Co-designing ESG Platform Functionality: A Digital Platform Ecosystem Approach

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Abstract

The concept of Environmental, Social, and Governance (ESG), has captivated the attention of firms and academics, driven by an EU directive for firms to report ESG. Digital platforms fulfill an essential role to support organizations to manage their ESG initiatives. Since ESG disclosure standards are ambiguous, designing a digital platform for ESG is challenging. The design of ESG platform functionality is hindered as essential knowledge is fragmented across various stakeholders. In this paper, we show how a platform owner, complementor, and platform user co-design ESG platform module features by applying an ecosystem approach. Situated in a socio-technical context, we apply Action Based Research (ADR) that includes a cyclic process of design iterations in an actual real-life setting. We identified ten challenges that may occur in the design process, and we explain which strategies have been applied to overcome the challenges.

Keywords: ESG, Action Design Research, Digital Platform Ecosystem, Prototype, Minimum Viable Product

1. Introduction

The concept of Environmental, Social, and Governance (ESG) has captivated the attention of firms and academics including the impact of ESG reporting and performance on corporate value (Atkins, 2020). This paper focuses on European corporate reporting regulations. The EU directive mandates firms to report ESG information. An essential aspect of this directive is to make Europe a carbon-neutral economy by 2050 (European Commission, 2019). The scope of ESG reporting spans various topics that require the attention of multiple departments and employees within a firm, such as sustainability, social inclusion, and corporate governance. Barker & Eccles (2019) argue that financial analysts are demanding more ESG information to assess corporate ESG reporting as a lack of information may result in valuation risks. This is consistent with the risk agenda outlined at the World Economic Forum (2020) that ESG is a critical factor in firms' decision-making and must collect, analyze, and monitor data that is stored in multiple retrieval systems both internally and externally. Examples of relevant ESG data correspond to firms' degree of energy consumption, gender equality, and the distribution of rights and responsibilities of stakeholders and shareholders.

Collecting ESG data manually is labor-intensive, time-consuming, and error-prone as data monitoring and analysis need to be conducted continuously. As data is fragmented across multiple internal and external retrieval systems data exchange may be hindered due to the accessibility, completeness, and correctness issues. As a result, ESG reporting timelines will be extended. A digital platform ecosystem (DPE) may provide useful support in sharing data between stakeholders and as such, mitigate potential data-oriented risks.

To support ESG reporting, the need arises to design a digital platform that can monitor, collect, and analyze ESG data that is provided by internal as well as external retrieval systems. However, most ex-post digital platform studies address successful cases of platform owners (Tilson et al., 2012). Considering their market position, platform owners are not willing to share insights on how to design a platform, which limits our understanding of how design choices affect platform features in the long run (Germonprez & Hovorka, 2013).

De Reuver et al. (2018, p. 129) state that "research on digital platforms has so far not revealed much direct design knowledge […] and that […] the secrecy of all the major platform owners makes reliable first-hand data on governance and design decisions almost impossible to ascertain". In a similar vein, Senyo et al. (2019) argue that platform design studies often focused on the technology context, while insights from non-IT domains are missing. We respond to the call of Chen et al. (2022) who claim that our knowledge of platform design is limited and that academics must deepen our knowledge of platform design. More specifically, little is known about how to design and develop a digital ESG platform in which the existence of multiple retrieval systems can be considered an important contingency.

The design of a digital platform corresponds to essential aspects like autonomic monitoring, collective intelligence, and data mining techniques (De la Rosa et al., 2011), which increases design complexity. The

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aim of this research is to develop a better understanding of the design process of an ESG platform module by identifying challenges that may occur during the design process steps. The design process of a digital ESG platform module and its features are being addressed in this study. The leading research question in this paper is:

Which process design challenges can be identified when designing and developing a digital platform solution that supports ESG features?

To answer our research question, we adopt an Action Design Research (ADR) perspective. We argue that ADR is an appropriate method for designing IT artefacts in a problem-inspired and action-oriented setting (Sein et al., 2011). We conducted an empirical study (single case study) that illustrates how a platform owner, a complementor, and a platform user as part of a DPE all contributed to the design of a digital platform module that provides ESG features.

This paper is organized as follows. First, in the next section, we present the DPE and ESG theoretical underpinnings. We then describe the methodology approach. Section 4 explains the Building, Intervention and Evaluation phase, the design framework, and provides insights from the design sprint iterations. The discussion and conclusions are presented at the end.

2. Theoretical Development

2.1. Digital Platform Ecosystems and ESG Digital Platforms

Derived from biology, the term ecosystem in an economic context generally refers to a group of interacting firms that depend on each other's activities. According to Ceccagnoli et al. (2012), a platform ecosystem is composed of the platform's sponsor and all complement providers that enhance the platform's value to consumers.

A business ecosystem represents a "community of organizations, institutions, and individuals that impact the enterprise and the enterprise's customers and supplies" (Teece, 2007, p. 1325). According to Ceccagnoli et al. (2012) and Gawer & Cusumano (2008), a platform ecosystem is composed of the platform's sponsor and all complement providers that enhance the platform's value to consumers. Platforms are a key component of many technological systems, and they provide a base for other related products, services, and technologies to be built upon. The increasing prevalence of digital technology has especially expanded the significance of platforms in the IT domain (Yoo et al., 2012). Digital platforms differ from applications due to their constantly evolving environment, diverse user base, and frequent introduction of new features and services. (Hanseth and Lyytinen, 2010). As such, platform designs must consider principles that meet the requirements of multiple unique user groups. (Evans et al., 2006).

Boudreau & Hagiu (2009) argue that digital platforms are technological entities that facilitate value creation by utilizing socio-technical means to orchestrate an autonomous ecosystem. This ecosystem comprises platform owners, stakeholders, complementors, and digital-platform-specific applications (Tiwana, 2015). Complementors represent external actors that join the DPE and create complementary products for platform users. Research suggests that complementors should focus on products that the platform owner is not likely to offer and as such, contribute to innovating the platform (Gawer & Cusumano, 2002). Connecting to the platform allows complementors to not only create complementary innovations but also to access the platform's customers, either directly or indirectly. Examples of this include independent business solutions vendors affiliating with IBM Power platform (Vieru et al., 2023) and developers producing video games for specific consoles (Cennamo & Santaló, 2013).

An Environmental, Social, and Governance (ESG) digital platform is a software solution designed to help organizations manage their ESG initiatives and report their ESG performance to stakeholders (Ketter et al., 2020). These platforms typically include features such as data collection and analysis, stakeholder engagement tools, and reporting templates. They often leverage digital technologies such as machine learning and data analytics to help organizations measure and track their performance on a variety of ESG metrics, including carbon emissions, employee diversity, and social impact (Widyawati, 2020). ESG platforms can be used by a wide range of organizations, including corporations, non-profits, and government agencies, to improve their ESG performance and demonstrate their commitment to sustainability and social responsibility. For instance, in 2022 Deloitte has built four new accelerators for use on the Workiva platform focused on ESG accounting and financial reporting and compliance. Accelerators are industry-focused base components that provide the platform's partners with a means to build solutions for their clients that are based on industry standards (best practices) supported by the platform owner. In general, accelerators are not involved in the early stages of platform development.

2.2. ESG Reporting

ESG reporting is an essential part of meeting the requirements of regulators, investors, customers, partners, and other stakeholders who are seeking to understand how a business is working towards constructing secure and socially responsible firms. In fact, according to a 2022 study by KPMG, 59% of CEOs are feeling pressure to increase ESG transparency. Firms address ESG issues by means of establishing ESG evaluation systems and applying

ESG disclosure standards. As the concept of ESG is gradually becoming mainstream, research mainly focuses on ESG investments (Daugaard, 2020), the use of metrics (Widyawati, 2020), and measuring corporate sustainability performance (Drempetic et al., 2020). ESG does not merely report on moral values, however, it measures real risks that threaten the provisioning of firms' products and services to the market.

Literature shows that within Europe, ESG reporting and quality are generally low (Alliance for Corporate Transparency, 2020) as firms currently focus on the quantity of collecting relevant ESG data. Considering the broadness of ESG goals firms must collect and analyze data first to create insights in ESG reporting. Hence, applying digital platforms is a useful approach to integrating data from multiple data sources (Dai & Tang, 2022). Consequently, a systems approach is necessary to design and develop a digital platform. We assume that within the context of a DPE various partners collectively generate value when designing a digital platform (Selander et al., 2010).

Recent industry reports suggest that designing an ESG platform requires a variety of skills, knowledge of industry best practices, and an understanding of an organization's specific needs and goals (cf., Henisz et al., 2019; Deloitte, 2022; KPMG, 2022;). Based on these industry reports, here are some general steps an organization can take to design an ESG platform:

1. Identify the organization's ESG priorities: identify key business areas where ESG factors are most relevant and align them with the organization's overall mission and values.

2. Develop an ESG measurement framework: This framework should be aligned with industry best practices to track key performance indicators. An example is the ESG-ICE framework (Ketter et al., 2020).

3. Develop an ESG reporting strategy: An ESG reporting strategy will help communicate the ESG initiatives to the stakeholders.

4. Engage stakeholders, including customers, employees, investors, and community members.

5. Monitor and evaluate the ESG platform on an ongoing basis. This is essential to ensuring that the platform is serving the needs of the stakeholders.

6. Consider the unique characteristics of the organization: size, industry, and geographic location, which can impact the specific ESG strategies and initiatives that are most relevant.

3. Research method

3.1. Action-Design Research (ADR)

Action-based research combines action research (AR) and design research (DR) and is often used in problem-driven situations and aims to build design principles based on iterative cycles (Markus et al., 2002). The value of ADR as a method in our design case study is that it aims to build design principles based on iterative cycles which as a result generate prescriptive knowledge. Sein et al (2011) argue that the object of ADR is to design an artifact that comprises technological and social elements (ensemble artifact). Regarding our case study, the artifact is an ESG platform module to support platform users in collecting, monitoring, and reporting ESG data.

More importantly, ADR researchers intervene in the research context during the design process. Although (ADR) has become widely accepted as a valuable information systems research method, Cronholm & Göbel (2022) posit that there is a lack of prescriptive ADR method support at the micro level as ADR has not been fully explored in a practical setting. Our ADR case is based on primary data and includes a cyclic process of design iterations in an actual and real-life setting. The action researcher used an observation log on a bi-weekly basis to reflect on the ADR process and track design challenges per process step.

3.2. Case Description

The case study is situated in an international context in the domain of a professional services firm. In this context three actors can be recognized: 1) the platform user; 2) the complementor; and 3) the platform owner. The platform user, which is a professional services firm, is in Switzerland and focuses on achieving sustainability goals for more than 10 years. The firm (henceforth known as S-User) is motivated to improve performance each year in order to contribute to a cleaner planet.

The complementor in our case description is a digital technology consulting firm that operates globally and includes various digital teams in different geographical regions (e.g., Europe, Asia, United States). The technology consulting firm is experienced in multiple technology-related domains, such as programming, configurations, and specialized in the design and development of low-code platform features. In addition, they have in-depth knowledge of ESG including reporting and performance-related topics. Finally, the platform owner is a globally operating technology firm with headquarters in the United States that provides digital platform services to complementors and platform users in various domains.

From a strategic perspective, the platform owner decided to extend the platform by designing and developing an ESG module. However, the platform owner lacks essential ESG knowledge and business insights. The complementor under study has an in-depth knowledge of both ESG and the digital platform at hand. Hence, the platform owner and complementor decided to identify a platform user that could be used as a 'launching customer' to design, develop and

implement a new ESG platform module. The complementor and platform owner discussed a novel approach in which the complementor designed and developed the ESG platform module and corresponding features in practice. As a result, ESG feature outcomes are added to the platform owner's services portfolio.

By involving the platform user's relevant business and ESG knowledge and experience all DPE actors contributed during the design and development process. To design and develop a new ESG platform module, the platform owner and complementor opted to establish a Minimum Viable Product (MVP) approach that subsequently can be extended.

A first set of requirements were identified by the platform user (S-User) at the end of 2020 and next discussed with the complementor. Two ADR teams became operational in early 2022 and in March 2023 the first set of ESG module features was introduced and operationalized by the complementor. More specifically, the MVP supports the following three environmental-related features: 1. carbon dioxide emissions, 2. travel emissions, and 3. energy consumption.

In 2022 an initial set of Critical Design Issues (CDIs) were discussed by the platform user, complementor and platform owner on management, as well as subject matter expert level. Design artifacts (i.e., roadmap, user stories) are used by ADR team representatives to elaborate on the three environmental-related features and plan new ESG platform module features over time. By applying an agile process (sprints), use cases were designed and tested to create insights into the platform's impact when developing features. The action researcher organized sessions to evaluate if the developed ESG module features would match the requirements as stated by the platform user.

The next step for the ADR teams is to design and develop social-related features (fall 2023) and governance-related features in early 2024. The goal of the platform users is to report their ESG metrics to their customers and as such become a role model in Switzerland.

4. Findings

4.1 The Problem, Building, Intervention, and Evaluation stages

The original problem at hand was identified by the S-user as its organization faced two key issues. The first issue is associated with the company's ambition to act as a front-runner in the Swiss market and inform its customers of ESG goals. As the work to collect, analyze, and report ESG goals manually was perceived as time-consuming, S-User addressed the need to automate these tasks. This issue corresponds to Sein et al.'s (2011) principle #1, which emphasizes the view of a field problem as a knowledge-creation opportunity. The second ADR stage (Building, Intervention, and Evaluation-BIE) focused on the instantiation of the platform module design in a Swiss setting and evaluated ESG features in practice. The BIE stage started in 2022 by designing and developing an MVP in which ADR team representatives of all DPE actors participated.

The intensive collaboration between ADR team representatives and their willingness to design and develop a novel IT artifact resulted in an innovative set of automated ESG module features. This corresponds to Sein et al.'s (2011) principle #3 of reciprocal shaping which includes both the IT artifact and the organizational context. The focus of the IT artifact (MVP) is twofold. First, the MVP shows S-User's willingness to act as a front-runner in the Swiss market by illustrating ESG reporting goals in a digital form. Second, S-User applies ESG platform module features to report on ESG outcomes to its domestic government taking ESG directives into account.

During the BIE stage, we experienced various expertise and organizational-related challenges. From an expertise-related view, complementor ESG subject matter experts (SMEs) are perceived as scarce resources because building dedicated ESG knowledge is time-consuming. We noticed that some of the complementor's SMEs were allocated to other projects which affected the design and development expertise of the team negatively.

As a result, ADR team lead times were extended. The action researcher suggested reorganizing SMEs across various projects and in doing so, the complementor was able to rebalance both ADR teams. As complementor ADR team members are geographically dispersed (Switzerland, United Kingdom, United States, India) we experienced coordination challenges at the start of design and development work. By establishing daily stand-up meetings and retrospective sessions we improved operational performance while spending less time on coordination tasks. Within the platform user organization involved ADR team representatives faced internal discussions about their availability as the design and development tasks were executed on top of their daily operational tasks. We agreed that representatives received internal budget hours in which they were able to offload daily work to other colleagues.

4.2 Design Framework

To identify and resolve contemporary challenges during the design and development of the ESG platform module we followed the ADR method. Situated in a socio-technical context, ADR addresses four stages, namely: 1) problem formulation, 2) building, intervention, and evaluation, 3) reflection

and learning, 4) formalization of learning. In our case situation, the problem formulation phase was already conducted, and the outcomes were used as input for the BIE phase. In addition, the reflection, learning, and formalization of learning are out of scope.

To conduct the iterations within the BIE, stage three design iterations were defined: 1) planning, 2) high-level design, and 3) detailed design (prototyping). Two ADR teams (e.g., the design and development team and research team) were staffed by representatives of the platform owner, complementor, and platform user. Both teams worked in parallel on the design and development of the ESG platform module. In the first iteration (e.g., planning) both ADR teams were involved in reviewing the preliminary set of requirements that can be considered as input for the high-level design. In addition, a design and development process was illustrated that comprises seven steps (see Figure 1). A project plan was drafted to sketch out the milestones, deliverables, planning, and required DPE subject matter experts.

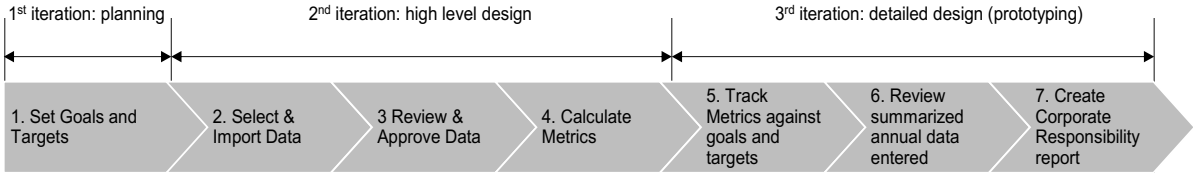

Figure 1. Design process steps

In the second design iteration ADR teams defined design principles within the boundaries of the platform to guide and structure the design and development of the ESG platform module. Next, a high-level design process and associated process steps were drafted and subsequently, the ADR teams provided a project plan and roadmap and created mock-ups of the ESG platform module.

Moreover, a high-level architecture of the platform module was designed to guide the detailed design and development of ESG platform module features. In parallel, the research team identified design issues and challenges by facilitating workshops and interviewing stakeholders. The research team developed multiple use cases and scenarios that were based on five personas in which each persona is associated with one or more process steps. Based on the conducted interviews the team refined the requirements.

In the third design iteration, ADR research team representatives of the platform owner and complementor discussed the boundaries of the ESG platform module and corresponding integration issues. The outcomes provided useful insights for the design and development team to draft architectural guidelines that were translated into a detailed platform module architecture. At the same time, the design and development team translated mock-ups into platform module features. Next, the research team refined the use cases and scenarios and evaluated platform module features by means of a user acceptance test in which platform user representatives participated specifically. Three ESG platform module features that will be supported are 1) carbon dioxide emissions, 2) travel emissions, and 3) energy consumption.

Based on a preliminary version of the MVP, the action researcher suggested planning a two-day design sprint workshop in which representatives of both ADR teams elaborated on the next step. As a next step, the design and development team refined the architecture and extended the preliminary MVP version. Again, a user acceptance test was conducted by both complementor and platform user representatives to ensure ESG functionality from a technical and user perspective. As an outcome of the improvement plan, an MVP prototype was introduced that can be used by the platform user. In addition, a demo version of the MVP prototype was developed that can be used by all DPE actors to discuss potential feature avenues.

4.3 Design Sprint Iterations

As mentioned in the introduction, the aim of this research is to identify challenges that may occur in the design process of a prototype ESG platform module. We follow the design steps as illustrated in Figure 1 and relate them to the design iterations. In addition, we explain which strategies have been applied to overcome the challenges.

The first iteration (e.g., planning) reveals two challenges that correspond to the *scope of the ESG platform* and *relevant knowledge and expertise*. Regarding the scope of the ESG platform module, complementor's architects discussed the scope of the ESG platform module, which type of features should be developed first, and limited the ESG scope.

Next, complementor's architects discussed the implementation of platform module features by sketching out the pros and cons of a big-bang scenario and an incremental scenario. One of the ADR team representatives summarized the discussion by arguing:

"We have multiple options, such as introducing a first set of features that corresponds to individual E, S, and G domains, or we apply a waved approach by implementing a limited number of E, S, and G features at the same time. We must decide as each option has serious design and development consequences."

To overcome this challenge, the action researcher decided to organize an *ideation session* for a full week. The goal of the ideation session was first to set the

implementation scope by sketching out the options, and second, to conduct a platform module impact analysis. The action researcher suggested focusing on a limited number of features for design and development. Launching all features at once (Big Bang) was not possible due to scarce resources. As an outcome, the ADR teams decided to opt for a waved approach by bundling a limited number of ESG features and designing, developing, and implementing them consecutively. Based on the waved approach identified activities and milestones were illustrated in a roadmap.

The second challenge that was identified is the absence of *specific knowledge and expertise* to design, develop, and build a prototype (MVP) of the ESG platform module. Complementor architects and developers found that knowledge regarding platform module guidelines was missing. The platform user has dedicated expertise about current environmental issues that are relevant to include in the design process. A lack of essential knowledge and expertise, however, may result in extended lead times to design, develop, and implement features. To overcome this challenge, the complementor decided to *involve representatives of all DPE actors* and established two ADR teams (design/development and research). Each ADR team exists of members that represent the platform owner, complementor, and platform user.

The outcomes of the second iteration correspond to the process steps 'Select and import data', 'Review and approve data', and 'Calculate metrics' as illustrated in Figure 1. Regarding the process step 'Select and import data', the ADR design and development team identified a challenge to accessing *data sources and related data quality*.

In practice, it was difficult to collect data sets from various internal and external data sources as data owners, for instance, energy suppliers, were reluctant to hand over data. When receiving data sets, platform designers and developers found that the data quality was insufficient as raw data and unstructured data had to be cleaned up first. One of the ADR designers mentioned:

"C*ollecting data is key, for instance, if we want to measure X tons of plastic waste, we need data from energy suppliers, waste companies, and travel agencies. Next, we had discussions about, who owns the data, who has the mandate to release the data, what the quality of the data is, and so on. But above all, suppliers must be willing to collaborate and share their data, which is a real struggle."*

As a response to this challenge, the ADR team set up a *master data management model* that is used to create insights into the degree of required data quality per data point. By cleaning and testing data sets, ADR team was able to identify the required quality level that can be used as a preparation to calculate metrics. By establishing this master data management model, the ADR team was able to overcome this challenge.

Within the process step 'Select and import data', we found a challenge that addresses the *integration of both internal and external data sources* to collect the data. Because the ESG platform module must support the exchange of data between multiple data sources architects discussed various integration scenarios. One of the ADR designers mentioned:

"We must collect data from multiple travel-related sources such as car travel, airport travel, and hotel stay. A key challenge is how to integrate data sources, do we build it ourselves or use an alternative?"

The complementor and the platform owner discussed how to provide frictionless platform services. As suppliers are assumed to have various types of interfaces, the question is whether to develop customized interfaces or use standardized APIs. As an outcome, the ADR designers *decided to use existing APIs* that are a part of the platform as a whole. This decision accelerated the design and development process as building new APIs is time-consuming and costly.

Addressing the process step 'Review and approve data', we found a design issue on *how to analyze ESG data*. An example was found in the analyses of energy consumption data as it became unclear how supplier data needs to be analyzed and which actions should be undertaken to verify who must approve the data. The ADR design and development team designed three process flows that support carbon dioxide emissions, travel emissions, and energy consumption. However, additional design tasks created an extension of the design and development timelines as multiple DPE actors were involved. To overcome this challenge, the ADR design and development team created *business process descriptions to analyze ESG data.* Based on the three ESG features in the scope of the ADR, designers illustrated detailed process descriptions by drafting corresponding process steps that include the collection of internal as well as external data. Moreover, platform user representatives provided information on how future ESG business processes should fit with existing information systems processes that support compliance and security. One of the ADR designers argued:

"Designing ESG processes is critical to defining process steps first to collect, analyze and report ESG data towards clients and government. For sure technology will help, however, we must sketch out which tasks should be fulfilled including detailed information on the type of data and its quality."

Within the process step 'Calculate metrics', we noticed a challenge in *how to calculate metrics without a blueprint.* The absence of clear calculation metrics norms created unclarity, for instance in the case of emission calculations that were not as accurate as expected. This caused additional time to gather spend data that had to be collected manually and created confusion about understanding the data. Since ESG is a broad field that comprises various themes, there are

no existing blueprints that may provide guidance on how to calculate ESG metrics. One designer argued:

"We have a serious issue on how to define the degree of transparency of employee data (e.g., type of transport, locations) as calculation norms are missing. This will create an accounting issue as data has to be requested from multiple travel systems, such as Uber, Amex Global, and SBB."

To overcome this challenge *a dictionary has been developed to normalize ESG data* first. The dictionary is developed for the Swiss market specifically as it must adhere to governmental regulations. Local guidelines were translated into a dictionary that includes both direct and indirect calculations. In case clear calculation regulations were missing, the ADR research team defined assumptions to overcome a lack of data.

The outcomes of the third iteration correspond to the process steps 'Track Metrics against goals and targets' and 'Review summarized annual data entered' and 'Create ESG report' (see Figure 1). When addressing the process step 'Track Metrics against goals and targets', the ADR research team experienced difficulties in *how to track metrics from a holistic perspective*. Since the complementor aims to design and develop multiple ESG platform module features over time, ADR team representatives concluded a mismatch between their current focus (e.g., wave 1 features) and the platform module's end state that represents environment, social and governance features. To solve this challenge, the ADR research team concluded that they needed to develop a compliance framework and corresponding financial framework that can be used to track metric actuals and related goals and targets. All DPE actors contributed to providing information that was deemed relevant to establish compliance framework components. In addition, a financial model was derived from the compliance framework to create tangible insights that can be shared in ESG disclosure reports. One of the ADR research team members specified:

"We started by applying a holistic view to define all relevant factors just to avoid a situation in which we miss some factors. Next, we excluded information that is not relevant to the features as defined in wave 1. We struggled a bit as we had to redo some design and development tasks because we already started to implement platform module tasks."

The ADR researcher suggested establishing a complementor team to keep the compliance framework and financials up to date as future regulations may change over time which will affect the financial model. Addressing the process step 'Review summarized annual data entered' the ADR design and development team faced a challenge as the platform user has *insufficient governance agreements in place*. Based on the design of ESG business processes, each process step needs to be fulfilled by a platform user role to review the annual data. However, responsible platform user representatives according to responsibilities were missing. This resulted in fierce discussions about formal governance roles and mandates. As one of the platform members stated:

"Defining roles regarding non-financial data we noticed the absence of clear roles and responsibilities as ESG goals are fragmented across the organization. The fact that we organized ourselves in traditional departments this silo-based structure conflicts with the horizontal approach of ESG business processes."

To deal with this challenge platform user representatives raised an internal discussion on appointing ESG business process owners that have the *mandate to check and validate the annual data entered*. Specifically, five personas were developed that reflect all process steps and corresponding tasks, which helped to allocate platform user representatives. To share insights, the platform user decided that the finance and accounting department should act as a middleman for other departments by sharing relevant knowledge, guidelines, and experience.

Within the process step 'Create Corporate Responsibility report', we found two challenges. The first challenge that was identified was *how to automate ESG metrics as part of an MVP*. From a content perspective, ADR teams faced data automation challenges specifically. To overcome this challenge, the complementor *developed automated workflows first*. Based on previously developed artefacts (e.g., dictionary, compliance framework, business processes), the complementor enhanced earlier stages of the ESG platform module. The development of automated workflows caused multiple discussions between the complementor and platform owner to understand the basic setup of the module (e.g., wireframe). The platform owner provided insights and guidelines by using their experience in designing other platform modules themselves. As a next step, a first version (prototype) of the MVP was launched.

The second challenge as part of the process step 'Create Corporate Responsibility report' highlights the *aggregation of ESG elements into a report* that exists of multiple environmental elements. The key challenge that was raised reflects a discussion about to what degree the technical design of the report must be customized. Additional design principles were formulated that future ESG processes must be automated by means of an out-of-the-box concept (i.e., standardized). To deal with this challenge the ADR teams created an *automated dashboard* to illustrate ESG outcomes. One of the ADR team developers argued:

"To finalize the automated dashboard, we develop multiple versions that were discussed with platform user representatives. We used roundtable sessions as feedback loops by showing automated dashboard versions step by step. Next, we used these round tables to identify the perceived added value of dashboard

functionality while exploring future ESG features in parallel."

Table 1 summarizes the identified ten challenges and the strategies to address them categorized by process step.

Table 1: Identified challenges and applied strategies.

Process steps	Challenges	Strategies
Set goals & targets	1. How to define the scope considering the broadness of ESG	Conduct an ideation session
	2. How to handle insufficient knowledge and expertise	Involve all DPE ecosystem actors
Select & import data	3. How to ensure data access and quality	Set up a master data management model
	4. How to integrate internal and external data sources	Decide to use existing APIs
Review & approve data	5. How to automate and analyze ESG data	Design and develop automated workflows to collect and analyze ESG data
Calculate metrics	6. How to calculate metrics without a blueprint?	Develop (by the Complementor) a dictionary to normalize data
Track metrics against goals & targets	7. How to track metrics against goals when norms are missing	Develop (by the DPE actors) a framework and financial model
Review summarized annual data entered	8. How to implement platform user governance agreements (roles and responsibilities)	Appoint roles that check/validate the entered data that are based on personas
Create an ESG report	9. How to automate the ESG metrics as part of an MVP	Launch a prototype of the automated platform
	10. How to aggregate ESG elements into a report that exists of multiple elements	Develop an automated dashboard

5. Discussion

In the execution of the Building, Intervention, and Evaluation (BIE) phase, we used the principles from (Sein et al. 2011) on how to design, develop and build a digital platform module that provides ESG features. The intensive collaboration between ADR team representatives and their willingness to design and develop a novel IT artifact resulted in an innovative set of automated ESG module features. By discussing the various challenges from a technology and organizational perspective, representatives of both ADR teams were able to develop strategies to deal with the issues as described. This corresponds to Sein et al.'s (2011) principle # 3 of reciprocal shaping which includes both the IT artifact and the organizational context.

Since ESG disclosure standards are open for interpretation, the complexity to design and develop a digital platform module resulted in ten challenges. To overcome complexity, various disciplines (e.g., technology, organization, ESG) are required to design and develop the ESG platform module. Establishing two ADR teams (e.g., design and development, and research) that comprise participants of the platform owner, complementor, and platform user insights from various stakeholders and perspectives has accelerated the design and development. This relates to the fourth principle of Sein et al.'s (2011) that addresses the relevance of mutually influencing roles as essential to deal with ESG complexity adequately.

During the iteration cycles, we experienced that the initial designs of the ESG platform module were adjusted regularly due to new ESG disclosure standards and governance insights. Based on input from the research team, ADR designers and developers adapted for instance personas, mock-ups, and automatic workflows. The action researcher was involved in regular evaluations to validate if design outcomes matched with original design goals. Evaluation as a continuous element within each design iteration cycle reflects principle # 5 (authentic and concurrent evaluation) of the BIE stage.

Looking back, the introduction of an MVP (prototype) with three environmental features was made possible by the drive of all DPE actors and an agile approach. The fact that participants of all three DPE actors were involved provides support for the research method Participatory Action Design Research (PADR) as introduced by Bilandzic & Venable (2011). PADR is helpful and relevant in the case of cross-disciplinary needs and research context of our design of an ESG platform module (e.g., technology, organizations, ESG).

When designing and developing the prototype, we experienced a risk regarding complementor's subject

matter expertise. Although lead times were extended, the rearrangement of experts contributed to the continuation of our process.

Interestingly, the second iteration cycle demonstrated that technology-oriented challenges had to be solved while the third iteration outlined predominantly governance and organizational challenges. Addressing the third iteration cycle specifically, we had to conduct a rework on the technical design of the prototype due to misinterpretations of ESG disclosure standards in the second iteration cycle. The prototype of the ESG platform module is perceived by all DPE actors as a valuable result of the BIE stage. In practice, the prototype is translated into a demo that is used by the platform user to illustrate their ESG goals to Swiss customers. By showcasing ESG features in the market, the platform user (S-User) explicitly underpins their position as ESG front-runner. Based on customer feedback, S-User explores now new ideas to develop future ESG features and define a strategy to scale up and valorize the design of new ESG features.

Our case illustrates that a platform ecosystem approach is needed to implement ESG reporting. ESG requires extensive data, which can partly be made accessible through digital platforms. Without platforms with generic interfaces to access data, custom interfaces would have to be created, which would lead to even longer design and development lead times. Besides generic resources from a platform, the ESG implementation also required specialized and scarce knowledge of ESG from the complementor. Consequently, both the platform and complementor are required to collaborate to enable ESG implementation. We do find that the ecosystem collaborated in an intense fashion, in contrast to the typical arm's length collaboration in platform ecosystems (e.g., Tiwana et al 2010). Due to the high degree of specialized knowledge and novelty of ESG, intensive collaboration was needed between the client, platform provider, and complementor. A joint team was established to deal with the challenges, such as creating a master data management model. An open question is whether the need for close collaboration fades as the ESG domain matures, or whether new and intense forms of platform collaboration remain.

The solutions that were created by the ADR team further underline the relevance of platform thinking to understand ESG implementation. A mix of governance and technical instruments was used to resolve the challenges in the design process. Especially the technical artefacts are interesting: the dictionary, compliance framework, and business process descriptions enabled the ADR team to collaborate and create the platform complements. Theoretically, they could thus be conceptualized as boundary resources (cf. Ghazawneh & Henfridsson 2013) that mediate between the platform owner and complementors. As such, the platform ecosystem did not merely create a complementary module on top of an existing platform but also instantiated boundary resources that help to make platform resources accessible.

6. Conclusion, limitations, and future research

Empirical research on design knowledge in the context of digital platforms remains scarce and little is known about which process design challenges affect the design and development of a digital platform module that supports ESG features. By studying design challenges, we answered the call of Chen et al. (2022) who claimed that academics must deepen our knowledge of platform design.

Our findings go beyond the research of Senyo et al. (2019) who found that platform design studies often focus on the technology context, while insights from non-IT domains are missing. We extend this study by incorporating technology, organizational, and ESG domains that facilitate value creation by utilizing socio-technical means. We argue that a DPE approach acts as an enabler as the knowledge and experience to design an ESG solution is fragmented across the platform owner, complementor, and platform user.

Our research shows that the design of ESG platform features requires an explorational approach. A major takeaway for ESG platform developers is that intensive collaboration amongst DPE actors demonstrated that strategies can be developed to overcome process design challenges. As such, collaboration between DPE actors may decrease design lead times. We argue that ADR researchers' suggestions contributed to the success of the design and development of the ESG platform module.

Based on a specific ADR case, our findings show first-hand data on the cross-disciplinary complexity of learning by means of design cycles. The research is based on a single case study which therefore limits the generalizability of the results.

The case study identifies multiple issues that require further research. First, we recommend analyzing the social interaction ties between DPE actors during the design process. Insights may shed some light on how to design iterations can be accelerated when DPE actors create stronger ties. By studying effects on an organizational and individual level we may find different mechanisms. Secondly, we recommend studying the culture and behavior of DPE actors as this might play an important role in the design process.

Finally, we recommend conducting multiple case studies to gain an overview of a variety of design challenges and effects, and based on these findings we recommend statically generalizing the findings. We would encourage other researchers to explore the topic of design knowledge in digital platforms and enlarge their understanding.

7. References

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