies' and consumers' stakeholder groups. However, it can theoretically be extended to other important groups within an ecosystem—e.g., non-profit organizations and governmental regulatory institutions.

Furthermore, our framework contributes to the literature on incentive systems, which is highly fragmented and specialized. For example, incentive systems in the corporate context have been traditionally viewed from an organizational perspective only. Within this stream of literature, research mainly focused on incentive systems that motivate employees to act in the interest of organizations (e.g., Clark & Wilson, 1961; Holmstrom & Milgrom, 1994; S. Kaplan & Henderson, 2005; Malik et al., 2015). In this work, we view incentive systems from the perspective of DEs and understand incentive systems on the organizational level as different from those within the context of DEs (L. Chen et al., 2022; X. Sun & Zhang, 2021). In our work, incentives systems refer to a set of stimuli congruent with companies' strategic goals, such that in response to the set incentives, companies' decisions are directed toward the desired behavior. Following this understanding, our framework represents a blueprint for the design of such incentive systems. This way, we expand the extant literature on incentive systems beyond their common application in employee-organization relationships.

From a practical perspective, the framework presented in this paper provides a pragmatic way to develop an ecosystem-specific incentive system. It supplies a set of concepts and mechanisms that strategically exploit company goals and consumer needs to identify and distill suitable stimuli into a comprehensive incentive system able to attract the actors a DE needs to thrive. The key concepts of the framework ground on existing literature from management, marketing, and IS. We demonstrated how DE designers could use the proposed framework in practice by applying it exemplarily to a DE in Smart Living. Notably, although the framework's exemplary application shows how to develop an incentive system for a DE in its inception phase, the framework and its elements are equally applicable to DEs from other domains and in different life cycle phases (e.g., maturity). The general framework remains consistent when applying the framework to further application scenarios. However, evaluating the proposed framework elements for relevance needs to be repeated to account for the context sensitivity of the developed framework. The whole application process must be carried out to ensure the highest possible effectiveness, as the evaluation of the most pressing company goals and consumer needs might differ within different contexts, i.e., in different application scenarios. To this end, the context is decisive when applying the framework for designing and orchestrating incentives. Nevertheless, applying the framework to the context of Smart Living should provide guidance and ease the further implementation of the framework.

Limitations and directions for future research

Despite the strengths of the presented framework, our work is not without limitations. The most important limitation of the framework is its focus. Our integrated framework focused on the species: consumers and companies. Although there are good reasons to start the development of incentive systems with these two species, we acknowledge the importance of other species within the DE. Depending on the perspective on the DE, it is, for instance, also necessary to consider technology providers (i.e., companies specialized in providing technology into the DE) as an additional key species within the ecosystem. Technology providers shape the ecosystem by providing digital technologies and infrastructure that support the digital ecosystem. Another vital group that merits attention are investors who finance businesses within the DE, governmental agencies that set the regulatory perimeters for the DE to develop and flourish, or associations related to the DE domain. Because developing incentive systems requires a comprehensive analysis of the target groups who are supposed to participate actively in the ecosystem, the perspective on the DE and the groups it reveals dictates whether the framework might have to be slightly adapted to further contexts and groups of interest.

Such adaptions include adding or reducing company goals or consumer needs and introducing new goals and needs specific to the newly added context.

Another potential limitation of the framework is its parsimony concerning the dynamics of DEs. The current version of the framework incorporates the idea that DEs evolve by introducing orchestrating mechanisms that help designers re-align and further develop incentives to fit the ecosystem's respective life cycle phase. Within the extant body of literature on DEs, various other theories and insights could be incorporated to capture DEs' evolutionary stages. After all, just like their natural counterparts, DEs are characterized by an inherent change and adaptation over time. Within digital ecosystems (DEs), components evolve based on their efficiency, utility, and adaptability. Within this environment, DE designers influence the evolutionary process by seeking to attract a particular company or user group. However, there are other forces at play that DE designers can only observe and act upon. As the punctuated equilibrium theory postulates, DEs can undergo phases of relative stability, where the existing structures and dynamics persist and remain relatively unchanged for extended periods (J. Xu & Cornelissen, 2023). However, these stable periods are periodically interrupted by disruptive events or innovations that lead to rapid and significant changes in the ecosystem's structure, interactions, and functioning. Punctuated equilibrium in DEs recognizes that evolutionary progress is not always gradual but can occur in distinct bursts or phases of rapid transformation (J. Xu & Cornelissen, 2023). This concept highlights the need for actors within DEs to be prepared for both incremental changes and disruptive shifts as they shape the trajectory and development of the ecosystem over time. The episodes of rapid evolution catalyzed by game-changing technological innovations, user behavior shifts, or regulatory changes force DEs into new equilibria, dictating the need for adaptive strategies and recalibrated incentive systems.

Our framework accounts for the evolutionary and dynamic nature of DEs by envisioning a realignment of the incentive system whenever necessary but does not consider reductions in transaction costs. Regarding the evolutionary dynamic of DEs, we note that as the DE evolves, the goals and needs of these species within the DE transform. A nuanced understanding of these shifts is essential to craft incentive systems that resonate with these actors at that particular time. While our framework allows DE designers to act upon changes and dynamics in the DE, its support for recognizing and addressing these changes is limited. One of the central challenges of punctuated equilibriums is their inherent unpredictability. While such dynamic changes can form a pattern that is recognizable retrospectively, predicting or even recognizing rapid shifts and their impact on the DE is very challenging. Thus, predicting how these rapid shifts will change the various DE stakeholders' goals and needs is also challenging. Against the background that the predictive alignment of the incentive system as a proactive strategic measure to punctuated equilibria is, in reality, challenging, future research could develop tools and mechanisms that help predict future developments in DEs and how these developments will influence organizations' goals and consumer needs. Such tools can be, for instance, monitoring frameworks or systems that can help detect early signals of rapid changes and thus ensure timely realignment of the currently deployed incentive system.

Regarding the transaction costs, we note that when digital ecosystems mature through their life cycles, they tend to streamline transaction costs, thus enhancing their attractiveness for participation. Digital ecosystems facilitate efficient market transactions, optimize managerial processes, and curtail the time required for tasks like searching and negotiating (Akter & Wamba, 2016). This efficiency presents a compelling value proposition, bolstering competitiveness and fostering innovation. Although this aspect is crucial for the detailed design of DEs, the intricacies and extensive repercussions of transaction cost efficiencies necessitate a focused, comprehensive study in future research efforts.

Ultimately, another potentially fruitful path for future research is conducting a meta-review to provide an extensive catalog of company- and consumer-related incentives. This meta-review can depart from the company goals and consumer needs proposed by our framework. Compiling a catalog of incentives suitable to address the company goals and consumer needs in our framework and mapping these to the particular company goals and consumer needs would significantly contribute to theory and practice. For practice, the value of such a study is straightforward: such a catalog would support designers in designing incentive systems even further. Theoretically, a catalog of incentives can extend the current research on developing incentive systems for DE participation. It could also help theorize the difference between incentives in the organizational versus DE context. Although various scholars (L. Chen et al., 2022; X. Sun & Zhang, 2021) contend that incentives are very different within these two contexts, as of today, there is no theoretical and structured investigation of these differences.

Conclusion

In the future, DEs will play an increasingly crucial role in shaping various industries and sectors. As these ecosystems evolve, designing the right incentive system becomes paramount for their success. An incentive ecosystem encourages active participation, fosters stakeholder collaboration, and ensures continuous engagement. By understanding the significance of designing incentives tailored to the needs of actors within the ecosystem, we can create thriving digital

ecosystems that drive innovation, enhance user experiences, and unlock new opportunities for growth and value creation. While robust, the framework presented has limitations that could be addressed in future research. Our framework is focused on consumers and companies. However, we acknowledge the potential need to expand it to include other DE stakeholders, such as technology providers and regulators. Our framework also simplifies the dynamic nature of DEs, addressing evolutionary changes without delving into the complexity of DE development stages. While it accommodates incentive realignment in response to DE evolution, it may not fully account for the unpredictability of rapid changes. Future research could predict these changes and further differentiate incentives in organizational and DE contexts. Despite these limitations, the integrated framework presented in this paper offers valuable insights and guidance for designing incentive systems that foster active participation and engagement within digital ecosystems, paving the way for sustainable DE growth and success.

Acknowledgements This work was funded by the Federal Ministry for Economic Affairs and Climate Action (Project ForeSight [Grant: 01 MK20004J], and Project SECAI [Grant: 01MD22005D]). Additionally, it was supported by the the Hessian State Chancellery – Hessian Minister of Digital Strategy and Development (Project CDR-CAT [Grant: 6/493/71574093]).

Funding Open Access funding enabled and organized by Projekt DEAL.

References

Acquisti, A., & Grossklags, J. (2005). Privacy and rationality in individual decision making. *IEEE Security and Privacy Magazine, 3*(1), 26–33. https://doi.org/10.1109/MSP.2005.22

Adjerid, I., Peer, E., & Acquisti, A. (2018). Beyond the privacy paradox: Objective versus relative risk in privacy decision making. *MIS Quarterly, 42*(2), 465–488. https://doi.org/10.25300/MISQ/2018/14316

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management, 43*(1), 39–58. https://doi.org/10.1177/0149206316678451

Agarwal, R., Animesh, A., & Prasad, K. (2009). Research note—social interactions and the "digital divide": Explaining variations in Internet use. *Information Systems Research, 20*(2), 277–294. https://doi.org/10.1287/isre.1080.0194

Akter, S., & Wamba, S. F. (2016). Big data analytics in E-commerce: A systematic review and agenda for future research. *Electronic Markets, 26*(2), 173–194. https://doi.org/10.1007/s12525-016-0219-0

Aulkemeier, F., Iacob, M.-E., & van Hillegersberg, J. (2019). Platform-based collaboration in digital ecosystems. *Electronic Markets, 29*(4), 597–608. https://doi.org/10.1007/s12525-019-00341-2

Baird, A., & Maruping, L. M. (2021). The next generation of research on IS use: A theoretical framework of delegation to and from agentic IS artifacts. *MIS Quarterly, 45*(1), 315–341. https://doi.org/10.25300/MISQ/2021/15882

Barykin, S. Y., Kapustina, I. V., Kirillova, T. V., Yadykin, V. K., & Konnikov, Y. A. (2020). Economics of digital ecosystems. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(4), 124. https://doi.org/10.3390/joitmc6040124

Bauer, J., Hechtel, M., Konrad, C., Holzwarth, M., Mayr, A., Schneider, S., Franke, J., Hoffmann, H., Zinnikus, I., Feld, T., Runge, M., & Hinz, O. (2020). ForeSight-AI-based Smart Living platform approach. *Current Directions in Biomedical Engineering, 6*(3), 384–387. https://doi.org/10.1515/cdbme-2020-3099

Bélanger, F., & Crossler, R. E. (2011). Privacy in the digital age: A review of information privacy research in information systems. *MIS Quarterly, 35*(4), 1017–1042. https://doi.org/10.2307/41409971

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly, 25*(3), 351–370. https://doi.org/10.2307/3250921

Bonina, C., Koskinen, K., Eaton, B., & Gawer, A. (2021). Digital platforms for development: Foundations and research agenda. *Information Systems Journal, 31*(6), 869–902. https://doi.org/10.1111/isj.12326

Briscoe, G., Sadedin, S., & De Wilde, P. (2011). Digital ecosystems: Ecosystem-oriented architectures. *Natural Computing, 10*, 1143–1194. https://doi.org/10.1007/s11047-011-9254-0

Brown, S. A., Dennis, A. R., & Venkatesh, V. (2010). Predicting collaboration technology use: Integrating technology adoption and collaboration research. *Journal of Management Information Systems, 27*(2), 9–54. https://doi.org/10.2753/MIS0742-1222270201

Burton-Jones, A., & Volkoff, O. (2017). How can we develop contextualized theories of effective use? A demonstration in the context of community-care electronic health records. *Information Systems Research, 28*(3), 468–489. https://doi.org/10.1287/isre.2017.0702

Camarinha-Matos, L. M., & Abreu, A. (2007). Performance indicators for collaborative networks based on collaboration benefits. *Production Planning & Control, 18*(7), 592–609. https://doi.org/10.1080/09537280701546880

Cao, Y., Zhao, K., Yang, J., & Xiong, W. (2015). Constructing the integrated strategic performance indicator system for manufacturing companies. *International Journal of Production Research, 53*(13), 4102–4116. https://doi.org/10.1080/00207543.2014.994715

Carl, K. V., & Mihale-Wilson, C. (2020). Consumer privacy concerns and preferences for certification and accreditation of intelligent assistants in the internet of things. In H. Roßnagel, C. H. Schunck, S. Mödersheim, & D. Hühnlein (Eds.) *Open Identity Summit 2020* (pp. 157–162). Gesellschaft für Informatik e.V. https://doi.org/10.18420/ois2020_13

Carl, K. V., Mihale-Wilson, C., Zibuschka, J., & Hinz, O. (2023). A consumer perspective on Corporate Digital Responsibility: an empirical evaluation of consumer preferences. *Journal of Business Economics,* 1–46. https://doi.org/10.1007/s11573-023-01142-y

Chapman, C. N., Love, E., & Alford, J. L. (2008). Quantitative early-phase user research methods: Hard data for initial product design. *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS)* (pp. 37–45). https://doi.org/10.1109/HICSS.2008.367

Chen, H., Li, T., & Zhang, C. (2021). Going too far is as bad as not going far enough: An inverted U-shaped relationship between internal controls and operational efficiency. *Journal of International Accounting Research, 20*(2), 25–50. https://doi.org/10.2308/JIAR-17-571

Chen, L., Tong, T. W., Tang, S., & Han, N. (2022). Governance and design of digital platforms: A review and future research directions on a meta-organization. *Journal of Management, 48*(1), 147–184. https://doi.org/10.1177/01492063211045023

Cimmino, A., Pecorella, T., Fantacci, R., Granelli, F., Rahman, T. F., Sacchi, C., Carlini, C., & Harsh, P. (2014). The role of small cell technology in future smart city applications. *Transactions on Emerging Telecommunications Technologies, 25*(1), 11–20. https://doi.org/10.1002/ett.2766

Clark, P. B., & Wilson, J. F. (1961). Incentive systems: A theory of organizations. *Administrative Science Quarterly, 6*(2), 129–166. https://doi.org/10.2307/2390752

Cresswell, K., Sheikh, A., Franklin, B. D., Krasuska, M., The Nguyen, H., Hinder, S., Lane, W., Mozaffar, H., Mason, K., Eason, S., Potts, H., & Williams, R. (2021). Interorganizational knowledge sharing to establish digital health learning ecosystems: Qualitative evaluation of a national digital health transformation program in England. *Journal of Medical Internet Research, 23*(8), e23372. https://doi.org/10.2196/23372

Daughety, A. F., & Reinganum, J. F. (1995). Product safety: Liability, R&D, and signaling. *The American Economic Review*, *85*(5), 1187–1206. https://www.jstor.org/stable/2950983

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*(3), 475–487. https://doi.org/10.1006/imms.1993.1022

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*(14), 1111–1132. https://doi.org/10.1111/j.1559-1816.1992.tb00945.x

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125*(6), 627. https://doi.org/10.1037/0033-2909.125.6.627

Evans, D. S. (2003). Some empirical aspects of multi-sided platform industries. *Review of Network Economics, 2*(3), 191–209. https://doi.org/10.2202/1446-9022.1026

Fischer, M., & Himme, A. (2017). The financial brand value chain: How brand investments contribute to the financial health of firms. *International Journal of Research in Marketing, 34*(1), 137–153. https://doi.org/10.1016/j.ijresmar.2016.05.004

Floetgen, R. J., Novotny, M., Hein, A., Weking, J., Urmetzer, F., Böhm, M., & Krcmar, H. (2022). Digital platform ecosystem performance: Antecedents and interrelations. *ACIS 2022 Proceedings*. https://doi.org/10.17863/CAM.90608

Gamayuni, R. R. (2015). The effect of intangible asset, financial performance and financial policies on the firm value. *International Journal of Scientific & Technology Research*, *4*(1), 202–212. http://repository.lppm.unila.ac.id/1439/1/The-Effect-Of-Intangible-Asset-Financial-Performance-And-Financial-Policies-On-The-Firm-Value.pdf

Garvin, D. A., Edmondson, A. C., & Gino, F. (2008). Is yours a learning organization? *Harvard Business Review*, *86*(3), 109–116. https://hbr.org/2008/03/is-yours-a-learning-organization

Gawer, A., & Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3), 417–433. https://doi.org/10.1111/jpim.12105

Gkeredakis, M., & Constantinides, P. (2019). Phenomenon-based problematization: Coordinating in the digital era. *Information and Organization, 29*(3), 100254. https://doi.org/10.1016/j.infoandorg.2019.100254

Granados, N., & Gupta, A. (2013). Transparency strategy: Competing with information in a digital world. *MIS Quarterly*, *37*(2), 637–641. https://www.jstor.org/stable/43825928

Gupta, R., Mejia, C., & Kajikawa, Y. (2019). Business, innovation and digital ecosystems landscape survey and knowledge cross sharing. *Technological Forecasting and Social Change, 147*, 100–109. https://doi.org/10.1016/j.techfore.2019.07.004

Hagiu, A., & Rothman, S. (2016). Network effects aren't enough. *Harvard Business Review*, *94*(4), 64–71. https://hbr.org/2016/04/network-effects-arent-enough

Hann, I.-H., Hui, K.-L., Lee, S.-Y.T., & Png, I. P. L. (2007). Overcoming online information privacy concerns: A information-processing theory approach. *Journal of Management Information Systems, 24*(2), 13–42. https://doi.org/10.2753/MIS0742-1222240202

Hassan, N. R., Lowry, P. B., & Mathiassen, L. (2022). Useful products in information systems theorizing: A discursive formation perspective. *Journal of the Association for Information Systems (JAIS), 23*(2), 418–446. https://doi.org/10.17705/1jais.00730

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2020). Digital platform ecosystems. *Electronic Markets, 30*(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019). Value co-creation practices in business-to-business platform ecosystems. *Electronic Markets, 29*(3), 503–518. https://doi.org/10.1007/s12525-019-00337-y

Helo, P., Hao, Y., Toshev, R., & Boldosova, V. (2021). Cloud manufacturing ecosystem analysis and design. *Robotics and Computer-Integrated Manufacturing, 67*, 102050. https://doi.org/10.1016/j.rcim.2020.102050

Ho, C. K. Y., Ke, W., Liu, H., & Chau, P. Y. K. (2020). Separate versus joint evaluation: The roles of evaluation mode and construal level in technology adoption. *MIS Quarterly, 44*(2), 725–746. https://doi.org/10.25300/MISQ/2020/14246

Hodapp, D., & Hanelt, A. (2022). Interoperability in the era of digital innovation: An information systems research agenda. *Journal of Information Technology, 37*(4), 407–427. https://doi.org/10.1177/02683962211064304

Holmstrom, B., & Milgrom, P. (1994). The firm as an incentive system. *The American Economic Review*, *84*(4), 972–991. https://www.jstor.org/stable/2118041

Hosseinian-Far, A., Ramachandran, M., & Slack, C. L. (2018). Emerging trends in cloud computing, big data, fog computing, IoT and smart living. In M. Dastbaz, H. Arabnia, & B. Akhgar (Eds.), *Technology for Smart Futures* (pp. 29–40). Springer. https://doi.org/10.1007/978-3-319-60137-3_2

Hsieh, J.P.-A., Rai, A., & Keil, M. (2011). Addressing digital inequality for the socioeconomically disadvantaged through government initiatives: Forms of capital that affect ICT utilization. *Information Systems Research, 22*(2), 233–253. https://doi.org/10.1287/isre.1090.0256

Immonen, A., Palviainen, M., & Ovaska, E. (2014). Requirements of an open data based business ecosystem. *IEEE Access, 2*, 88–103. https://doi.org/10.1109/ACCESS.2014.2302872

Isckia, T., De Reuver, M., & Lescop, D. (2018). Digital innovation in platform-based ecosystems: An evolutionary framework. In R. Chbeir, H. Ishikawa, K. Sumiya, K. Hatano, & M. Koeppen (Eds.), *Proceedings of the 10th International Conference on Management of Digital EcoSystems* (pp. 149–156). https://doi.org/10.1145/3281375.3281377

Jacobides, M. G. (2019). In the ecosystem economy, what's your strategy? *Harvard Business Review*, *97*(5), 128–137. https://hbr.org/2019/09/in-the-ecosystem-economy-whats-your-strategy

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal, 39*(8), 2255–2276. https://doi.org/10.1002/smj.2904

Jahantigh, F. F., Malmir, B., & Avilaq, B. A. (2018). An integrated approach for prioritizing the strategic objectives of balanced scorecard under uncertainty. *Neural Computing and Applications, 29*, 227–236. https://doi.org/10.1007/s00521-016-2509-z

Jiménez, C. E., Solanas, A., & Falcone, F. (2014). E-government interoperability: Linking open and smart government. *Computer, 47*(10), 22–24. https://doi.org/10.1109/MC.2014.281

Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). Transforming provider-customer relationships in digital servitization: A relational view on digitalization. *Industrial Marketing Management, 89*, 306–325. https://doi.org/10.1016/j.indmarman.2020.02.004

Kaplan, R. S., & Norton, D. P. (2004). *Strategy maps: Converting intangible assets into tangible outcomes*. Harvard Business Press. https://www.hbs.edu/faculty/Pages/item.aspx?num=15760

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard: Measures that drive performance. *Harvard Business Review*, *70*(1), 71–79. https://hbr.org/1992/01/the-balanced-scorecard-measures-that-drive-performance-2

Kaplan, R. S., & Norton, D. P. (2001). Transforming the balanced scorecard from performance measurement to strategic management: Part 1. *Accounting Horizons, 15*(1), 87–104. https://doi.org/10.2308/acch.2001.15.1.87

Kaplan, S., & Henderson, R. (2005). Inertia and incentives: Bridging organizational economics and organizational theory. *Organization Science, 16*(5), 509–521. https://doi.org/10.1287/orsc.1050.0154

Khanagha, S., Ansari, S., Paroutis, S., & Oviedo, L. (2022). Mutualism and the dynamics of new platform creation: A study of Cisco and fog computing. *Strategic Management Journal, 43*(3), 476–506. https://doi.org/10.1002/smj.3147

Kimiloglu, H., Ozturan, M., & Kutlu, B. (2017). Perceptions about and attitude toward the usage of e-learning in corporate training. *Computers in Human Behavior, 72*, 339–349. https://doi.org/10.1016/j.chb.2017.02.062

Kitchenham, B., Pearl Brereton, O., Budgen, D., Turner, M., Bailey, J., & Linkman, S. (2009). Systematic literature reviews in software engineering–A systematic literature review. *Information and Software Technology, 51*(1), 7–15. https://doi.org/10.1016/j.infsof.2008.09.009

Kopalle, P. K., Kumar, V., & Subramaniam, M. (2020). How legacy firms can embrace the digital ecosystem via digital customer orientation. *Journal of the Academy of Marketing Science, 48*, 114–131. https://doi.org/10.1007/s11747-019-00694-2

Kretschmer, T., Leiponen, A., Schilling, M., & Vasudeva, G. (2022). Platform ecosystems as meta-organizations: Implications for platform strategies. *Strategic Management Journal, 43*(3), 405–424. https://doi.org/10.1002/smj.3250

Krizanova, A., Lăzăroiu, G., Gajanova, L., Kliestikova, J., Nadanyiova, M., & Moravcikova, D. (2019). The effectiveness of marketing communication and importance of its evaluation in an online environment. *Sustainability, 11*(24), 7016. https://doi.org/10.3390/su11247016

Kuang, L., Huang, N., Hong, Y., & Yan, Z. (2019). Spillover effects of financial incentives on non-incentivized user engagement: Evidence from an online knowledge exchange platform. *Journal of Management Information Systems, 36*(1), 289–320. https://doi.org/10.1080/07421222.2018.1550564

Lee, O.-K., Sambamurthy, V., Lim, K. H., & Wei, K. K. (2015). How does IT ambidexterity impact organizational agility? *Information Systems Research, 26*(2), 398–417. https://doi.org/10.1287/isre.2015.0577

Lee, S., Costello, F. J., & Lee, K. C. (2021). Hierarchical balanced scorecard-based organizational goals and the efficiency of controls processes. *Journal of Business Research, 132*, 270–288. https://doi.org/10.1016/j.jbusres.2021.04.038

Lee, S. M., & Lee, D. (2020). "Untact": A new customer service strategy in the digital age. *Service Business, 14*(1), 1–22. https://doi.org/10.1007/s11628-019-00408-2

Leimeister, J. M., Österle, H., & Alter, S. (2014). Digital services for consumers. *Electronic Markets, 24*(4), 255–258. https://doi.org/10.1007/s12525-014-0174-6

Leminen, S., Westerlund, M., Rajahonka, M., & Siuruainen, R. (2012). Towards IOT ecosystems and business models. In S. Andreev, S. Balandin, & Y. Koucheryavy (Eds.), *Lecture Notes in Computer Science: Vol. 7469. Internet of Things, Smart Spaces, and Next Generation Networking. ruSMART NEW2AN 2012* (pp. 15–26). Springer. https://doi.org/10.1007/978-3-642-32686-8_2

Lettner, N., Wilhelm, S., Güldenberg, S., & Güttel, W. (2022). Customers as knowledge partners in a digital business ecosystem: From customer analytics towards knowledge partnerships. *Journal of Digital Economy, 1*(2), 130–140. https://doi.org/10.1016/j.jdec.2022.08.001

Lewis, G. A. (2013). Role of standards in cloud-computing interoperability. *Proceedings of the 46th Hawaii International Conference on System Sciences (HICSS)* (pp. 1652–1661). https://doi.org/10.1109/HICSS.2013.470

Liang, Y.-H. (2015). Performance measurement of interorganizational information systems in the supply chain. *International Journal of Production Research, 53*(18), 5484–5499. https://doi.org/10.1080/00207543.2015.1026614

Liao, C., Palvia, P., & Chen, J.-L. (2009). Information technology adoption behavior life cycle: Toward a technology continuance theory (TCT). *International Journal of Information Management, 29*(4), 309–320. https://doi.org/10.1016/j.ijinfomgt.2009.03.004

Liu, X., Lam, K. H., Zhu, K., Zheng, C., Li, X., Du, Y., Liu, C., & Pong, P. W. T. (2019). Overview of spintronic sensors with Internet of things for Smart Living. *IEEE Transactions on Magnetics, 55*(11), 1–22. https://doi.org/10.1109/TMAG.2019.2927457

Makkonen, H., Nordberg-Davies, S., Saarni, J., & Huikkola, T. (2022). A contextual account of digital servitization through autonomous solutions: Aligning a digital servitization process and a maritime service ecosystem transformation to autonomous shipping. *Industrial Marketing Management, 102*, 546–563. https://doi.org/10.1016/j.indmarman.2022.02.013

Malik, M. A. R., Butt, A. N., & Choi, J. N. (2015). Rewards and employee creative performance: Moderating effects of creative self-efficacy, reward importance, and locus of control. *Journal of Organizational Behavior, 36*(1), 59–74. https://doi.org/10.1002/job.1943

Manica, E., Manica, L., de Souza, L. T., & da Silva, S. (2017). Deployment of the balanced scorecard as a tool for measuring performance: The case of a technology company in Brazil. *Business Management Dynamics*, *7*(6), 8–18. https://scholar.google.com/citations?view_op=view_citation&hl=pt-BR&user=HwYgHeIAAAAJ&citation_for_view=HwYgHeIAAAAJ:u5HHmVD_uO8C

Martin, G. P., Wiseman, R. M., & Gomez-Mejia, L. R. (2019). The interactive effect of monitoring and incentive alignment on agency costs. *Journal of Management, 45*(2), 701–727. https://doi.org/10.1177/0149206316678453

Martinsons, M., Davison, R., & Tse, D. (1999). The balanced scorecard: A foundation for the strategic management of information systems. *Decision Support Systems, 25*(1), 71–88. https://doi.org/10.1016/S0167-9236(98)00086

Maruping, L. M., Bala, H., Venkatesh, V., & Brown, S. A. (2017). Going beyond intention: Integrating behavioral expectation into the unified theory of acceptance and use of technology. *Journal of the Association for Information Science and Technology, 68*(3), 623–637. https://doi.org/10.1002/asi.23699

Masli, A., Richardson, V. J., Sanchez, J. M., & Smith, R. E. (2011). The business value of IT: A synthesis and framework of archival research. *Journal of Information Systems, 25*(2), 81–116. https://doi.org/10.2308/isys-10117

Maxwell, J. A. (2012). *Qualitative research design: An interactive approach*. Sage publications. https://us.sagepub.com/en-us/nam/qualitative-research-design/book234502

Meyerhoff Nielsen, M., & Jordanoski, Z. (2020). Digital transformation, governance and coordination models: A comparative study of Australia, Denmark and the Republic of Korea. In S . - J . Eom, & J. Lee (Eds.), *The 21st Annual International Conference on Digital Government Research* (pp. 285–293). https://doi.org/10.1145/3396956.3396987

Mihale-Wilson, C. A., Zibuschka, J., & Kubach, M. (2019). Consumer-based ranking for strategic selection of iot business models. In H. Krcmar, J. Fedorowicz, W. F. Boh, J. M. Leimeister, & S. Wattal (Eds.), *Proceedings of the 40th International Conference on Information Systems (ICIS)*. https://aisel.aisnet.org/icis2019/business_models/business_models/11/

Mihale-Wilson, C., Hagen, S., Kohl, T., Kortum, H., Illgen, F., Rebstadt, J., Thomas, O., & Hinz, O. (2023). Introducing a methodological approach to determine value shares in Digital Ecosystems. *Proceedings of the Wirtschaftsinformatik 2023 (WI 2023)*. https://aisel.aisnet.org/wi2023/82

Mihale-Wilson, C., Hinz, O., van der Aalst, W., & Weinhardt, C. (2022). Corporate digital responsibility: relevance and opportunities for business and information systems engineering. *Business & Information Systems Engineering, 64*(2), 127–132. https://doi.org/10.1007/s12599-022-00746-y

Mihale-Wilson, C., Zibuschka, J., Carl, K. V., & Hinz, O. (2021). Corporate Digital Responsibility – Extended Conceptualization and Empirical Assessment. In F. Rowe, R. El Amrani, M. Limayem, S. Matook, D. Rosenkranz, E. A. Whitley, & A. El Quammah (Eds.), *Proceedings of the 29th European Conference on Information Systems (ECIS)*. https://aisel.aisnet.org/ecis2021_rp/80

Mihale-Wilson, C., Zibuschka, J., & Hinz, O. (2017). About user preferences and willingness to pay for a secure and privacy protective ubiquitous personal assistant. In I. Ramos, V. Tuunainen, & H. Krcmar (Eds.), *Proceedings of the 25th European Conference on Information Systems (ECIS)* (pp. 32–47). https://aisel.aisnet.org/ecis2017_rp/3

Mihardjo, L., Sasmoko, S., Alamsjah, F., & Elidjen, E. (2019). Digital leadership role in developing business model innovation and customer experience orientation in Industry 4.0. *Management Science Letters, 9*(11), 1749–1762. https://doi.org/10.5267/j.msl.2019.6.015

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage publications. https://books.google.ch/books/about/Qualitative_Data_Analysis.html?id=U4lU_-wJ5QEC&redir_esc=y

Milis, K., & Mercken, R. (2004). The use of the balanced scorecard for the evaluation of information and communication technology projects. *International Journal of Project Management, 22*(2), 87–97. https://doi.org/10.1016/S0263-7863(03)00060-7

Mishra, A., Shukla, A., Rana, N. P., Currie, W. L., & Dwivedi, Y. K. (2023). Re-examining post-acceptance model of information systems continuance: A revised theoretical model using MASEM approach. *International Journal of Information Management, 68*, 102571. https://doi.org/10.1016/j.ijinfomgt.2022.102571

Murthy, R. K., & Madhok, A. (2021). Overcoming the early-stage conundrum of digital platform ecosystem emergence: A problem-solving perspective. *Journal of Management Studies, 58*(7), 1899–1932. https://doi.org/10.1111/joms.12748

Nambisan, S., Zahra, S. A., & Luo, Y. (2019). Global platforms and ecosystems: Implications for international business theories. *Journal of International Business Studies, 50*, 1464–1486. https://doi.org/10.1057/s41267-019-00262-4

Ojala, A., & Lyytinen, K. (2022). How do entrepreneurs create indirect network effects on digital platforms? A study on a multi-sided gaming platform. *Technology Analysis & Strategic Management*, 1–16. https://doi.org/10.1080/09537325.2022.2065977

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. *Sprouts: Working Papers on Information Systems, 10*(26). http://sprouts.aisnet.org/10-26

Panico, C., & Cennamo, C. (2022). User preferences and strategic interactions in platform ecosystems. *Strategic Management Journal, 43*(3), 507–529. https://doi.org/10.1002/smj.3149

Paré, G., Trudel, M.-C., Jaana, M., & Kitsiou, S. (2015). Synthesizing information systems knowledge: A typology of literature reviews. *Information & Management, 52*(2), 183–199. https://doi.org/10.1016/j.im.2014.08.008

Park, Y. J., Chung, J. E., & Shin, D. H. (2018). The structuration of digital ecosystem, privacy, and big data intelligence. *American Behavioral Scientist, 62*(10), 1319–1337. https://doi.org/10.1177/0002764218787863

Parker, G., Van Alstyne, M., & Jiang, X. (2017). Platform ecosystems. *MIS Quarterly, 41*(1), 255–266. https://doi.org/10.2139/ssrn.2861574

Pellizzoni, E., Trabucchi, D., & Buganza, T. (2019). Platform strategies: How the position in the network drives success. *Technology Analysis & Strategic Management, 31*(5), 579–592. https://doi.org/10.1080/09537325.2018.1524865

Quezada, L. E., Reinao, E. A., Palominos, P. I., & Oddershede, A. M. (2019). Measuring performance using SWOT analysis and balanced scorecard. *Procedia Manufacturing, 39*, 786–793. https://doi.org/10.1016/j.promfg.2020.01.430

Rappaport, A. (2006). Ten ways to create shareholder value. *Harvard Business Review*, *84*(9), *66–77*. https://hbr.org/2006/09/ten-ways-to-create-shareholder-value

Redjeki, F., & Affandi, A. (2021). Utilization of digital marketing for MSME players as value creation for customers during the COVID-19 pandemic. *International Journal of Science and Society, 3*(1), 40–55. https://doi.org/10.200609/ijsoc.v3i1.264

Rietveld, J., Schilling, M. A., & Bellavitis, C. (2019). Platform strategy: Managing ecosystem value through selective promotion of complements. *Organization Science, 30*(6), 1232–1251. https://doi.org/10.1287/orsc.2019.1290

Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association, 1*(4), 990–1029. https://doi.org/10.1162/154247603322493212

Romanova, S., Maryanova, S., & Naumov, A. (2021). Analysis of the key financial factors affecting the profitability of enterprises in the context of the digitalization of the economy. In Y. Silin (Ed.), *Second Conference on Sustainable Development: Industrial Future of Territories (IFT 2021)* (pp. 260–265). Atlantis Press. https://doi.org/10.2991/aebmr.k.211118.047

Rosati, P., Fox, G., Kenny, D., & Lynn, T. (2017). Quantifying the financial value of cloud investments: A systematic literature review. *2017 IEEE International Conference on Cloud Computing Technology and Science (CloudCom)* (pp. 194–201). IEEE. https://doi.org/10.1109/CloudCom.2017.28

Royakkers, L., Timmer, J., Kool, L., & van Est, R. (2018). Societal and ethical issues of digitization. *Ethics and Information Technology, 20*(2), 127–142. https://doi.org/10.1007/s10676-018-9452-x

Saleem, S. (2011). The impact of financial incentives on employees commitment. *European Journal of Business and Management*, *3*(4), 258–266. https://www.semanticscholar.org/paper/The-Impact-of-Financial-Incentives-on-Employees-Saleem/ca612feaec0c2d73257938c7e3357a0c1095aa28

Schneider, S., & Kokshagina, O. (2021). Digital transformation: What we have learned (thus far) and what is next. *Creativity and Innovation Management, 30*(2), 384–411. https://doi.org/10.1111/caim.12414

Schreieck, M., Wiesche, M., & Krcmar, H. (2016). Design and governance of platform ecosystems–Key concepts and issues for future research. *Proceedings of the 24th European Conference on Information Systems (ECIS)*. https://aisel.aisnet.org/ecis2016_rp/76/

Sebastian, I. M., Weill, P., & Woerner, S. L. (2020). Driving growth in digital ecosystems. *MIT Sloan Management Review 62*(1), 58–62. https://sloanreview.mit.edu/article/driving-growth-in-digital-ecosystems/

Shah, D., Rust, R. T., Parasuraman, A., Staelin, R., & Day, G. S. (2006). The path to customer centricity. *Journal of Service Research, 9*(2), 113–124. https://doi.org/10.1177/1094670506294666

Shen, L., Zhang, X., & Liu, H. (2022). Digital technology adoption, digital dynamic capability, and digital transformation performance of textile industry: Moderating role of digital innovation orientation. *Managerial and Decision Economics*, *43*(6), 2038–2054. https://doi.org/10.1002/mde.3507

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Statista. (2023). *Smart home worldwide market forecast*. Statista. Retrieved September 1, 2023, from https://www.statista.com/outlook/dmo/smart-home/worldwide.

Subramaniam, M. (2020). Digital ecosystems and their implications for competitive strategy. *Journal of Organization Design, 9*, 1–10. https://doi.org/10.1186/s41469-020-00073-0

Subramaniam, M., Iyer, B., & Venkatraman, V. (2019). Competing in digital ecosystems. *Business Horizons, 62*(1), 83–94. https://doi.org/10.1016/j.bushor.2018.08.013

Sun, H., Rabbani, M. R., Ahmad, N., Sial, M. S., Cheng, G., Zia-Ud-Din, M., & Fu, Q. (2020). CSR, co-creation and green consumer loyalty: Are green banking initiatives important? A moderated mediation approach from an emerging economy. *Sustainability, 12*(24), 10688. https://doi.org/10.3390/su122410688

Sun, X., & Zhang, Q. (2021). Building digital incentives for digital customer orientation in platform ecosystems. *Journal of Business Research, 137*, 555–566. https://doi.org/10.1016/j.jbusres.2021.08.068

Sun, Y., Li, S., & Yu, L. (2022). The dark sides of AI personal assistant: Effects of service failure on user continuance intention. *Electronic Markets*, *32*(1), 17–39. https://doi.org/10.1007/s12525-021-00483-2

Sussan, F., & Acs, Z. J. (2017). The digital entrepreneurial ecosystem. *Small Business Economics, 49*, 55–73. https://doi.org/10.1007/s11187-017-9867-5

Tallon, P. P., & Kraemer, K. L. (2007). Fact or fiction? A sensemaking perspective on the reality behind executives' perceptions of IT business value. *Journal of Management Information Systems, 24*(1), 13–54. https://doi.org/10.2753/MIS0742-1222240101

Tallon, P. P., Mooney, J. G., & Duddek, M. (2020). Measuring the business value of IT. *Measuring the Business Value of Cloud Computing*, 1–17. https://doi.org/10.1007/978-3-030-43198-3_1

Tan, B., Pan, S., Lu, X., & Huang, L. (2015). The role of IS capabilities in the development of multi-sided platforms: The digital ecosystem strategy of Alibaba.com. *Journal of the Association for Information Systems*, *16*(4), 248–280. https://doi.org/10.17705/1jais.00393

Tan, F., Tan, B., & Pan, S. (2016). Developing a leading digital multi-sided platform: Examining IT affordances and competitive actions in Alibaba.com. *Communications of the Association for Information Systems*, *38*(1), 738–760. https://doi.org/10.17705/1CAIS.03836

Teece, D.J. (2017). Dynamic capabilities and (digital) platform lifecycles. In *Entrepreneurship, Innovation, and Platforms* 37, Emerald Publishing Limited, Leeds, pp. 211–225. https://doi.org/10.1108/S0742-332220170000037008

Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning, 51*(1), 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

Treiber, M., Theunissen, T., Grebner, S., Witting, J., & Bernhardt, H. (2023). How to successfully orchestrate content for digital agriecosystems. *Agriculture, 13*(5), 1003. https://doi.org/10.3390/agriculture13051003

Turilli, M., & Floridi, L. (2009). The ethics of information transparency. *Ethics and Information Technology, 11*(2), 105–112. https://doi.org/10.1007/s10676-009-9187-9

Valdez-De-Leon, O. (2019). How to develop a digital ecosystem: A practical framework. *Technology Innovation Management Review*, *9*(8), 43–54. https://doi.org/10.22215/timreview/1260

de Vaz, T. N., & Nijkamp, P. (2009). Knowledge and innovation: The strings between global and local dimensions of sustainable growth. *Entrepreneurship and Regional Development, 21*(4), 441–455. https://doi.org/10.1080/08985620903020094

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Verma, P., Kumar, V., Daim, T., Sharma, N. K., & Mittal, A. (2022). Identifying and prioritizing impediments of Industry 4.0 to sustainable digital manufacturing: A mixed method approach. *Journal of Cleaner Production, 356*, 131639. https://doi.org/10.1016/j.jclepro.2022.131639

Volberda, H. W., Khanagha, S., Baden-Fuller, C., Mihalache, O. R., & Birkinshaw, J. (2021). Strategizing in a digital world: Overcoming cognitive barriers, reconfiguring routines and introducing new organizational forms. *Long Range Planning, 54*(5), 102110. https://doi.org/10.1016/j.lrp.2021.102110

Wang, P. (2021). Connecting the parts with the whole: Toward an information ecology theory of digital innovation ecosystems. *MIS Quarterly, 45*(1), 397–422. https://doi.org/10.25300/MISQ/2021/15864

Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology ecosystem governance. *Organization Science, 25*(4), 1195–1215. https://doi.org/10.2139/ssrn.2201688

Wasiuzzaman, S. (2019). Resource sharing in interfirm alliances between SMEs and large firms and SME access to finance: A study of Malaysian SMEs. *Management Research Review, 42*(12), 1375–1399. https://doi.org/10.1108/MRR-10-2018-0369

Weber, T. (2006). *Anreizsysteme für die betriebliche Forschung und Entwicklung*. Deutscher Universitätsverlag. https://doi.org/10.1007/978-3-8350-9121-4

Weissenberger-Eibl, M. A., & Hampel, T. (2021). Bridging the gap: Integrating external knowledge from open innovation platforms. *SN Business & Economics, 1*, 1–32. https://doi.org/10.1007/s43546-021-00101-5

Weisstein, F. L., Monroe, K. B., & Kukar-Kinney, M. (2013). Effects of price framing on consumers' perceptions of online dynamic pricing practices. *Journal of the Academy of Marketing Science, 41*(5), 501–514. https://doi.org/10.1007/s11747-013-0330-0

Wu, H.-Y. (2012). Constructing a strategy map for banking institutions with key performance indicators of the balanced scorecard. *Evaluation and Program Planning, 35*(3), 303–320. https://doi.org/10.1016/j.evalprogplan.2011.11.009

Xiao, B., & Benbasat, I. (2011). Product-related deception in e-commerce: A theoretical perspective. *MIS Quarterly, 35*(1), 169–196. https://doi.org/10.2307/23043494

Xu, J., & Cornelissen, J. (2023). Disequilibrium and complexity across scales: A patch-dynamics framework for organizational ecology. *Humanities and Social Sciences Communications, 10*(1), 1–13. https://doi.org/10.1057/s41599-023-01730-x

Xu, Y., Sun, H., & Lyu, X. (2023). Analysis of decision-making for value co-creation in digital innovation systems: An evolutionary game model of complex networks. *Managerial and Decision Economics 44*(5). https://doi.org/10.1002/mde.3852

Yu, C., & Wong, T. (2014). A supplier pre-selection model for multiple products with synergy effect. *International Journal of Production Research, 52*(17), 5206–5222. https://doi.org/10.1080/00207543.2014.900199

Zhang, Q., & Sun, X. (2023). How incentive synergy and organizational structures shape innovation ambidexterity. *Journal of Knowledge Management, 27*(1), 156–177. https://doi.org/10.1108/JKM-11-2021-0847

Zhang, S., Pauwels, K., & Peng, C. (2019). The impact of adding online-to-offline service platform channels on firms' offline and total sales and profits. *Journal of Interactive Marketing, 47*(1), 115–128. https://doi.org/10.1016/j.intmar.2019.03.001