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# Trade-offs and synergies of digital choice environments: Towards a taxonomy and configurational model

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## Abstract

The advancing digitalization of daily life has led to an increasing number of choices in the digital sphere. User interfaces that require either a judgment or a decision, the so-called digital choice environments (DCEs), are essential focal points for interventions to alter behaviors towards individual or societal welfare. However, there is a lack of descriptive and prescriptive knowledge within the field of DCEs. In this research, we follow a multi-stage approach to classify the characteristics of DCEs from a choice-centric viewpoint and disclose configurational trade-offs. To achieve this, we first build a taxonomy of DCEs that we validate through expert interviews. Subsequently, we use cluster analysis to identify four configurations of DCEs, which serve as the basis for the development of a configurational model that outlines configuration-specific user outcomes. Our results contribute to the existing knowledge of digital value creation as well as the explanatory understanding of trade-offs among different DCEs.

**Keywords** Taxonomy · Digital choice environments · Configurational model

**JEL classification** D70

## Introduction

“The relevance of the digital choice environment derives from the increasing number of decisions made with the help of digital technologies” (Dolgoplova et al., 2021, p. 1), and from emergent virtual worlds such as the Metaverse in which humans are about to live, socialize, and even work (S.-M. Park & Kim, 2022). Digital choices have become a significant part of our daily lives, from online grocery shopping (Gottschewski-Meyer et al., 2023) to investment trading with the help of the so-called “robo-advisors” (Jung et al., 2018). All of these choices are made in digital choice environments (DCEs), which are defined as “user interfaces – such as web-based forms and ERP screens – that require people to make judgments or decisions” (Weinmann et al.,

2016, p. 433). Well-designed DCEs can help businesses improve user choices by enhancing the quality of choices (Thaler & Sunstein, 2009), decrease the necessary amount of information for the choice (Weinmann et al., 2016) to avoid information overload (Phillips-Wren & Adya, 2020), minimize decision complexities as well as to increase customer value (Gauri et al., 2021), and therefore improve sales by the use of interventions (e.g., nudges, cf. C. Schneider et al., 2018). Apart from private firms, organizations under public law or e-government platforms can benefit from thoroughly designed DCEs in terms of organizational success factors, such as increased trust in the digital infrastructure of a state or greater citizen satisfaction with governmental services (D. Schneider et al., 2020). DCE users can benefit from consciously created DCEs in various terms. Users may save time (Gottschewski et al., 2022), receive streamlined information to facilitate a thorough and substantial contemplation of the selection (Leipold et al., 2023), and ultimately choose from options in a more informed way (Weinmann et al., 2016).

Due to their immanent practical relevance for digital business and their potential implications for society and the economy, as well as their conceptual and design-related complexity, DCEs have become an important research field

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for the information systems (IS) community, especially for the human–computer interaction (HCI) as well as the user experience (UX) and user interface (UI) design research stream. DCEs are commonly used for intervention points to achieve IS priority goals such as more sustainable choices (Auf der Landwehr et al., 2021; Watson et al., 2021). However, in the realm of scientific inquiry surrounding the subject, the absence of a unified descriptive knowledge base is conspicuous, owing to the diverse array of disciplines within IS research (e.g., HCI, UX/UI design) and other fields of study (e.g., engineering, medicine, management science, and psychology, cf. Li et al., 2022) engaging with the topic. In the pursuit of formulating design solutions within DCEs to create or modify UIs, designers face the challenge of instigating user motivation for instantaneous engagement, cultivating recurrent user visits, and, fundamentally, augmenting the holistic UX by orchestrating environments that encapsulate desirable outcomes such as trustworthiness, ease of use, and utility (Bleier et al., 2019; Gefen et al., 2003). To address this complex task, designers often draw upon a spectrum of information sources, including their organization's tacit knowledge and personal experiences, or engage in comprehensive exploration across diverse research disciplines characterized by heterogeneous terminology and specialized knowledge derived from niche domains (Karmokar et al., 2016). For example, Williams et al. (2008) provided a taxonomy of different types of digital services and their respective design. However, the taxonomy lacks insights into any other digital environments apart from digital services and focuses on a limited number of different contexts. Münscher et al. (2016) developed a taxonomy for choice architecture intervention techniques in a rather generic way, but not dependent on choice contexts, and thus, disregarded contextual UI design, which is known to be an influencing factor for choice behavior (Mirsch et al., 2018).

Furthermore, a dearth of prescriptive knowledge persists, hindering the conceptualization of varied outcomes, such as trust (e.g., Balakrishnan & Dwivedi, 2021) and UE (Sabherwal et al., 2006), arising from different combinations of characteristics within DCEs. The generation of prescriptive knowledge within the realm of DCEs holds significant importance within design science research (DSR) in ensuring the applicability and transference of researched knowledge to alternative application scenarios (Möller et al., 2021), such as DCEs within the Metaverse (cf. S.-M. Park & Kim, 2022). Nevertheless, the question of the effect of DCE characteristics on specific outcomes remains unresolved. If every element in a DCE can influence decisions (cf. Weinmann et al., 2016), then it is obvious that previous approaches and theories to elucidate the outcome effects of individual design characteristics such as user-centered design (Redström, 2006) or interaction design (Preece et al., 2015) are insufficient as they

can only explain linear effect relationships (cf. Ma et al., 2023). Consequently, the entirety of all design characteristics within a DCE and their mutual interactions are neither captured nor accounted for. Hence, grounded in the paradigms of mutual causality, discontinuity, punctuated equilibria, and non-linear change (El Sawy et al., 2010), our work is motivated by the assumption that DCEs are comprised of distinct design characteristics, each capable of inducing varied outcomes only in conjunction with specific patterns of conditions. Drawing on configuration theory, we posit that modifying a single characteristic within DCEs can affect the effects of the entire set of characteristics, contingent upon the interactions with the remaining characteristics within the set. Thus, the configuration theory lens, which explains complex phenomena as a result of different conditions configured in a certain way, is of paramount importance since only the collective ensemble of individual properties elucidates the results of a set of characteristics, a so-called configuration (cf. Ma et al., 2023). Understanding the interplay between individual design characteristics of DCEs in a configurational model (CM) can help designers and researchers alike to enhance DCE design towards specific outcomes and ultimately achieve overarching goals (e.g., such as more sustainable choices, cf. Auf der Landwehr et al., 2021).

Previous attempts to explain DCEs solely in terms of the effects of the interaction of individual characteristics have been sparse or incomplete. For example, Mayer et al. (2012) examined the UI components of management support systems in a configurational approach to evaluate the best end-user devices for the selected situations of use with a limited focus on managers' working styles, corresponding use cases, and contexts (i.e., management support systems). Alnawas and Al Khateeb (2022) found and verified eight salient e-commerce website elements, which enhance customer experiences. However, their study did neither delve into the specific characteristics of the individual elements nor explore the interactions between them and their associated effects when combined differently. This is important because every choice architect's design decision within a DCE can lead to a different choice (Weinmann et al., 2016), which was also proven by various experimental studies (e.g., Gottschewski et al., 2022; Gottschewski-Meyer et al., 2023; Wrabel et al., 2022, 2023). Furthermore, different combinations of DCE characteristics are likely to produce different user-centric outcomes (Blanco et al., 2010).

Overall, descriptive and prescriptive knowledge about DCE characteristics and their combinatorial effects remains scarce. To fill this gap, we opt to investigate the individual characteristics of DCEs, their interplay, and the respective outcomes of different configurations of characteristics in a holistic manner. Hence, we ask the following research questions:

RQ1: What are the different design characteristics and structural features that characterize DCEs?

RQ2: What are archetypical configurations of DCEs and what are their respective differences in terms of their characteristics?

RQ3: Which specific outcomes do archetypical configurations of DCEs entail for users?

To answer these research questions, we seek to create descriptive as well as prescriptive knowledge using a multitude of methods. First, we develop a choice-centered taxonomy of DCEs to answer RQ1, which serves as a coding scheme for analyzing 90 real-world objects (i.e., DCEs). Second, we perform a cluster analysis to identify distinct DCE configurations addressing RQ2. Third, drawing on configuration theory, we measure the individual user-centric outcomes of user experience (UX), perceived ease of use (PEOU), perceived usefulness (PU), and trust of the corresponding DCE configurations to disclose value relationships and highlight the various factors and bonds that moderate an overarching benefit of these configurations to ultimately answer RQ3. In doing so, we seek to contribute to research and practice as follows: first, our work structures and formalizes the solution space of DCE characteristics and, as a theory for analyzing (Gregor, 2006), adds descriptive knowledge to numerous IS streams such as HCI, UX, and UI design. Second, it discloses individual and configurational relationships that guide scholars, policymakers, and UI/UX practitioners opting to design DCEs or digital interventions in fulfillment of different objectives (i.e., sustainable decisions, user-friendly experience) by building a foundation for a more appropriate and efficient creation of measures, methods, and tools within DCEs. Third, it provides researchers with additional knowledge on how different configurations of DCEs impact the perceived user-centric outcomes and how to optimally build DCEs for laboratory studies, which ultimately can result in an in-depth understanding of the effectivity of DCEs. Likewise, practitioners and policymakers acting in the digital hemisphere are supported in designing choice architectures to enhance UX and, along with this, improve organizational success (e.g., sales or service quality). Fourth, a uniform terminology is proposed to enhance clarity and consistency within the DCE literature, supporting scholars as well as practitioners in communicating within the research subject of DCEs.

The remainder of this paper is structured as follows: first, we shed light on the theoretical background and provide a synopsis of the related work in the field of DCEs to introduce the main constructs that are relevant to our CM. Then, we explain our methodology and outline the taxonomy and CM development approach. Lastly, we provide a discussion of our findings, including limitations, and conclude the paper with an outlook on future research.

## Theoretical background

### Choices in digital environments

Every day, we perform multiple tasks and have to decide for or against manifold options, such as attire selection in response to weather conditions (Sahakian & LaBuzetta, 2015). Driven by digitization, an ever-growing share of these choices is being made in the digital environment (Weinmann et al., 2016). Choices in the digital hemisphere can result in the acquisition of either digital goods (e.g., non-fungible tokens), physical goods (e.g., groceries), or digital/physical services (e.g., online movies) (Franzoi & vom Brocke, 2022). Moreover, choices in organizational IS can have effects on the overall financial or operational success of an organization (Weinmann et al., 2016), underlining the importance of comprehending the influencing factors for choices in digital environments for IS research in various themes.

Humans underlie certain heuristics and biases when confronted with a choice (Thaler & Sunstein, 2009). When choosing between options, they use heuristics to achieve a satisfactory trade-off between decision accuracy and effort, creating a choice strategy that is influenced by the specific features of the DCE (Del Missier, 2004; Tversky & Kahneman, 1974). Moreover, “even theoretically irrelevant aspects of a decisional context can affect choices” (Congiu, 2022, p. 162). That is because most of these choices are done rather effortlessly and fast (system 1), driven by individual perception of relevance (Stanovich & West, 2000). Other choices are made more consciously and effortful (system 2), which allows the human brain to cope with all the influences of daily life (Kahneman, 2003). Therefore, the interaction between humans and the actual DCE is influenced by the perception of every single element in the corresponding DCE, which necessitates comprehending why and how architects of DCEs can alter behavior to support users in improving their daily digital choices (Jameson, 2013).

There is wide consensus that a shift towards more economically, ecologically, and socially sustainable choices (e.g., individual consumption or business decisions) is necessary to tackle the United Nations Sustainable Development Goals (such as combating climate change) and that individuals as well as organizations can contribute to change with their daily choices in digital environments (Schoormann & Kutzner, 2020; Sutanto et al., 2021; Watson et al., 2021). DCEs can act as pivotal intervention points to achieve the utmost priority objectives of IS research, such as fostering sustainable alternatives and promoting environmentally conscious choices (Auf der Landwehr et al., 2021; Watson et al., 2021). Thus,

an in-depth understanding of the design and development process of DCE architectures is a topic of increasing relevance for IS research to further elaborate on possible intervention points for persuasive systems, digital nudges, and alike (Oinas-Kukkonen, 2013; Weinmann et al., 2016). In that sense, it holds the potential to yield significant advantages across various fields within IS research, such as DSR when it comes to “the design and evaluation of innovative, useful, generic problem solutions to important and relevant design problems in organizations” (Winter & Baskerville, 2010), or Green IS when it comes to the behavior-oriented transformation of society towards ecological alternatives (Dedrick, 2010) as well as digital sustainability in terms of a more perspicacious understanding of (potential) implications resulting from the configuration of different DCEs (Kotlarsky et al., 2023). A thorough investigation of the characteristics of DCEs, their respective interplay, and different combinatorial outcomes within a profound CM serves as a poignant exemplification of the inherent peculiarities in the design and performance of DCEs, unfolding within a dynamic milieu that harmonizes contextual UI design with the paramount consideration of behavioral science. Consequently, the exigency arises for a specialized and nuanced theorization within the expansive landscape of IS research to comprehensively capture and illuminate the multi-faceted dimensions of DCEs.

### Digital choice environments

Before choosing an option, humans perceive their current environment and separate the non-essential things from the relevant ones (Sahakian & LaBuzetta, 2015). Choice environments are defined as “every element that the decision-maker can find in her physical or virtual surroundings, perceive through her senses, and interact with” (Congiu, 2022, p. 162). They present a digital system that is characterized by interaction (i.e., judgment or decision) between UI and user (Weinmann et al., 2016) and can be described as surface structures “that allow users to access and interact with the representations, such as the inventory system’s user interface, including its screens, menus, and report layouts” (Burton-Jones & Grange, 2013, p. 636). DCEs are designed by so-called choice architects (Thaler & Sunstein, 2009), who design digital UI, such as “websites, mobile apps, and enterprise resource planning (ERP) or customer relationship management (CRM) systems in various domains, from e-government to e-commerce, in our private and professional lives” (Meske & Amojó, 2020, p. 404). Analog choice architectures pertain to environments where users are assisted in making decisions by improving content arrangement (Thaler et al., 2014). Conversely, within the digital domain, emphasis is placed on structuring digital contexts to enhance the facilitation of decision-making processes

(Bergram et al., 2020). Compared to analog environments, the perception of the digital environment is limited to sight and sound (Rahman et al., 2018). Thus, textual and graphical elements as well as the architecture of the UI (e.g., menu navigation of a webpage) are more relevant for choices than in the analog world, where people can also smell, touch, and taste. It is possible to provide a lot of information to the customer in digital environments in different ways (textual, visual, etc.), which is done to help users make more informed decisions and provide a perception of virtual presence (cf. Chen, 2023). Eventually, every information in the DCE might change a user’s behavior. However, “the availability of an abundance of information is both a blessing and a curse” (Steckel et al., 2005, p. 310), and too much information might bias the decision and influence it in a negative way (Phillips-Wren & Adya, 2020). Additionally, users in the analog world are often confronted with humans when choosing an option, getting influenced by the accompanying social presence (e.g., Argo et al., 2005).

Altogether, every DCE characteristic has the potential to trigger an individual to alter behavior in either desired or undesired directions, both individually and collectively, regardless of whether the choice architect intended it or not (Sunstein, 2015). Therefore, it is interesting to note that a holistic examination of the individual characteristics of DCEs, their interplay, and their users’ perceived benefits (e.g., UX) has not yet been comprehensively done. Williams et al. (2008) provided an extensive taxonomy of digital services, but only considered a limited amount of digital services and contexts. Münscher et al. (2016) developed a taxonomy for choice architecture intervention techniques. However, the taxonomy disregards individual choice contexts and contextual UI design, which is known to be an influencing factor for choice behavior (Mirsch et al., 2018). Further, it did not consider the digital sphere, similar to other frameworks, which presented nudging techniques but only focused on the alteration of choices in the analog world (e.g., Dolan et al., 2012; Johnson et al., 2012; Michie et al., 2013). Mayer et al. (2012) examined the UI components of management support systems in a configurational approach, focusing on managers’ working styles, corresponding use cases, and contexts (i.e., management support systems), not considering any other contexts but organizational systems. Bleier et al. (2019) provided prescriptive knowledge on how and when to focus on informative, entertaining, social, and sensory experiences in an empirically validated two-step design guide for e-commerce shops. However, their view was limited to e-commerce websites and excluded other contexts (e.g., e-government, mobility platforms), since their goal was to understand how to increase purchases rather than investigating the interplay of various characteristics in DCEs. Alnawas and Al



Khateeb (2022) found that e-commerce websites can consist of a multitude of (visual, textual, design, interactive, etc.) elements, but did neither explain the peculiarities of the single elements nor investigate the interplay between them and their related effects.

Given that “the digital world differs from its offline counterpart in ways that have important consequences for people’s online experiences and behavior” (Kozyreva et al., 2020, p. 106), there is a clear need to examine DCEs more specifically and especially the digitality of the decision-making environment. Moreover, in constellations of individual characteristics, several single characteristics can act synergistically and provide different effects (Birkinshaw & Morrison, 1995). Also, due to the possibility of perceiving the smallest, seemingly insignificant characteristics in the DCEs, decisions can be influenced in favor of the individual and society, for example in questions of ecological (e.g., Loeser et al., 2017) or social sustainability (e.g., Gottschewski-Meyer et al., 2023). DCEs should always be designed with the principle of providing users with a comprehensive UX, ultimately guiding them toward better choices (Thaler et al., 2014), which necessitates an easy-to-use and trustworthy UI (Gefen et al., 2003). This necessity is further enhanced by the increasing and ongoing digitalization and the steadily increasing number of decisions in the digital space in all areas of life (Weinmann et al., 2016).

To extract meaningful insights applicable to IS research in a broader sense, as well as within the specific domains of DSR and HCI, researchers and practitioners alike must endeavor to furnish both descriptive and prescriptive knowledge. This concerted effort aims to make a substantial contribution to the evolution of DCEs that facilitate the transition toward socially, ecologically, and economically sustainable user behavior as called for by Watson et al. (2021). Additionally, it serves the purpose of safeguarding users against unwittingly making suboptimal choices influenced by the DCE, in line with concerns raised by Sunstein (2015), while concurrently guiding them toward more favorable outcomes. Therefore, it is imperative to comprehensively comprehend the effects of individual, interacting characteristics on user choice behavior within DCEs. Only through a nuanced understanding of these intricate relationships can the research community harness the potential for transformative change in users’ conduct, aligning with the sustainability imperatives advocated by contemporary research discourse (e.g., Schoormann & Kutzner, 2020). This necessity emphasizes the essential prerequisite of unraveling the interplay between individual characteristics and their collective impact on user behavior in a CM, serving as the cornerstone for the informed design and implementation of DCEs that facilitate sustainable decision-making processes.

## User-centric outcomes

Choice architects follow the goal of organizing digital context to enable users’ decision-making (Bergram et al., 2020). They accomplish this by constructing a choice architecture, which can assume various manifestations, each characterized by distinctive compositions and configurations that have the potential to impact user conduct contingent upon how the architecture is articulated (Johnson et al., 2012). Combining specific website characteristics within a DCE can foster user-centric outcomes, such as a positive UX, satisfaction, and trust (Alnawas & Al Khateeb, 2022). Choice architects therefore seek not only to design space, but they also try to improve decision-making for the users (Thaler et al., 2014). In addition, they strive to achieve a high UX (among other possible metrics) using various website characteristics that are positively perceived by users (Bleier et al., 2019; Gefen et al., 2003). Thus, for the creation of positive user perceptions and the long-term success of DCEs, it is crucial to meet several user requirements, such as intuitive usability (Gefen et al., 2003) and a high use-performance relationship (i.e., perceived usefulness, cf. Agarwal & Karahanna, 2000). Another indicator of a valuable DCE is the overall UX of a person when using IS (Sabherwal et al., 2006) and the cognition of the perceived reliability, honesty, and security of the environment, namely trust (Morgan-Thomas & Veloutsou, 2013). Thus, we seek to investigate UX, trust, PU, and PEOU as user-centric factors for DCEs.

UX is an important user-centric outcome when evaluating DCE configurations. Likewise, trust, PEOU, and PU are antecedents of the intended use of websites in manifold contexts (Agarwal & Karahanna, 2000; Gefen et al., 2003). UX is defined as the overall experience of a person when using IS (Sabherwal et al., 2006). It mainly derives from the following factors: appealing design, ease of navigation, information provision in real time, personalization, timeliness, and truthfulness of information (Balakrishnan & Dwivedi, 2021). When users are choosing between options, they value the usefulness of the system such as the possibility of enhancing their choice by the DCE (Agarwal & Karahanna, 2000), which ultimately can lead to higher user satisfaction (Calisir & Calisir, 2004). Furthermore, users place importance on factors concerning the PEOU, such as the user-friendliness and clarity of the interface as well as the flexibility of the environment (Agarwal & Karahanna, 2000; Gefen et al., 2003). In other words, the mental exertion required for users to effectively utilize the DCE describes the PEOU (Hwang, 2009), which is a critical user-centric outcome of a DCE’s effectiveness. Finally, trust is crucial for users to overcome uncertainty and engage in trust-related behaviors with DCEs (Kuen et al., 2023), as either personal information is shared or financial obligations are involved (McKnight et al., 2002). Factors contributing to building

trust in digital environments include perceived reliability, honesty, and security (Balakrishnan & Dwivedi, 2021; Gefen et al., 2003; Morgan-Thomas & Veloutsou, 2013). Trust is influential in encouraging customers to return to the DCE again (Gefen, 2002; Pan et al., 2012; Tandon et al., 2021). The selected constructs effectively measure DCEs' performance and user perceptions, leading to increased customer benefit and more informed choices. To investigate which configurations of DCE characteristics entail the above-mentioned outcomes for users, we opt to provide prescriptive knowledge by building a CM.

## Configuration theory

Configuration theory in IS research originated from IS strategy and was mainly used in the context of organizational systems to elucidate the effects of single but interconnected characteristics (El Sawy et al., 2010). The configuration theory approach can deal with complex phenomena and can provide a holistic understanding of the interaction between the individual characteristics of a system (Y. Park & Mithas, 2020). A CM illuminates the relationships between system components, dimensions, and their overarching systemic consequences (A. D. Meyer et al., 1993). Compared to other approaches that use the net effects of each single variable (i.e., correlational approaches) to explain complex phenomena, the configurational approach uses configurations of conditions to explain its synergetic outcomes within the research object (Y. Park & Mithas, 2020) to elucidate on “conjunctural causation or causal complexity” of the phenomenon (Sun et al., 2024, p. 3). Recently, scholars have used configuration theory to describe configurations of shadow IT systems (Fürstenau et al., 2021) or IS integrations in the wake of merger and acquisition transactions (Henningsson & Kettinger, 2016) and their respective outcomes. CMs explain systems via their unique configuration of interrelated characteristics, indicating that each unique configuration of single characteristics can lead to a different outcome (Fiss et al., 2013).

As complex phenomena, DCEs can vary in terms of usage, goals, layout, structure, appeal, presentation, and spatial presence. To overcome the complexity of the phenomena, researchers and practitioners alike employ (among others) user-centered design (Redström, 2006) or interaction design (Preece et al., 2015) approaches in the process of designing DCEs. However, these approaches only suggest that digital environments can be designed to achieve certain user-centric benefits such as satisfaction. They do not allow for exploration of the interrelationships within the designed environment. Therefore, studies in the field of designing digital environments that measure performance rely heavily on variance-based methods or correlational theories (cf. Setia et al., 2013), which are not suitable for managing

causal complexity because of the abundance of correlational theorizing that views the social world solely through linear relationships (Furnari et al., 2021; Ma et al., 2023). Correlational theorizing frequently isolates individual factors within a larger construct, simplifying the complex reality of causal relationships by not considering situations in which the presence or absence of certain factors does not linearly predict the presence or absence of an outcome (Furnari et al., 2021). Thus, a more holistic approach is needed to understand how individual characteristics interact within digital environments. In the current study, we adopt the configuration theory lens, since it delves into the (non-linear) combination of multiple attributes in various configurations to elucidate a phenomenon, acknowledging that complex causal explanations may require multiple attribute configurations to achieve a desired outcome (Furnari et al., 2021). Configuration theory offers advantages over variance-based methods or correlational theories by acknowledging that, depending on the presence of and interrelationships with other characteristics, an element may play a critical role in achieving a desired outcome in one scenario but may be insignificant or detrimental in another (Y. Park et al., 2020). In contrast, variance-based theories predict outcomes based on predictor variables assuming a fixed cause-effect relationship and are therefore not ideal for conditions with non-linear elements and relationships (El Sawy et al., 2010), such as DCEs.

Captured in taxonomies, the different dimensions, characteristics, and synergetic peculiarities of DCEs can be ideally clustered in configurations to provide generalizable insights (A. D. Meyer et al., 1993). Moreover, CMs can address intricate phenomena, encompassing a level of complexity that escalates exponentially with the inclusion of additional elements into the system (Fiss et al., 2013, p. 2). Their composition is mainly driven by the ideas of choice architects (Kozyreva et al., 2020) which form “holistic patterns and combinations of causal elements that influence preferable outcomes” (El Sawy et al., 2010, p. 839). Also, most of the design decisions are based on intuitions (Bleier et al., 2019), but not on either descriptive or prescriptive knowledge. Therefore, a CM based on a comprehensive taxonomy (which identifies and explains the single characteristics of a DCE) can provide several advantages. First, to understand how combinations of design-related, interactive, structural, textual, and graphical (and alike) elements work individually and jointly within a configuration, a CM can provide a holistic overview of possible combinations of DCE characteristics. Second, a CM can conceptualize different outcomes based on configurational settings. Third, the various combinations including a nuanced representation of their interaction processes can be compared against each other regarding their specific configuration and individual outcomes, which results from the interaction of several characteristics. Utilizing a configuration theory approach,

the respective similarities and differences in the effect of interacting characteristics can be recognized and compared accordingly (Hinings, 2018). Thus, we adopt this theory as the theoretical underpinning for our study since it can effectively capture the multi-faceted and complex nature of complex DCEs.

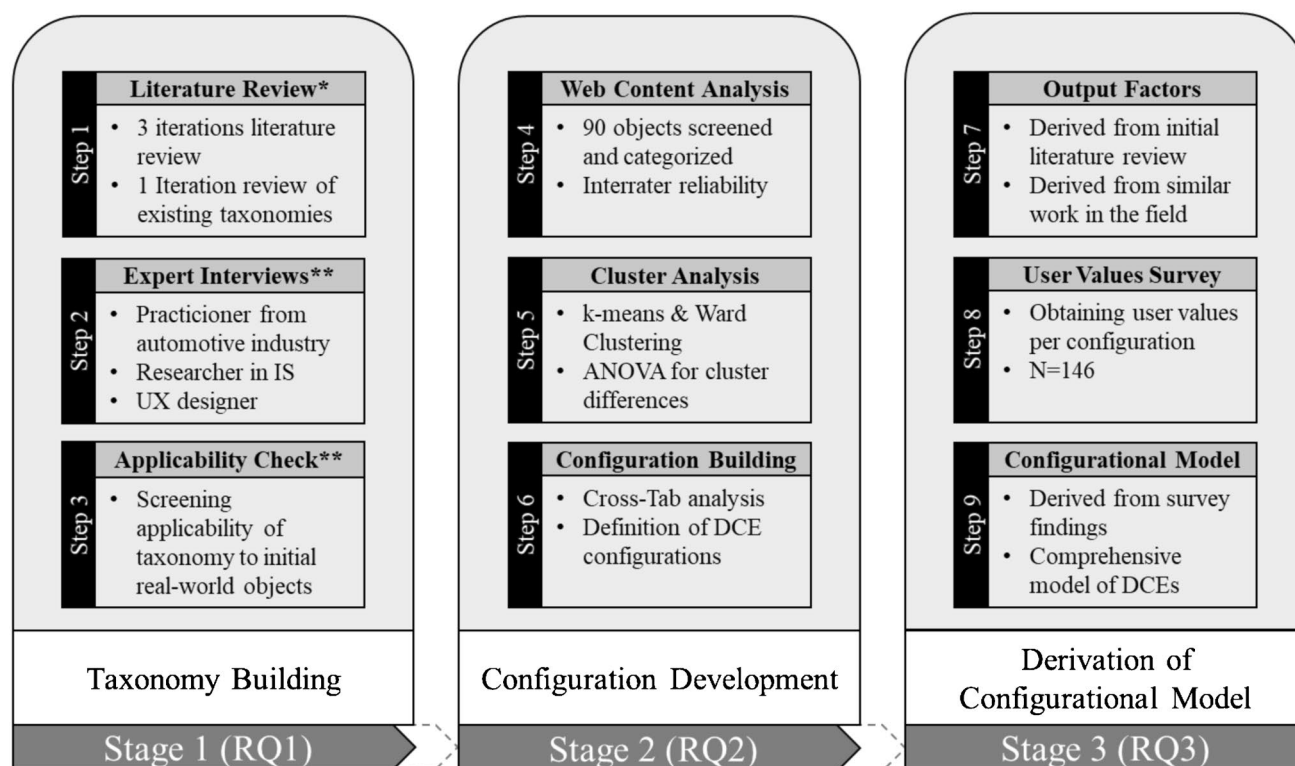
## Methodology

We employed a multi-stage approach to develop, demonstrate, and evaluate a taxonomy of DCEs and built a user-centric CM of DCEs, which discloses value relationships and trade-offs among DCE characteristics. Each methodological stage was implemented to address a specific research question (i.e., RQ1 is addressed by Stage 1, RQ2 by Stage 2, RQ3 by Stage 3). Figure 1 provides an overview of this research paper's methodology, in which the taxonomy-building process serves as the initial stage.

### Taxonomy building

For taxonomy building, we adopted the well-established method of Nickerson et al. (2013) and enriched this scheme with the advanced design process of Kundisch

et al., (2021). We first defined the subject according to the definition of Weinmann et al. (2016) and identified researchers and practitioners in the fields of UI and web design, e-commerce, internet services, and alike as our target group to assist them in developing, structuring, and understanding present and future DCEs. Our meta-characteristic was formulated as follows: structural and conceptual characteristics of digital user interfaces. We applied subjective and objective ending criteria and used a representative sample of objects to ensure objectivity. Further details are depicted in the Online Resource. Following the recommendations of Nickerson et al. (2013), we first chose a conceptual to empirical approach by conducting a literature review according to Webster and Watson (2002) in four iterations to create a database on possible DCE characteristics. We searched six databases, screened 550 papers, and identified 129 articles relevant to our taxonomy. Further information regarding the literature review can be found in the Online Resource under the section titled "Literature Review." Within this phase, we focused on characteristics and peculiarities within DCEs, which are crucial for the actual choice outcome and result in a direct consequence for the user. Afterward, an initial version of our taxonomy was created, which was further refined within the course of our research.



\* Conceptual to Empirical, \*\* Empirical to Conceptual

Fig. 1 Overall methodology to build a CM of DCEs



Drawing on the propositions of Kundisch et al., (2021) and to test the usefulness of our initial version of the taxonomy, we conducted three semi-structured expert interviews with a UX designer working in the field of software development, a practitioner from the automotive industry with extensive experience (i.e., + 10 years) on the use of corporate UI, and an academic expert for taxonomies (i.e., + 10 years of experience) to evaluate both the understandability and usefulness of the taxonomy. We conducted interviews in German using an interview guideline based on Misoch (2019). The interviews were conducted via video conference and lasted approximately 1 h each. During the interviews, participants were questioned regarding their comprehension of the taxonomy, their views on specific dimensions and traits, and potential practical benefits associated with its implementation (a more detailed description can be found in the corresponding section in the Online Resource). Recommendations from the interviewed participants were taken into consideration, and minor adjustments to our taxonomy were made based on the given input (e.g., uniform wording across dimensions to increase readability). Thus, we considered the taxonomy as a useful tool within our research framework.

As a last step, we conducted a web content analysis (WCA) by screening 90 real-life objects to develop, refine, and evaluate our taxonomy, which has proved to be a valuable approach in IS (Szopinski et al., 2019). During this step, selected samples were coded into categories and analyzed systematically (Herring, 2010; McMillan, 2000; Srivastava et al., 2009). As a sample selection method, based on the individual availability of data objects, we either used convenience samples or random samples (e-government), which are shown in the Online Resource in Table 4. We assessed 90 DCEs (e.g., websites, ERP systems, order screens, mobile apps) from nine consumption domains (e.g., hospitality, e-commerce, e-government, mobility, food) between January and March 2023 to derive additional DCE characteristics (see Table 6 in Online Resource). After the objects could successfully and flawlessly be classified via the present taxonomy and no new dimensions had to be added, we considered the taxonomy evaluation as successful (i.e., ending conditions were met, cf. Nickerson et al., 2013). A detailed view of the final taxonomy can be found in the results section (cf. Table 3), while a change log of our taxonomy is presented in Table 2 in the Online Resource.

## Configuration development

Utilizing the taxonomic framework as our foundational structure, we employed cluster analysis as a methodological approach to distilling prevalent combinations of characteristics into discernible archetypes, which is a common approach in IS research (e.g., Nickerson et al., 2013; vom

Brocke & Lippe, 2011). In light of the substantial array of compiled characteristics, it is imperative to underscore that “clustering is the only method that can adequately construct the necessary typology” (Bailey, 1989, p. 17). Subsequently, we assigned a binary code of 1 to each of the observable characteristics within the ultimate taxonomy pertaining to the 90 real-life DCE instances, while attributing a 0 to non-observable characteristics. This endeavor resulted in the development of a comprehensive classification system for each of the DCEs in question. Additionally, interrater reliability was examined with a total of 3 coders and 20 randomly chosen samples with an agreement rate of 90.4% and a Cohen’s kappa  $k = 0.773$  which is substantial according to Landis and Koch (1977). In line with Balijepally et al. (2011), we used Ward’s method to identify the ideal number of configurations, followed by K-means to assign the DCEs to the clusters, which is a widely accepted methodical approach to form archetypes in IS research (Backhaus et al., 2023). Accordingly, we determined the number of configurations based on the homogeneity of the respective objects and their characteristics (Ward, 1963). Following Kaufman and Rousseeuw (2005), we visualized the results using a dendrogram, which revealed the four- and five-cluster solutions as the most suitable setups.

In elucidating the cluster solutions, our analytical approach encompassed a thorough exploration of individual variances within group settings. This involved the application of a cross-tab analysis to discern distinctive attributes characterizing each cluster, coupled with a series of analysis of variance (ANOVA) tests aimed at delineating the maximal number of statistically significant mean differences among the groups and their respective characteristics. Ultimately, we found the four-cluster solution to feature the highest degree of uniqueness. Finally, we proceeded to delineate the configurations unearthed through cross-tabulation analysis and ANOVAs, thus affording us a means to visually encapsulate the idiosyncratic attributes and characteristics inherent to the DCE configurations on an individual basis.

## Derivation of the configurational model

In the last step, we derived a CM of DCEs based on the results of the cluster analysis. Since we understand configuration theory “as holistic patterns and combinations of causal elements that influence preferable outcomes” (El Sawy et al., 2010, p. 839), we focused on user-centric outcomes of DCE configurations. To identify appropriate indicators that measure user-centric outcomes, we screened additional literature in the field that utilizes different types of constructs to gather user-beneficial outcomes and were able to derive a set of existing scales (i.e., trust, PU, PEOU, and UX) for all measures (Table 1).

**Table 1** Measures, items, and sources

Measure	Derived from source	Number of items
Trust	Balakrishnan and Dwivedi (2021); Morgan-Thomas and Veloutsou (2013)	4
Perceived usefulness (PU)	Agarwal and Karahanna (2000)	4
Perceived ease of use (PEOU)	Gefen et al. (2003)	4
User experience (UX)	Balakrishnan and Dwivedi (2021)	6

To assess the user perceptions about the single objects in our configurations, we conducted a survey in the German language via the crowdsourcing platform Clickworker. Consequently, all 18 items (cf. Table 7 in Online Resource) were translated. Using crowdsourcing platforms like Amazon’s Mech Turk or Clickworker has been found to be highly diverse in terms of participants (Mason & Suri, 2012) and is also frequently used in IS research (e.g., Wrabel et al., 2022). Within the survey, participants were distributed randomly to one of 12 groups (three objects per configuration), where participants were asked to visit a DCE to either book a service, order a good, or complete a task (i.e., in case the DCE was an ERP system). Thereby, participants were relieved from any payment obligations. For app-based interventions, participants were selected based on their experience with the respective app (e.g., Uber). For configuration 3, we only permitted participants who already had experience in working with ERP systems to avoid biased answers from participants new to the complex structure of ERP UIs. After completing the task, participants were confronted with the questions mentioned above using a 7-point Likert scale. Finally, to improve the overall data quality, several attention-check questions were included in the survey (Kumar et al., 2021).

## Results

### Taxonomy of digital choice environments

Throughout the taxonomy development process, we identified 56 characteristics in 16 dimensions within a total of four meta-dimensions. Although taxonomies should be concise to not “exceed the cognitive load of the researcher” (Nickerson et al., 2013, p. 6), we posit that our taxonomy, as evidenced through our evaluation episodes, substantiates its comprehensive nature in adherence to established criteria. Furthermore, to enhance comprehensibility among the considerable multitude of dimensions and characteristics, we constructed four meta-dimensions. This strategic endeavor, aimed at facilitating a better understanding, was acknowledged positively during the academic expert interviews. Since our taxonomy is choice-centered, the following meta-dimensions have emerged: *Choice origin* (“Why is

the choice necessary?”), *Choice object* (“What is the choice about?”), *Choice restrictions* (“What hinders the choice?”), *Choice platform structure* (“How is the DCE designed?”), and *Choice presentation* (“How is the choice presented?”). An overview of our taxonomy is depicted in Table 3, and definitions of the single characteristics are given in Table 3 in the Online Resource.

### Choice origin

Within the meta-dimension, *choice origin*, *purpose*, and *reason* can be differentiated as major dimensions. The dimension denoted as *purpose* serves to elucidate the underlying rationale behind a given choice, encompassing a discernment of conscious intent and the envisaged outcome. This includes deliberate endeavors, such as administrative or coordinative tasks, ranging from scheduling appointments and information dissemination to networking with peers, and even the straightforward act of procuring goods. In contrast, the second dimension, labeled as “reason”, delves into the motivating factors driving the initiation of a choice. This facet allows for a nuanced differentiation between choices propelled by intrinsic motivation, indicative of a voluntary inclination, and those necessitated by external factors or obligations. This conceptualization corresponds to the seminal works of Katz and Assor (2007) as well as Ryan and Deci (2000), while also accounting for instances where a choice may stem from a convergence of both intrinsic and extrinsic influences, rendering them indistinguishable.

### Choice object

Within the overarching meta-dimension of *choice object*, a meticulous distinction can be drawn concerning the nature of the object itself. This encompasses a discernment between *physical* and *digital* goods or services, as well as whether they are immediately accessible or made available to the user of the DCE after the choice is made. Moreover, a salient feature within this framework pertains to the categorization of *usage cycles*, a concept foregrounded in the seminal works of Moore and Taylor (2009) and Tu et al. (2022). This delineation pertains to the temporal span over which a product can be utilized by the user, culminating in the identification

of two distinct modes: limited and unlimited. Additionally, an intriguing possibility emerges, wherein an indistinct *usage cycle* prevails. This scenario envisages a product that can be either rented for a predetermined period or outright purchased by the user, as exemplified by the multi-faceted offerings of the German electronics retailer, Media Markt, which extends both rental and purchase options for a diverse array of products through their online platform.

### Choice restrictions

In the realm of the meta-dimension pertaining to *choice restrictions*, a meticulous delineation of diverse dimensions, each exerting its own sphere of influence over choice, becomes imperative, given the profound impact that these constraints hold on decision-making behavior, as expounded by Botti et al. (2008). The concept of general *accessibility*, a pivotal facet within this domain, unveils itself in a dual manifestation, one characterized by localized constraints and the other contingent upon specific devices, exemplified in instances where certain mobile applications are exclusively tailored for handheld interfaces, as is the case with Uber. Conversely, there exists a scenario wherein no restrictions whatsoever encumber access, rendering the DCE universally attainable across all devices and geographical locations. Furthermore, choices may also be delimited by the *network* within which the DCE operates, presenting a dichotomy between interfaces accessible on the expansive terrain of the internet (i.e., *internet and online*), akin to a web shop, and those confined within the enclave of an *intranet*, thereby limiting accessibility to a localized and *offline* user base, as typified by ERP systems.

The categorization of choices unveils a dichotomy: they can be delineated as either falling within the ambit of single or multiple *choice categories*, each imposing its own set of restrictions on the *choice options* available. A vivid illustration of this can be found in the online retail landscape, where amazon.de stands as a notable exemplar. This platform offers an extensive array of products, spanning from fashion to food, thus meriting its classification under the purview of multiple *choice categories*. In contrast, platforms like zalando.de exclusively specialize in fashion products, warranting their designation as single *choice category* DCEs. Moreover, the introduction of *authentication barriers*, illustrated by the mandatory login functions requisite for perusing available options on platforms such as secretescapes.com, constitutes an additional layer of constraints upon the user's freedom of choice. Lastly, the dimension of *payment options* emerges as a pivotal element that bears considerable weight on the user's decision-making process, a notion underscored by Botti et al. (2008). This dimension further fragments into distinct characteristics, including scenarios of no payment at all, as often encountered within e-government

environments, disentangled payment models like the “book now, pay later” paradigm, and the conventional practice of full payment at the point of purchase or booking.

### Choice platform structure

Each DCE boasts a distinctive structural framework, predominantly shaped by its underlying architecture, thereby exerting a significant influence over users' decision-making processes, as highlighted by Weinmann et al. (2016). This structural delineation encompasses a spectrum of *types of choice environments*, ranging from commercial to non-commercial, each thoroughly crafted to cater to specific *platform user groups*, including private, business, or a blend thereof.

Furthermore, a pertinent classification of DCEs can be made in terms of their corresponding *interface setups*, a notion highlighted by Dames et al. (2019). A DCE may adopt a browsing-centered configuration, facilitating navigation through the seamless traversal of links and inspection of content. In contrast, an input-centered design prioritizes user engagement through the input of information or task execution, facilitated by interactive elements like forms, buttons, and an array of interactive components including links, menus, and popup messages, in accordance with the research of Lutfi and Fasciani (2017), Martins et al. (2021), and Xu et al. (2022).

Yet, another pivotal dimension lies in the spatial presence, characterized by the “illusory sense of being spatially located within the digital environment” (Coxon et al., 2016, p. 203), elaborated as an n-dimensional space wherein users interact, in line with the insights of Chaturvedi et al. (2011). This *spatial presence* dichotomizes into immersive environments reminiscent of the Metaverse, and two-dimensional spaces akin to a conventional web shop or booking website. Notably, some website providers augment primarily two-dimensional DCEs with immersive features, a paradigm exemplified by platforms like mindfactory.de, wherein users navigate through a three-dimensional virtual space, thereby improving the overall UX.

In the realm of user *interaction* within the DCE, a crucial distinction emerges between unidirectional and bidirectional modes, as explicated by M. Meyer et al. (2021). In the former, no discernible response or action ensues from the system or any human representative after the user's *interaction* with a design element of the DCE. Conversely, in bidirectional interaction, there is a reciprocal response from the system or a human representative following the user's action. This *interaction* extends beyond the confines of the digital environment itself, encompassing engagement with other users via rating systems or recommender algorithms, as exemplified by platforms like amazon.de.

Moreover, the spectrum of *interaction* extends to engagement with the DCE itself through interactive elements,

adopting a unidirectional mode, or with a designated DCE representative, facilitated through channels like live chat, adopting a bidirectional mode. This multi-faceted interaction paradigm provides users with a diverse array of pathways to engage with the DCE and achieve their objectives.

### Choice presentation

The ultimate meta-dimension, denoted as *choice presentation*, undergoes a comprehensive subdivision into three discernible characteristics: choice information, choice visualization, and choice centralization. This division serves as a crucial framework for the classification of DCEs, particularly within the dimensions of *information and visualization*, where distinctions are drawn based on the extent of textual and graphical content integrated into the choice presentation. This classification assumes paramount significance as it is acknowledged that the degree of elaboration necessitated for each presentation type diverges in terms of both temporal investment and cognitive capacity, thus exerting a seizable influence over users' ultimate choices, as observed by Soh and Sharma (2021).

In light of this, a stratification of levels (confined, supportive, exhaustive) becomes an imperative endeavor. Drawing from the insights of Huang (2012), the depth of information disseminated within a DCE encompasses varying degrees of detail and contextualization. Within the dimension of *information*, confined content is circumscribed to a concise description coupled with a visual representation, devoid of additional contextual cues about the choice option. In turn, supportive content extends beyond the rudimentary, encompassing a brief description along with supplementary details, such as usage instructions, in tandem with a dedicated section addressing frequently asked questions. Lastly, exhaustive content endeavors to furnish the user with the

most comprehensive array of information, encompassing the aforementioned content levels (confined and supportive), augmented by additional choice option highlights and intricate contextual information, for instance, implications of higher quality, aligning with the delineation of Huang (2012).

Similar to its predecessor, the *visualization* dimension is stratified into three tiers of preview extent (confined, supportive, exhaustive preview). Confined visualization entails a minimalist portrayal, providing a limited visual perspective, whereas exhaustive preview affords an expansive array of visuals, incorporating elements like 3D views or immersive videos, offering a comprehensive overview of the choice options, akin to the immersive 360° room tours offered by platforms like immobilienscout24.de.

Finally, the dimension of *centralization* casts a discerning eye on whether the presentation of choice is oriented towards a singular focal item, or if it tends towards a more multi-faceted and potentially distractive approach, involving tactics like up-selling and cross-selling initiatives, in accordance with the observations of Schmitz et al. (2014). For a consolidated overview of the taxonomy delineating DCEs, refer to Table 2.

### Configurations of digital choice environments

The result of our cluster analysis revealed four distinct configurations, which are characterized as follows.

#### Configuration 1: Multi-faceted platforms

The DCEs in this configuration, which can be accessed online without any restrictions based on devices or locations, exclusively offer single categories of rather digital choice objects with options for single or multiple choices that have

**Table 2** Taxonomy of DCEs

Meta-dimension	Dimensions	Characteristics			
Choice origin	Purpose	Administration & coordination	Sharing, obtaining information & networking		Purchasing & donating
	Reason	Voluntarily	Obligated / Task-driven		Indistinguishable
Choice object	Type	Physical choice object	Digital choice object		Physical & digital choice object
	Availability	Immediate availability	Decoupled availability		Immediate and decoupled availability
	Usage cycle	Limited	Unlimited		Limited and unlimited
Choice restrictions	Accessibility	Locally restricted	Device restricted	Locally & device restricted	No restriction
	Network	Internet / online		Intranet/ offline	
	Choice categories	Single category		Multiple categories	
	Choice options	Single option		Multiple options	
	Authentication barrier	Barrier present		Barrier absent	
	Payment	Mixed payment	No payment	Disentangled payment	Full payment
	Type of choice environment	Commercial		Non-commercial	
Choice platform structure	Platform user group	Business users	Private users		Business & private users
	Interface setup	Browsing-centered		Input-centered	
	Spatial presence	Immersive	2-dimensional		Enriched
	Interaction	Unidirectional interaction		Bidirectional interaction	
	Information	Confined content	Supportive content		Exhaustive content
Choice presentation	Visualization	Confined preview	Supportive preview		Exhaustive preview
	Centralization	Choice-centered		Distractive	
Frequency of characteristics		0%	1-33%	34-66%	> 67%



mainly a limited usage cycle. In this configuration, the DCEs primarily have a two-dimensional layout, allowing users to interact with them in a unidirectional manner through the use of interactive elements and similar features. The information related to choices is presented in a relatively confined manner, with a strong focus on the choices themselves (e.g., does not feature distracting elements which could guide the user to other choices). Compared to the other configurations, the characteristics are the most diversified and possess a relatively subtle and nuanced profile. Common examples of this configuration of DCEs are Unesco ([unesco.org/en/donate](https://unesco.org/en/donate)) and Disaster Ready ([get.disasterready.org](https://get.disasterready.org)).

### Configuration 2: Commercial plazas

This configuration of purely commercial DCEs, which is represented by e-commerce shops such as Amazon ([amazon.de](https://amazon.de)) and Booking ([booking.com](https://booking.com)), is accessible to all user groups for online shopping and donation purposes, without any device or location restrictions. The provided configuration primarily (but with exceptions) presents multiple choice options within a single category. However, users' selections are often hindered by distracting alternatives, constituting the only configuration among the four configurations that diverts users from their intended choices. In contrast to the other configurations, its interface setup is mainly input-centered and allows the user to interact with either the DCE or its representatives in a bidirectional way (i.e., live chat functionality) by still offering an exhaustive level of information about and an exhaustive visualization of the choice object.

### Configuration 3: Administrative centers

Unlike the previous cluster, this configuration of DCEs is essential for mandatory/task-driven activities for administration and coordination purposes, which constitutes the only configuration for this purpose. DCEs in this configuration are represented by ERP systems such as IntarS Lite ([intars.de](https://intars.de)) and Axelor ([axelor.com](https://axelor.com)). Both, digital and physical object types, are available for selection.

The choice objects predominantly manifest as immediately accessible and decoupled entities, affording users the flexibility to utilize them for either limited or unlimited durations. DCEs in this configuration are primarily local and device-restricted and can be used online after an authentication barrier (required login or alike) is overcome. Choice options are available in multiple categories containing several options for the users to choose from and, unlike the other configurations, no payment is required in these non-commercial DCEs. Further, this collection of DCEs offers a two-dimensional sphere with an exclusively unidirectional way to interact, presenting mainly confined informational and visual content for the choice-centered option.

### Configuration 4: Dedicated spaces

In this configuration, the DCEs exclusively provide either physical or digital choice options, but not a blend of both. The primary focus is to offer multiple options within a single category, and the usage duration for the chosen items is limited. The DCEs in this configuration implement authentication barriers, and, in contrast to the other configurations, the access is either locally or device-restricted, or a mixture of both, which is one of the most distinct features of this configuration. Their interface setups primarily revolve around browsing activities. These DCEs are designed with a purely two-dimensional layout, allowing users to interact with them solely through unidirectional interactive elements. The interface is intentionally non-distractive to facilitate decision-making. Unlike the other configurations, no specific preference in terms of the network, user groups, their reasons, or purposes of the choice takes precedence. Prominent examples of DCEs within this configuration are McDonald's self-service kiosks and Pinduoduo ([en.pinduoduo.com](https://en.pinduoduo.com)).

### Configurational model of digital choice environments

To answer our RQs, based on our taxonomy and DCE configurations, we built a comprehensive CM of DCE. The key aspect of configuration theory stated in El Sawy et al. (2010) is that a combination of characteristics (i.e., DCE configuration) leads synergistically to outcomes of preference (i.e., trust, PU, PEOU, and UX). As a reference for this approach, we used the works of Fürstenau et al. (2021) and Henfridsson and Bygstad (2013) and employed our taxonomic dimensions and characteristics as explanatory factors for the related outcomes, namely the performance constructs trust, PU, PEOU, and UX. Since our taxonomy is rather comprehensive than concise, only dominant characteristics for each dimension and configuration were taken into consideration for the model, which supports better readability and a clear distinction of the configurations in their dominant characteristics.

Results of our survey show that participants ( $N = 133$ ) perceived *multi-faceted platforms* as particularly easy to use, useful, trustworthy, and UX-friendly. On the other hand, *administrative centers* were perceived as ambivalent in terms of the measured constructs of PEOU and PU (scores between 4.0 and 4.9 on a 7-point Likert scale, cf. Table 8 in Online Resource). The configurations *commercial plazas* as well as *dedicated spaces* both showed confirmation for trust, PEOU, and UX, but ambiguous results for PU (scores between 4.0 and 4.9 on the 7-point Likert scale). The details of our derived CM of DCEs are depicted in Fig. 2.

From the configurational analysis, we learned that *multi-faceted platforms* primarily feature online DCEs

Meta-dimension	Multi-faceted Platforms		Commercial Plazas		Administrative Centers		Dedicated Spaces	
Choice origin	Purchasing & donating		Purchasing & donating		Administration & coordination		Purchasing & donating	
	Voluntarily		Voluntarily		Obligated / Task-driven		Voluntarily	
Choice object	Digital choice object		Physical choice object		Physical & digital choice object		Physical or digital choice object	
	Immediate availability		Decoupled availability		Immediate and decoupled availability		Immediate or decoupled availability	
	Limited usage cycle				Limited and unlimited usage cycle		Limited usage cycle	
Choice restrictions	No accessibility restriction	Internet / online	No accessibility restriction	Internet / online	Locally & device restricted		Locally and / or device restricted	
	Single category		Single category	Multiple options	Multiple categories	Multiple options	Single category	Multiple options
			Authentication barrier present	Mixed payment	Authentication barrier present	No payment	Authentication barrier present	
Choice platform structure	Private user groups	Browsing-centered	Commercial	Input-centered	Non-commercial	Browsing-centered	Commercial	Browsing-centered
	2-dimensional	Unidirectional interaction	Enriched spatial presence	Bidirectional interaction	2-dimensional	Unidirectional interaction	2-dimensional	Unidirectional interaction
Choice presentation	Confined content		Exhaustive content		Confined content		Confined content	
			Exhaustive preview		Confined preview		Confined preview	
	Choice-centred		Distractive		Choice-centred		Choice-centred	
Outcomes	PEOU	Trust	PEOU	Trust		Trust	PEOU	Trust
	PU	UX		UX		UX		UX
<div>Weakly pronounced</div> <div>Moderately pronounced</div> <div>Strongly pronounced</div>								

**Fig. 2** Configurational model of DCEs (only dominant characteristics per each dimension and configuration)

with unrestricted access, offering single-category digital choice options for single or multiple selections with limited usage cycles. The DCEs of this configuration have a two-dimensional layout and prioritize a focused presentation of choices, devoid of distractions. Users perceived this configuration positively in regard to overall UX, usefulness such as the enhancement of their choice by the DCE, the PEOU of the digital environments, such as the user-friendliness and clarity of the interface as well as the flexibility of the environment. Also, users tend to trust this configuration. By offering clearly defined and concise options (such as a single category, limited content, and a focus on user choice, i.e., perceived efficiency), it can be assumed that the relatively straightforward choice process with immediate results for the users (such as instant access to the available digital options, i.e., perceived effectiveness) improves the PU in comparison to the other three configurations (e.g., Yeh & Teng, 2012), which lack support for this measure.

*Commercial plazas* are designed for diverse user groups for online shopping and donations, offering multiple choice options within a single category with distraction features prior to a possible choice. The interface emphasizes interaction, including bidirectional communication through live chat, while maintaining a comprehensive choice object

visualization. The modalities of engagement with either the DCE or its designated representative, juxtaposed with the comprehensive presentation of visual and textual information within the configuration, establish a distinctive set of prominent features within the identified configurations. This underscores a pronounced emphasis on digital customer service (Bacile, 2020). Since the DCEs within this configuration are input-centered and offer multiple choice options within a single category in a distracted choice presentation, we assume that users may have a clear understanding of the specific type of physical object they are looking for and that they will encounter a gratifying user experience when utilizing the DCEs in this configuration owing to the intricate interplay of the aforementioned characteristics (i.e., being in a state of enjoyment, cf. Balakrishnan & Dwivedi, 2021). Thus, users perceive the DCEs in this configuration as easy to use, trustworthy, and ultimately as a good UX. However, compared to *multi-faceted platforms*, the DCEs of the configuration *commercial plazas* are providing an exhaustive amount of visual and textual information and an enriched spatial presence, which we assume to be the reason for a lower PU (cf. Phillips-Wren & Adya, 2020; Wang & Strong, 1996). *Multi-faceted platforms* have a rather simple overall design and offer only confined information as well

as choice options in a single category, which results in a higher PU. Thus, it is imperative for designers who are creating commercial choice environments to carefully weigh the pros and cons of an exhaustive informational content (i.e., to provide detailed information to the users for their choice) alongside a visually distracting choice presentation (e.g., for up-selling and cross-selling initiatives aimed at increasing sales, cf. Schmitz et al., 2014) and creating a more confined textual and graphical presentation which potentially leads to a higher PU.

*Administrative centers* are essential for task-driven activities, offering both digital and physical objects for selection. They are rather local and device-restricted, accessible after authentication. Multiple categories with various options are available, and these non-commercial DCEs present focused informational content in a unidirectional interface. It is the only configuration that features non-commercial DCEs in combination with the task-driven choice origin, as well as multiple choice categories and multiple choice options. Being the exclusive configuration among the four identified, the DCEs within this particular setup were characterized by a lack of perceived ease of use, flexibility, and perceived usefulness. Consequently, they were not positively regarded in terms of enhanced effectiveness and efficiency (e.g., Yeh & Teng, 2012). *Administrative centers* seem to have a steeper learning curve (Scott, 1999), which affects users' ability to skillfully interact with the DCE, which decreases PEOU (Gefen et al., 2003). Further, *administrative centers* exhibit a diminished level of adaptability in terms of flexibility owing to their task-oriented disposition (Venkatesh, 2006), but with a wide range of choice options (i.e., multiple options in multiple categories) to choose from, which consequentially yields reduced flexibility and at the same time an informational overload (Phillips-Wren & Adya, 2020; Wang & Strong, 1996), and thus, leading to a low level of PEOU (Gefen et al., 2003).

*Dedicated spaces* exclusively provide either physical or digital choice options within a single category, with limited usage durations. In contrast to the other configurations, they are locally and/or device-restricted. Users did not perceive the DCEs in this configuration as an enhancement of their productivity and usefulness. After conducting a thorough comparison with the other configurations, it is posited that the imposition of access restriction combined with the browsing-centered structure and its inherent cognitive overload (Adipat et al., 2011) serves as a significant determinant contributing to the diminished level of PU. Thus, choice architects should therefore consider this insight when designing choice environments.

Altogether, all configurations were found to be trustworthy and consistently provided a positive user experience, characterized by appealing interactions, easy navigation, prompt display of desired objects, personalized

interactions, and up-to-date, accurate information in the DCEs. Due to the nature of configurations, different compositions can result in equal outcomes (i.e., equifinality, cf. Fiss et al., 2013).

## Discussion

### Summary

This research opts to identify and explain the fundamental design attributes, as well as the structural and conceptual components, inherent in the digital UIs that define DCEs from a choice-centric perspective. In pursuit of this objective, we thoroughly constructed an exhaustive taxonomy of DCEs, outlining four distinctive configurations and illustrating their respective disparities in terms of both design and functional features. Employing configuration theory as our analytical framework, we expound upon the distinct user-centric outcomes associated with each configuration, specifically focusing on trust, PU, PEOU, and UX. The CM encapsulates a myriad of idiosyncrasies and attributes inherent in DCEs and their interrelationships derived from real-world scenarios across diverse contexts, all the while comprehensively encompassing the user-centric outcomes intrinsic to each individual configuration.

In this research, we adopt a configuration theory lens to explicate complex digital phenomena (i.e., DCEs) in the IS research discipline. In this manner, our primary contributions are as follows: first, we provide a structured representation of DCE characteristics that contribute to HCI, UX, and UI design, thereby addressing a relevant research gap in major IS research streams. Prior to our research, scholars and practitioners had to delve into various research disciplines or rely on tacit knowledge to design DCEs with a pre-defined outcome. The present study offers a novel perspective and a comprehensive overview of the distinctive characteristics of DCEs. Second, we guide DCE design by elucidating the structural relationships between DCE characteristics for scholars, policymakers, and practitioners. Third, we provide insights into how DCE configurations influence user-centric outcomes and guide strategies for building DCEs. Our CM provides a comprehensive analysis of the interactions between the design characteristics of DCEs and their impact on user-centered outcomes. Unlike traditional linear variance or correlation-based studies, our approach accounts for the causal complexity of the interactions between individual design elements within a DCE. Fourth, we introduce a uniform terminology for improved clarity and consistency in DCE literature, thereby aiding effective communication among scholars and practitioners.

## Theoretical contributions

Our research contributes to research in the following ways: first, our work provides a structured and formalized representation of the solution space of DCE characteristics, which contributes descriptive knowledge to various IS streams such as HCI, UX, and UI design. Our taxonomy offers a new perspective and comprehensive overview of the peculiarities of DCEs. Prior to our research, no comprehensive investigation had been undertaken that delved into the intricacies of DCEs with a scope encompassing such a diverse array of contexts. Historically, choice architects often relied on their organization's tacit knowledge, personal experiences, or extensive exploration across diverse research disciplines that possess distinct terminology and specialized knowledge derived from niche domains when creating or modifying DCEs. Thus, to contribute to the existing body of knowledge in this regard, we provide a more holistic understanding and a foundation for further analysis of the design and the underlying mechanisms when investigating choices in the digital sphere. Second, our work uncovers individual and configurational relationships that offer guidance to scholars, policymakers, and UI/UX practitioners who aim to design DCEs or digital interventions in pursuit of different objectives (i.e., empowering users to make more sustainable choices, providing an improved user experience or create digital value). Third, our work provides researchers with additional insights into how different configurations of DCEs influence the perceived user-centric outcomes and offers strategies for constructing digital environments for both laboratory studies and real-world applications. This, in turn, allows for a thorough understanding of the effectiveness of DCEs. Prior to our work, researchers utilized variance-based or correlational approaches (e.g., Setia et al., 2013) to explore linear relationships between the design and performance of digital environments. However, these approaches were limited in terms of managing the causal complexity of the designed DCEs. Our research demonstrates the significant impact that individual elements and their interactions can have on DCEs while acknowledging the complexity of the subject matter. This ultimately supports designers and choice architects in building DCEs and enhances existing knowledge in this research field. Four different configurations of DCEs (i.e., multi-faceted platforms, commercial plazas, administrative centers, and dedicated spaces) were identified, each with a unique setup in terms of the meta-dimensions, dimensions, and characteristics. We learned that the configuration of *multi-faceted platforms* is the only configuration that received confirmation in all measured constructs (trust, PU, PEOU, and UX). We therefore expect that the configuration of characteristics will ensure that users will continue to use

DCEs today and in the future, as measures were indicating such behavior (Venkatesh, 1999). Further, a concise choice presentation without distractive features combined with an immediate acquisition of the choice object (coupled with a given choice origin) leads to an increased PU. *Commercial plazas* emphasize interaction, including bidirectional communication through live chat, while maintaining a comprehensive choice object visualization. While this shows the centrality of customers in this context, the PU of the users could not be confirmed. Since too much information can bias the choice and might be overwhelming for the users (Steckel et al., 2005), we believe that the PU was decreased by the exhaustive amount of visual and informational presentation of the choice object and overall distracting DCE. This indicates that consideration of comprehensive information content in the DCE requires a careful evaluation of its pros and cons, particularly in terms of balancing the provision of detailed information with the avoidance of design features that may distract users' attention from the actual choice. In *administrative centers*, sales are not the primary focus, and the implications of the choice are clearer compared to the other configurations. Thus, utilizing confined textual and visual information instead of including supportive or exhaustive content is beneficial for *administrative centers*, as it serves as a support to focus on an efficient workflow and swift decisions, in contrast to platforms like Amazon (i.e., *commercial plazas*). In contrast, *commercial plazas* impede the decision process intently, most likely due to intended up-selling or cross-selling initiatives to increase the share of wallet and towards a higher expenditure of the user (Schmitz et al., 2014). Since *administrative centers* showed the opposite (i.e., ambiguous results for PEOU and PU measures), investigations regarding the enhancement of the UI for an improved PU and PEOU are required, especially since it provides multiple choice categories and choice options. The latter indicates the presence of a large choice space, which is likely to result in a low level of PU. Similarly, PU could not be confirmed for *dedicated spaces*. Having in mind the idea of equifinality, it is clear that different combinations of specificities within a system can lead to the same outcome (Fiss, 2011). However, contrary to the same result, the reason there does not seem to be an overwhelming mass of visual and content-related information or distractive features since it is a rather choice-centered and confined choice presentation. Comparing both configurations, it seems that the interplay between the browsing-centered structure and the accessibility restrictions leads to a low PU here.

Fourth, with the taxonomy and the CM, we provide a uniform terminology to improve clarity and consistency within the DCE literature to facilitate effective communication among scholars and practitioners within the field of



DCE research. Prior to our study, a universally agreed upon set of terminologies did not exist, which is due to the wide range of academic disciplines encompassed by IS research (e.g., HCI UX/UI design) as well as various other fields of study that address DCEs.

### Theoretical implications

From a theoretical viewpoint, our taxonomy of DCEs enhances understanding of user choices in digital environments by providing descriptive knowledge on the choice origin, objects, restrictions, platform structure and presentation, and their corresponding sub-levels. This study provides researchers with additional insights into how different configurations of DCEs influence the perceived user-centric outcomes and offers optimal strategies for constructing digital environments for laboratory studies. This, in turn, allows for a thorough understanding of the effectiveness of DCEs. By establishing a solid foundation, we enable the development of more suitable and efficient measures, methods, and tools within the realm of DCEs. Also, by providing researchers guidance on building DCEs for experimental research, researchers benefit by obtaining a comprehensive understanding of possible intervention points to foster better, more informed, and more sustainable user choices (cf. Thaler et al., 2014). Our work can be used to drive forward the scientific analysis of the design characteristics of DCEs and their underlying mechanisms when investigating choices in the digital sphere. Furthermore, choice architects of *dedicated spaces* should consider redesigning the DCEs in terms of the browsing-centered structure and accessibility restrictions to enhance PU, since the comparison of this configuration with *commercial plazas* showed that this might be fruitful. Researchers benefit from our work in understanding the various effects that browsing and input-centered interfaces can have in DCEs, yet further investigation is needed to investigate the interplay effects within *dedicated spaces*.

Finally, by providing a uniform terminology within the DCE literature, we improve communication among and between scholars and practitioners within the field of DCE research to improve clarity and consistency. We hope that our efforts will enable the dissemination of knowledge across the diverse range of research domains in which DCEs are currently found.

### Practical implications

UX/UI designers can benefit from our work and make use of the CM built either as a guide in creating or enhancing DCEs. Also, as suggested by the UX designer in the expert interview, our taxonomy could be used as a kind of working aid for a common understanding of customer requirements within the conceptual development of DCEs. Our

taxonomy aids practitioners and policymakers in the creation and development of DCEs by structuring the design from a choice-centered view, while also facilitating comprehension of the factors that impact choices within DCEs and, along with this, enhance UX, trust, PU, and PEOU, and thus, improve organizational success (e.g., sales or service quality) through improved user experience or enhanced digital value. Likewise, especially in regard to ERP systems, our work can support businesses to improve their corporate system interfaces in terms of PU and PEOU. More specifically, we found that all constructs (trust, PU, PEOU, and UX) could be confirmed for *multi-faceted platforms*, and therefore, the continuation intention and general system usage are supposed to be high, which implicates that to enhance the various measures, designers should keep the DCE as simple as possible. Using a more concise structure, fewer options, and less informational content to reduce friction (Gauri et al., 2021), also *commercial plazas* could be improved. However, this is a trade-off choice architects need to be aware of, as by reducing informational (textual, graphical, immersive) content, they might also reduce the service level for the customers. It was also found that *administrative centers* were not found to be useful and easy to use for the survey participants. Since this configuration contains mainly ERP systems, UI designers for ERP systems should consider being more concise and offering fewer options or a faster and more efficient way to execute obligated tasks within these DCEs.

### Limitations and future research

To gain a thorough comprehension of the findings of this study, it is imperative to acknowledge its limitations. Since digital environments are rapidly changing and are easy to alter, the existing taxonomy should be considered a snapshot only and as a valid basis for further evolution. Likewise, although we learned from our expert interviews that the taxonomy was considered a versatile and valuable tool for achieving different goals, assessing the usefulness of our taxonomy requires additional iterations (Szopinski et al., 2019). Thus, we call for future research to critically review and develop our taxonomy. Moreover, we adopted a choice-centered view on DCEs in our taxonomy to capture distinct peculiarities that influence the user's choice. However, the individual choice is influenced by many other aspects, such as personal preference (e.g. Jahng et al., 2002), or individual circumstances such as financial background (e.g., Ullah & Yusheng, 2020) or mood (e.g., Vries et al., 2012), which was not covered by our work. Therefore, examining the various external and internal influences and mechanisms of choices in DCEs in a holistic framework could greatly enrich the results of this study.

Furthermore, despite the judicious selection of our sample, it is noteworthy that no immersive environments were explicitly acknowledged within the examined DCEs. Considering the pervasive integration of digitalization into our daily lives, the proliferation of immersive DCEs is inevitable. Their increasing prevalence warrants meticulous investigation to comprehensively assess the taxonomy and CM proposed in this study. Consequently, an extended evaluation within the immersive sphere holds the potential to offer additional insights, thereby validating and augmenting the results of our study. It is imperative to acknowledge that while the measured outcomes exhibit logical coherence, the presence of heterogeneous configurations and the absence of comprehensive contextual information concerning the design processes of the scrutinized objects (i.e., DCEs) naturally introduce a significant degree of interpretive flexibility. Eventually, we encourage fellow researchers to leverage our accumulated knowledge as a foundational resource for their independent evaluations or critical discourse. Our aspiration is that our insights catalyze the refinement and expansion of existing paradigms, thereby stimulating further exploration in this burgeoning domain of research.

## Conclusion

Despite the frequent utilization of DCEs in academic research to explore various concepts and contexts, there has been a lack of systematic and comprehensive examination of the core dimensions of DCEs themselves. Thus, research in the field of DCEs is scarce and lacks understanding of its peculiarities and characteristics. This research transcends the conventional, compartmentalized approach to individual domains within a singular context. Across diverse application domains and grounded in tangible instances, this study elucidates the nuanced classification and reevaluation of DCEs through the lens of our comprehensive CM. It posits DCEs not merely as isolated entities, but as intricate amalgamations of individual characteristics synergistically operating as an integrated whole. These characteristics wield and will continue to exert a profound influence on the decision-making processes inherent in our digital lives. This research aspires to contribute to the trajectory toward a digitally sustainable society by providing a framework through which researchers and practitioners can discern potential intervention points. These points serve as strategic junctures to augment user choice behavior in a manner conducive to broader societal welfare.

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## Declarations

**Conflict of interest** The authors declare no competing interests.

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